UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

A stakeholder assessment of the Food Fraud Vulnerability of the South African meat sector. A case study of the Tshwane Metropolitan Area.

by

Vhutshilo Nelwamondo

Dissertation

Submitted in fulfilment of the Degree of Master of Science (Agricultural Economics)

in the

Department of Agricultural Economics, Extension and Rural Development

Faculty of Natural and Agricultural Sciences

University of Pretoria

Supervisor: Dr Daniel Jordaan

September 2023

DECLARATION

I, Vhutshilo Nelwamondo, declare that the dissertation, which I hereby submit for the degree MSc in Agricultural Economics at the University of Pretoria, is my work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNATURE:

_____

DATE:

_____

DEDICATION

This dissertation, my dearest effort, is dedicated to my wonderful, special and caring parents, Matodzi and Thinawanga Nelwamondo, for their endless and supporting prayers that helped me to achieve this to date. Along with all the dedicated lecturers and well-respected fellow students who motivated my journey and now remain great friends.

ACKNOWLEDGEMENTS

Thank you, Lord, for the strength, confidence, and courage to complete my academic journey.

Dr D Jordaan deserves special acknowledgement for his guidance through the course of the project. His advice carried me through from day one. He helped with positive criticism, comments, reviews, and suggestions, not forgetting his flexibility between my school and unpredictable work schedule. I thank you.

Greatest and special thanks to my husband, Pfarelo Charles Mabela, and my sons, Kharendiwe and Arehone, for their understanding when writing my project, even after hours. Their late-night presence helped me stay awake and pushed me through for an extra page.

To my siblings, Vhuthu, Vhugala and Vhuhwavho, thank you for your assistance, endless jokes, and prayers. God bless you abundantly.

ABSTRACT

A stakeholder assessment of the Food Fraud Vulnerability of the South African meat sector. A case study of the Tshwane Metropolitan Area.

By

Vhutshilo Nelwamondo

Degree: MSc Agric (Agricultural Economics)

Department: Agricultural Economics, Extension and Rural Development

Study Leader: Dr Daniel Jordaan

Occurrences of food fraud have highlighted the importance of understanding the vulnerability of food chains to fraud and so be able to improve companies' ability to reduce fraud within their own institutions and throughout their supply chain. The food industry is generally vulnerable to crime and the meat industry is mentioned as one of the most vulnerable. The South African meat industry is experiencing its own crisis, as scientists have, for instance, found beef products that contain buffalo, donkey, pig, or goat meat, which is not on the labels on local products, as well as chicken products that contain pork.

While a growing number of academics and scientists have begun to research the food fraud issue in Africa, experts say the lack of policing and enforcement is contributing to massive food fraud in South Africa, which thrives because of weaknesses in systems that stem from poor reinforcing and policing.

To contribute towards some practical and scientific knowledge to combat the problem of food fraud, the purpose of this study is to assess the food fraud vulnerability factors in South Africa in the Tshwane metropolitan area. The research purpose outlined was explored to address and inform discussions on the study objectives, regarding a) determining the extent of food fraud vulnerability in South Africa (Tshwane metropolitan area); b) determining the key opportunities for food fraud vulnerability in Tshwane metropolitan area; c) determining the key motivations for food fraud vulnerability in Tshwane metropolitan area ; and d) determining the key control measures for food fraud vulnerability in Tshwane metropolitan area.

The objectives set out for this research were measured quantitatively by utilising a single cross-sectional approach, guided by the positivist paradigm. In keeping with the dictates of ensuring the highest levels of reliability and validity, measurement items developed from the SSAFE food fraud vulnerability assessment tool were adopted. This was to help assess issues relating to food fraud in the meat and meat products sector, which flows from production to the end user as the consumer, although this tool is relatively related to the supplier. The tool

comprises indicators categorised as opportunities, motivations, and control measures to gain an insight into the food fraud vulnerabilities factors related to meat and meat products within the South African context. The study area covered Pretoria, which is in the Gauteng Province of South Africa. Pretoria, also known as the City of Tshwane, is located around 50 km north of Johannesburg in the northeast of South Africa. Since it was difficult in this study to obtain an accurate database on the meat consumers and food specialists around Pretoria, the acquisition of the actual population size was rendered problematic. Resultantly, it was difficult to group together a sample that is representative of the larger population. For this reason, and since data was collected during the period controlled by COVID-19 movement restrictions, the sample was based on the availability of respondents. In total, 100 participants were surveyed (80 for meat consumers and 20 for food specialists). Given the time and financial restrictions, the sample for meat customers was simply chosen from butcheries within a 20-kilometer radius of Pretoria's Central Business District. Food experts, on the other hand, were specifically chosen for their knowledge of food fraud vulnerability issues.

Various factors that exacerbate food fraud vulnerability opportunities in South Africa were identified, which include wide availability of technology and knowledge for adulterating raw materials and final products; low fraud detectability in raw materials and raw materials; inadequate access by external parties to production lines/processing activities in food production; lack of transparency in the food chain network of meat and meat products; and inadequate historical evidence of fraud in raw materials for meat and meat products. On the other hand, the findings showed that the majority of respondents were of the opinion that the opportunities for food fraud vulnerability related to meat and meat products were characterised by: inadequate economic health maintenance (healthcare) initiatives to determine food fraud in meat and meat products; lack of investment in valuable components to detect food fraud in meat and meat products; inadequate supply and pricing raw materials features (freshness, cuts, origin & composition) of meat and meat products; and inadequate enforcement of criminal offenses on internal individuals involved in food fraud events related to meat and meat products.

Lastly, the results raised significant concern about the functioning of the meat supply chain in the country, as it established that insufficient control measures were available to guard against food fraud vulnerability within the supply chain. Specifically, the findings revealed inadequate fraud monitoring systems of and on raw materials of meat and meat products to fight food fraud, inadequate tracking and tracing food systems within companies to control food fraud for meat and meat products, and insufficient integrity screening on own employees to control food fraud for meat and meat products.

Key words: Food, fraud, vulnerability, opportunities, motivations, control measures

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND INFORMATION

Incidents of food fraud highlight the need to comprehend how susceptible food networks are to fraud and how to improve the capacity of businesses to reduce fraud, both internally and externally, across their supply chains. Food fraud "involves the deliberate substitution, addition, tampering or misrepresentation of food, food ingredients or food packaging, or false or misleading statements made about a product for economic gain" (Silvis, van Ruth, van der Fels-Klerx & Luning, 2017: 80). Sammut, Gopi, Saintilan and Mazumder (2021: 35) aver that, "these actions can harm human health, thus raising food safety concerns, as demonstrated by outbreaks of disease caused by the adulteration of food." Food fraud happens inside both the international and domestic food systems, and because there are so many interconnected networks and supply chains for food, it is getting more difficult to tackle. Lord, Flores Elizondo and Spencer (2017) are of the opinion that food fraud is committed by organised crime groups with the aim of illicitly participating in the food supply chain for financial gains. Fraud vulnerability is represented by the weakness or flaws that create undesirable openings related to the food chain system, and can be defined by three elements, namely opportunity, motivation and control measures (van Ruth, Huisman & Luning, 2017). The aspect of 'opportunity' relates to conditions that prompt fraudsters to become willing and able to carry out the fraudulent activities, 'motivation' is defined as those events that cause the fraudsters to form the desire to carry out such fraud activities, and the 'control measures' are the results of experiencing the outcomes of vulnerability, and represent the preventative measures and strategies put in place to secure food safety as a result of those opportunities and the motivations (Manning & Soon, 2016; Soon 2014).

The issue of food fraud has reached epic proportions; across the world, fraud accounts for up to 25 % of all food safety incidents (Visciano & Schirone, 2021). The scope of food fraud vulnerability, however, is unknown in the worldwide markets and not all cases are reported, although there are some global food fraud databases available, such as the Rapid Alert System for Food and Feed (RASSFF), the National Centre for Food Fraud Protection and Defence (Bouzembrak, Steen, Neslo, Linge, Mojtahed & Marvin, 2018). Brooks, Parr, Smith, Buchanan, Snioch and Hebishy (2021) have espoused the view that, while a number of fraud incidents have been documented, they may only represent a small fraction of the true number

of incidents. Undetected acts of fraud are continually affecting the food supply chain. The Grocery Manufacturers' Association, previously the Grocery Manufacturers of America, based in Washington, D.C., for instance estimates that global food fraud costs between $10 billion and $15 billion per year, equating to an estimated 10% of all food products sold commercially, whereas others, such as PricewaterhouseCoopers (PWC), estimate the amount to be much higher, at $30 to $40 billion annually (Robson, Dean, Brooks, Haughey & Elliott, 2020). As such, the need for innovative and accessible solutions has never been more pressing or globally relevant. Food fraud is a significant threat, affecting not only the integrity of the food supply chain, but public health as well. For example, in 1981, adulterated cooking oil resulted in more than 20,000 illnesses and up to 600 deaths in Spain (Kilbourne et al., 1991). Similarly, 294,000 illnesses and at least six deaths occurred in infants and children in China in 2008 as a result of the presence of melamine in milk products (Ingelfinger, 2008). More recently, the Canadian Food Inspection Agency found that 21% of honey samples collected in 2018 were adulterated with added sugar, while in Europe, authorities seized more than 16,000 metric tons of fraudulent food items and arrested 672 individuals during a five-month operation that started in December 2018 (Europol, 2019; Naila, Flint, Sulaiman, Ajit & Weeds, 2018).

Recently, food fraud has been putting many South African lives at risk, and this has been as a result of the burgeoning trade in fake food and beverages. Some of the largest incidents in the South African fraud food industry include fake olive oil, milk products mixed with melamine, illegal food colouring, expired meat with labels that have been tampered with, and illegal alcohol. According to South African National Department of Health Food Control Directorate, because of the growth of the untrustworthy sector in the food industry, it has now become very difficult quantify, and even internationally, the extent of the problem is not known (PackagingSA, 2017). Poor people in the country are bearing the brunt of food fraud, as the fraudulent products come in at prices much cheaper than those of the originals. The Department claims that this South African fraud food industry has thrived because of the weak systems of the government that are seen in the lack of policing and enforcement. Dr Harris Steinman, Director of the Food and Allergy Consulting and Testing Services, has stated that fraudsters are taking products like chicken that has expired, washing and repackaging the products, and then affixing 'new' fake expiry dates to the expired products, while employees of some shop owners in South Africa claim that their employers were selling anything from expired snacks, to fake Albany bread and fake bottled water. On the customers' side, some claim to have known about these defective products, but they nevertheless bought the goods because they are cheaper and also because the stores that sell these goods are closer to them. Van Ruth, Huisman and Luning (2017: 70) argue that "food fraud prevention and fraud vulnerability reduction are the first steps to combat food fraud and require a recurrent effort

throughout the food supply chain. Due to the intentional nature of fraud, it requires different tactics than the common food safety approaches". However, little is known about the factors that contribute to food fraud risk, notably in the South African meat supply chain.

Meat and meat products represent a vital component of the human diet (Ballin & Lametsch, 2008). Meat is a source of high biological value proteins, lipids, B vitamins (especially vitamin B12), and minerals such as iron and zinc. These macro- and micro-nutrients are essential for growth and body functions (Baltic & Boskovic, 2015). Meat has not often been associated with adulteration because it was typically marketed as fresh produce and then domestically prepared for consumption (Nakyinsige, Man & Sazili, 2012). Recently, there has been a shift in meat consumption patterns, with an increased consumption of processed and ready-to-eat convenience products (Cawthorn, Steinman & Hoffman, 2013). These products include mince, patties, sausages, meatballs, and pâtés. When these products are processed, there is a subsequent loss of morphological characteristics of the meat (Alamprese, Amigo, Casiraghi & Engelsen, 2016), making it increasingly difficult to differentiate between different muscle types and species. This affords people the opportunity to fraudulently replace or substitute meat of premium quality with inferior species or muscle types (Downey & Beauchêne, 1997).
Consumers are adversely affected by these types of fraudulent activities because they could potentially lead to loss of income, consumption of meat prohibited in certain religions, unknowingly being exposed to food allergens, and general food safety concerns (Dean, Murphy & Downey 2006). The meat production system is therefore challenged by these fraudulent activities, and it is of vital importance that meat products are intensively controlled, monitored, and inspected during their processing, storage, and distribution. The problem statement of this dissertation thus develops the context to assess the food fraud vulnerability factors in South Africa.
The importance of understanding food fraud vulnerability remains prevalent as it will help consumers on what are the driving factors for producers to participate in food fraud activities in their production chains of food whether, it is the demand for ingredients, market prices of finished goods or the state of the food product that makes it easier manipulate at the expense of consumers.

1.2 PROBLEM STATEMENT

Food fraud vulnerability can be classified as a white-collar crime, which is a criminal activity carried out by companies that utilise their management and its employee as actors to accomplish the targets for their businesses (Simpson, 2011). When fraudulent activities take

place with food, the possibility of vulnerability occurs and with greater chances that an adulterant substance will be tampered with or mishandled, leading to health threats in the food product – a major threat to South Africa's food industry. The Food Control Directorate of the National Department of Health has noted that there is a misconception among the majority of South African consumers that dates on products express the only food safety risks, yet foodstuffs can be unsafe depending on other factors that are independent of the date marking (PackagingSA, 2017). Robson et al. (2020) noted that various factors, such as adulteration, tampering, over-run, theft, diversion, simulation, and counterfeiting, are usually what cause or pose a risk to food becoming unsafe, and so South African consumers must always follow or be aware of such issues. As the fraud food industry grows in South Africa, poor people in the country are increasingly bearing the brunt, as the products come cheaper than original products. This industry is seemingly thriving because of weak regulatory systems.

In South Africa, studies (see, for example, Edwards, Manley, Hoffman & Williams 2021; Cawthorn et al., 2013; D'Amato, Alechine, Cloete, Davison & Corach, 2013) have particularly found that the meat industry appears to be the most affected, as the misrepresentation of meat products has become a habit for most retailers, and consumers are unknowingly consuming both unnamed animal and plant residues more often than before. In particular, the practice of mislabelling food has resulted in unethical health consequences and violates the South African overall regulations for trading in processed meat products. Nguegan Nguegan (2017) investigated seven supply chain management problems within the food processing industry, and identified the fact that food fraud opportunities are dominant in the province of Gauteng, and that supplier relationship management and regulatory factors played a critical role in contributing to the fraudulent behaviour. While a growing number of academics and scientists have begun to research the food fraud issue in Africa (see Onyeaka, Ukwuru, Anumudu & Anyogu, 2022; Onyeaka, Kalane, Guta & Tamasiga, 2022; Ahmed, 2016), it is crucial to recognise that a number of reasons, not the least of which are the increasingly complicated global supply chain, uneven legislation, and lack of reliable testing procedures, make it extremely difficult to solve. Particularly in South Africa, the issue is made worse by the absence of support from decision-makers. Experts have reiterated the lack of policing and enforcement as a contributing factor to food fraud in South Africa, which is attributable to weakness of systems stemming from poor reinforcing and policing. From the aforementioned, it is evident that South Africa is reeling from food fraud vulnerability, particularly within the meat sector, and if not properly addressed, it has the potential of adversely disrupting the national meat supply chain.

There is a global growing demand to eliminate food fraud and strengthen food safety. The financial losses on food fraud are estimated to be US$30 - 40 billion per year, according to the

Fraud and food safety systems 2018. Very little has been done to understand the food fraud vulnerability factors in South Africa (Tshwane metropolitan area); within the meat and meat products.

1.3 STUDY OBJECTIVES

The broad goal of the study is to assess food fraud vulnerability factors, specifically affecting the South African meat sector, in order to address the research problem highlighted in the preceding section. The following specific objectives will aid in achieving the overall goal:

a) Determine the extent of food fraud vulnerability within the meat sector in South Africa in the Tshwane metropolitan area
b) Determine the key opportunities for food fraud vulnerability within the meat sector of Tshwane metropolitan area in South Africa
c) Determine the key motivations for food fraud vulnerability within the meat sector in South Africa within Tshwane metropolitan area
d) Determine the key control measures for food fraud vulnerability within the meat sector in South Africa (Tshwane metropolitan area)

1.4 STUDY RESEARCH QUESTIONS

In order to for the research objectives to be properly explored, they were guided by the following research questions:

a) What is the extent of food fraud vulnerability within the meat sector in Tshwane metropolitan area ?
b) What are the key opportunities for food fraud vulnerability within the meat sector in South Africa of Tshwane metropolitan area?
b) What are the motivations behind food fraud vulnerability within the meat sector in within Tshwane metropolitan area?
d) How can food fraud vulnerability within the meat sector be controlled in South Africa?

1.5 STUDY PROPOSITION

Despite the growing reports of food fraud in South Africa, awareness of such fraud and its potentially devastating effects remains limited. This leaves the door open to dishonest traders and exposes unwitting consumers to the potential risk of illness and even death, making efforts to eradicate food fraud even more critical. To address this critical challenge, this research attempts to identify food fraud vulnerability factors within the meat sector in South Africa. To achieve this, four research propositions were developed. These propositions would allow for some limited statistical analyses to be performed and will be evaluated in accordance with Cooper and Schindler's (1998:131) definition of a proposition, which is an assertion about a concept that can be judged as true or false, depending on whether it refers to observable events. The following are the propositions that are informed by the research question:

P1: There is a greater extent of food fraud vulnerability within the meat sector in South Africa in the Tshwane metropolitan area.

P2: Opportunities exist for food fraud vulnerability within the meat sector in South Africa especially in Tshwane metropolitan area.

P3: Motivations exist for food fraud vulnerability within the meat sector in South Africa in Tshwane metropolitan area.

P4: There are ways in which food fraud vulnerability within the meat sector can be controlled in South Africa with special interest in Tshwane metropolitan area.

1.6 STUDY JUSTIFICATION

Generally speaking, the food business is characterised by high production rates and small profit margins. A range of new product development trends are being used by large food firms to find new ways to optimise manufacturing processes and access new markets in response to increasing regulatory pressure, rising commodity prices, rising customer demands, and economic uncertainty. The fact that some new product development trends are emerging in South Africa (together with products that derive from these trends) raises the possibility of opportunities for fraud, and given the country's current economic situation, fraud is expected to expand.

The prevalence of incidents of food fraud vulnerability in South Africa, and globally, as discussed in previous sections, has drawn the attention of new research. Food fraud,

particularly within the meat industry, is putting the lives of thousands of South Africans at risk daily because of the burgeoning trade in fake food (Boatemaa, Barney, Drimie, Harper, Korsten & Pereira, 2019; Erasmus & Hoffman, 2017). For instance, according to Patricios (2013), more South Africans are avoiding mince, sausages, burger patties, dry meats, and deli meats these days. In the past, they would not think twice about cooking some sausages on the braai (barbeque), eating a boerewors roll, or biting into a thick burger. This demonstrates how a meat fraud incident that directly threatens customer confidence has overtaken the South African meat sector. This raises serious concerns about how the South African meat supply chain operates, since Cawthorn et al. (2013) note that the system's consistency presents potential for gaps that could lead to food fraud. Therefore, it is crucial that these issues be addressed to prevent customer deception (Erasmus & Hoffman, 2017).

Payne (2019) notes that some limited studies have been conducted pertaining to meat fraud vulnerability within the South African context. In order to determine practical prevention and detection strategies for implementation in South Africa's meat industry, future research must first determine the food fraud vulnerability factors in the country, as well as the most prevalent fraud types and areas of vulnerability within the meat value chain. By doing this, the sector would be able to better safeguard both its customers' businesses and their food supply. Consumer trust is a prerequisite for any food business to expand and provide high-quality food products. Everything the industry is striving to accomplish will be made more difficult if trust is lost.

The emergence of new research on food fraud vulnerability factors would contribute to the existing body of research and provide guidelines on how to address and/or mitigate the fraud vulnerability factors faced by the South African food sector, particularly the meat value chain. The study may also be used as a point of reference for future studies within the field of food fraud.

1.7 ORGANISATION OF THE STUDY

This dissertation follows the organised five-chapter format advised by Perry (1994), which is the norm for a master's dissertation in the economic and social disciplines. The chapters of this dissertation are organised as follows:

Chapter 1: Introduction – This chapter provides an overview of the study background, which serves as the study's framework. The chapter also emphasises the importance of conducting

the study. This chapter also discusses the problem statement, the research objectives, and the research questions.

Chapter 2: Literature Review – specifies the theoretical and empirical review of the literature as it relates to context of the study.

Chapter 3: Methodology – This goal of the chapter is to examine the research methods applied to the study's goals. The research design, study location, demographics, and sampling criteria will all be covered in more detail in this chapter.

Chapter 4: Analysis and Interpretation of study results – The areas covered in Chapter 4 are data analysis and interpretation. The outcomes of earlier empirical research will be compared with the results attained.

Chapter 5: Conclusion and Recommendations – This chapter finishes with suggestions for further research, as well as a list of limitations of the study.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 highlighted the increasing severity of food fraud incidents involving companies that produce and manufacture food for human consumption. Despite the growing interest in the subject of vulnerability to food fraud, particularly among those who produce food for human consumption, the literature and empirical research addressing it is only now starting to appear (van Ruth et al., 2017; van Ruth et al., 2018). This study would be able to make a contribution to the rapidly developing body of knowledge in this area of scholarly inquiry, if a thorough evaluation could be constructed that would assess the degree of susceptibility to food fraud regarding food products meant for human consumption. The aim of this chapter is to present the theoretical background and discuss the key concepts that guide this dissertation.

The current increase in public interest in food fraud has coincided with the expansion of the literature on the topic in several academic fields (Smith, Manning & McElwee, 2017). The most pertinent research in this area can be categorised into three interconnected strands from an economic perspective: (1) comprehending the fraud motives of suppliers; (2) calculating the effects of fraud on the economy and public health; and (3) creating the best regulatory response (Moyer, DeVries & Spink, 2017; Song & Zhuang, 2017; Ali Meerza & Gustafson, 2018; Ali Meerza, Giannakas & Yiannaka, 2018). This chapter describes the empirical and theoretical review of the literature as it pertains to the study's context.

2.2 FOOD FRAUD

The literature does not provide a precise definition of the false representation of the source of food products. Food fraud refers to the intentional modification of food, in which a food ingredient is illicitly added for financial gains. It is also referred to concerning food that has been adulterated with an economic motive (EMA) (Everstine, Spink, & Kennedy, 2013). In respect of obtaining financial gain, Spink and Moyer (2011: 13) define food fraud as "deliberate and intentional replacement, addition, tampering, or false representation of food, food ingredients, or food packaging, labelling, product information, or inaccurate or deceptive information provided about a product". In an effort to establish consistency for academic research teams, as well as the personnel dedicated to enforcing measures against food fraud,

Spink and Moyer (2011) combined multiple points of view to suggest a common idea of “food fraud”. This is supported by Grundy, Kelly, Charlton and Collin (2012) who advocate the view that food fraud is a deliberate, economically motivated crime, undertaken together with related behaviours in order to avoid being discovered by regulatory agencies or consumers. On the other hand, Lord et al. (2017) argue that the food industry should instead consider crime opportunities brought about within its own routine business practices, rather than viewing food fraud as an external threat from organised crime syndicates.

Spink and Moyer (2011) aimed to more precisely distinguish between behaviours that would be considered to be fraudulent and those that pertained to food safety while they were creating their definition. They concluded, using criminology literature as a guide, that the key distinction between these episodes was found in the participants’ motivations. They discovered that most fraudsters’ actions of tampering with or adulterating food were not motivated by a desire to cause harm to people. Instead, their actions were motivated by a desire for financial gain and were deliberate in nature. Their definition specified two essential characteristics for a food tampering or counterfeiting incident to be considered as food fraud. These requirements are a deliberate and motivated desire for financial gain. Additionally, the premeditated nature of food fraud actions makes them criminal in character and subject to legal prosecution (Spink et al., 2017). This definition excludes from the definition of food fraud any inadvertent, unintentional, or coincidental harm to or contamination of food goods (Spink & Moyer, 2011).

A supplier may commit fraud for a variety of reasons, which might be both internal and external to the company (Smith, McElwee & Somerville, 2017). Suppliers are likely to have little to no control over the price that they are paid for their goods owing to economic factors, as they frequently receive take-it-or-leave-it offers, with no room for negotiation. They might therefore be able to influence the net profit levels of their companies by reducing costs, or perhaps by engaging in fraud (Manning & Soon, 2014; Spink et al., 2016). Song and Zhuang (2017) refer to food fraud as a “market for lemons” problem. In the contemporary food system, anonymity makes it challenging for customers to recognise fake goods and might even prompt them to completely shun certain product categories. Macroeconomic considerations can also affect the likelihood of food fraud occurring (Moyer, DeVries & Spink, 2017). For instance, Manning, Smith and Soon (2016) identify the horsemeat incident the occurred in 2013 as having been exacerbated in part by the 2008 financial crisis. McElwee, Smith and Lever (2017) and Somerville, Smith and McElwee (2015) report case studies in the effort to gain an understanding of the particular motivations for food theft, and examine how criminal networks continue to perpetrate fraud.

2.2.1 Food fraud incidence in South Africa

The growing trade in fake food is affecting South African consumers through the perpetration of food fraud. Mofokeng (2018) has stated that we simply do not know how widespread the various forms of counterfeiting in the food chain are. Everyone agrees that it is getting worse. Following the listeriosis outbreak in 2018, a government-backed campaign was launched in various departments to address food safety concerns, focusing on the unorganised food supply chain (Tembe, Mukaratirwa, & Zishiri, 2018). Large amounts of "fake" or counterfeit food and beverages were found being offered to customers; as a result, certain products were seized and enterprises were shut down. The use-by dates for chicken were extended at formal food markets in 2019, which is not only a form of fraud but also places the consumer at risk regarding food safety. This does not only happen in the unorganised sector (FactsSA, 2020). Business Day Live also noted that, in 2014, several of South Africa's top stores were found to be altering food labels on products in the provinces of Mpumalanga and the North-West (News24, 2014). The incidents involved the removal of label information, the removal of complete labels, and the relabelling of foods with fictitious expiration dates. FoodSure, a South African company that verifies food labels, has provided the following statistics and comments for the years from 2007 to 2014 (Food 24, 2014). Early 2023, other incidents reported in Gauteng included the selling of expired Woolworths branded foods and meat products from a butchery Benoni - Ekurhuleni municipality (IOL,2023). And within the same proximity of the butchery, approximately 90% of the food stock including meat (especially poultry) was outdated/expired and were unfit for human consumptions. The culprit admitted to buying "second-hand perishables at low prices deliberately in one of the well-known retail shops so that she could further make a sale.

2023- the Transnational Alliance to Combat Illicit Trade (TRACIT) reiterated that the South Africa food markets continues to be challenged by the illicit trade on multiple fronts in different sectors which included food, alcohol and fish. The alliance emphasised that one of the biggest enablers for illicit trade into the country can be best controlled within law enforcement and border control agencies, as borders also play a role in importing counterfeited food and food products in the country (IOL,2023).

2014 – South African bakeries will no longer use the contentious ADA addition in their bread ingredients. ADA is a flour-whitening ingredient used in bread making. According to the controversial blogger (also known online as 'Food Babe') who brought attention to it, the chemical is "the same chemical used to make yoga mats, shoe soles, and other rubbery objects. It's not supposed to be food or even eaten for that matter. And it's definitely not 'fresh' " (Food 24, 2014). Evidently, ADA was prohibited in Europe and Australia, and bakeries in

South Africa started to take action. According to this post on Food Stuff, South African bread producers like Sasko, Steers, Wimpy, and Debonairs Pizza, as well as Pick & Pay, started removing ADA from their bread. It further says that the manufacturer of bread for Woolworths was advised to remove ADA by July 2014 (Food 24, 2014).

2013 – The meat label scandal exposed several large stores. Retailers in South Africa were accused of lying about the meats that are used in items like beef patties, viennas, and other prepared meats. In a study by Stellenbosch University, 139 samples of meat goods were evaluated, and over 60% of them contained animal species whose DNA was not identified on the food labels. Between April and August of last year, the university conducted product testing in response to new, stricter meat labelling rules. Stellenbosch University scientist, Professor Louw Hoffman, told the *City Press*, "Our study confirms the mislabelling of processed meats is commonplace in South Africa and not only violates food-labelling regulations, but poses economic, religious, ethical and health impacts." (Mail & Guardian, 2013).

2013 – South African consumers were concerned about food labelling, as a food-labelling concern in the UK had tentacles that could reach as far as South Africa. Findus in the UK was found at the centre of a scandal in which horse meat was used in place of beef in a number of its ready meals. Despite the fact that authorities in Europe had been quick to point out that products containing horse meat offered no health risks, this incident raised major questions about dishonest tactics in the food chain (news24, 2013).

2011 – Muslims in South Africa responded angrily to claims that a major meat importer had labelled pork as halal. Muslims in South Africa have reacted angrily to claims that a major meat importer with headquarters in Cape Town mislabelled pork as halal (BBC, 2011).

2010 – Horror of frozen chicken. For years, South Africans have been purchasing and eating large quantities of frozen chicken that has been repackaged. After the expiration date for frozen chicken had passed, it would be washed, given an injection, renamed, and sold once more at prestigious supermarkets. Furthermore, the third-largest producer of poultry in South Africa, Supreme Poultry, had been producing reprocessed frozen chickens with new expiration dates. He claimed that after being transferred back to Supreme, expired chicken was defrosted at room temperature for 24 hours. To lessen the bacterial load, chlorine was then applied to some of the birds (news24, 2010).

2008 – Baby Formula is recalled by Nestle. After tests revealed that certain batches of Nestlé baby formula contained unacceptable high amounts of melamine, the products were removed

from shelves in South Africa. Health officials advised mothers to stop using Nido and Lactogen and to return them to the stores where the items were purchased. After ingesting milk tainted with the chemical in September, more than 6000 people became ill in China, including three infants who died (The bovine, 2008).

2005 – The red scare in Sudan grows. The health agency reported on Thursday that tests on nine additional food products revealed they contained trace amounts of the illegal chemical dye Sudan Red. Food products such chili powder, spices, sauces, and related goods all contained the illegally used dye. Therefore, it is required that the responsible parties nationwide recall these items and make sure that any chilli powder and similar food components in their possession do not contain the forbidden dye (news24, 2005).

Details pertaining to meat fraud incidences in South Africa are elaborated in Subsection 4.12.1.

2.2.2 Challenges in the South African meat sector

As the world's population continues to rise in virtually every section of the earth, particularly in emerging countries, the demand for meat products is rising (Delgado, 2003). According to Erasmus and Hoffman (2017: 71), "meat forms an integral part of the South African cuisine. In fact, for most South Africans, a meal without meat is considered not to be a meal at all. The consumption of meat dates to the precolonial period (before the arrival of stock-raising) where the indigenous Khoisan (pastoral Khoikhoi/Hottentots and foraging San/Bushmen) groups hunted wild game to survive". The expected annual total meat consumption in South Africa, at 41.0 kg per person, is the second-highest in Africa (behind Ghana), and it closely reflects the anticipated global average of 41.2 kg per person (Oirere, 2019). However, with beef being one of the most costly foods in South Africa, and more than 50% of the population living in poverty, it is a tremendous financial burden (Tembe, Mukaratirwa & Zishiri, 2018). Particularly, after the year 2000, the cost of beef from cattle and mutton from sheep has increased dramatically, and these foodstuffs are now regarded as luxury goods in South Africa, retailing for nearly twice as much as chicken, and up to 1.5 times as much as pork (Agriorbit, 2020). Since the year 2000, in particular, the price of beef from cattle and mutton from sheep has climbed substantially, and these are now considered luxury products in South Africa, retailing for up to 1.5 times as much as pig and nearly twice as much as chicken, respectively (Cawthorn, Steinman & Hoffman, 2013).

Faced with rising meat prices, customers have recently and increasingly sought more detailed information about the origin, makeup, and safety of the meat and meat products they consume (Apostolidis & McLeay, 2016). South African regulatory agencies released new regulations in response to public demands for greater transparency and accurate food product descriptions. While there are national laws in place to protect consumers from inferior or falsely described meat and meat products, appropriate and consistent implementation of these laws is still lacking in the country, which is challenging (Cawthorn, Steinman & Hoffman, 2013). Evidence has also shown that, despite increased calls for greater transparency in the food industry, fraud-related cases of processed meats remains a problem in the country.

Because inadvertent cross contamination and intentional substitution both occur, it has been shown that undeclared species may appear in prepared meat products (Cawthorn, Steinman & Hoffman, 2013). This has significant economical, religious, ethical, and public health repercussions. Furthermore, these occurrences frequently violate South African law and undermine fair trade on the domestic meat market. Despite the implementation of tougher local and international food labelling requirements, the increase in the adulteration or misrepresentation of meat and meat products for illegal financial advantage has been linked primarily to dishonest financial gains being made within the meat supply chain (Boatemaa, Barney, Drimie, Harper, Korsten & Pereira, 2019). Because of the rising costs of commercial meat commodities, the globalisation of the food trade, and the increased processing of meat into value-added products, the incidence of meat adulteration and fraud has also increased in South Africa (Tembe, Mukaratirwa, & Zishiri, 2018). This raises serious questions about how the South African meat supply chain is operating.

Other food safety issues that may have an impact on health have been identified in the meat retail sector in South Africa, in addition to meat adulteration and fraud. For instance, meat and meat products displayed for sale have been found to have bacterial infections, pesticide residues, and antimicrobial/antibiotic residues (Moyane, Jideani, and Aiyegoro, 2013). Furthermore, some butcheries are unable to uphold hygienic practices throughout the course of the preparation, display, and handling of meat (Sibanyoni, Tshabalala & Tabit, 2017). Because there is intermittent access to energy in the informal sector, meat cannot be properly chilled or stored (Boatemaa et al., 2019). However, the media has played a significant role in drawing attention to these problems and, as a result, some consumers have developed doubts about food safety and have lost faith in the food retail industry (Rootman, 2016).

2.3 FOOD FRAUD VULNERABILITY

An instance of fraud vulnerability represents a structural flaw or weakness that fraudsters can take advantage of. According to the vulnerability assessment principle proposed by the British Retail Consortium (BRC) (2015), the formulation below can be used to measure vulnerability to food fraud: opportunities, drive, and prevention strategies all influence food fraud vulnerability (Spink, Ortega, Chen & Wu, 2017; van Ruth et al., 2017). These three elements – referred to as the 'FFV factors' – provide academics with a foundation for looking into this situation (Silvis et al., 2017). Each of these elements has been shown to have different dimensions or characteristics that, when combined, have different consequences on sensitivity to food fraud in different situations (van Ruth, Huisman & Luning, 2017). To determine the food fraud vulnerability, one needs to look at the opportunities together with the motivations and control measures and not in isolation. The opportunities and motivations with high fraud vulnerability can be lowered with adequate control measures. From 2.3.1, each component that makes up the food fraud vulnerability has been well explained with the aim of better understanding each element and how it influences the rest of the concept. The food supply chain's food fraud vulnerability assessment tool (FFVA) was developed using this concept (SSAFE, 2017). The industries that manufacture food products comprise most of the users of the tool.

2.3.1 Opportunities for food fraud vulnerability

Technical opportunities are linked to the degree of food composition and counterfeiting, as well as the difficulty in detecting or verifying such adulterations, while prospects in time and place are related to manufacturing and distribution processes, which may affect access to locations where fraud can be perpetrated (van Ruth et al., 2017).

The opportunity part of the formula for vulnerability to food fraud describes the suitability of potential victims (van Ruth, Huisman & Luning, 2017; Hollis & Wilson 2014). This suggests that the structure of opportunity for fraudsters to commit an offence is influenced by the traits of probable targets (Pratt et al., 2010). As a result, understanding fraud opportunities is critical, since it helps to explain how it is that fraudsters can commit fraudulent activities (Coleman, 1987). Cohen and Felson (1979) noted that a good target would have the following four characteristics: visibility, accessibility, value, and inertia (Leukfeldt & Yar, 2016). The first two dimensions relate to how readily available target products are to fraudsters, while the last two relate to how valuable the desired product is and how easy or difficult it is to produce the counterfeit goods (Hollis et al., 2015). Furthermore, these traits – which were created

expressly for victims of food fraud – were split by van Ruth, Huisman, and Luning (2017) into two main categories: technological opportunities, and time and space.

2.3.1.1 Technical opportunities

It is widely noticed that the vulnerability to food fraud increases when technical opportunities for fraud exist. This refers to factors like a straightforward product composition and the simplicity with which fraudsters can obtain the information and tools needed to adulterate food products (SSAFE, 2017; Silvis et al 2017). In instances where it is difficult to identify fraud, and advanced technology is required to spot fake items, this element of vulnerability is also expanding (Silvis et al., 2017). According to Yang (2021), from a technical perspective, fraudsters are capable of manipulating foods in practice because of the ease by which adulteration can be achieved and the availability of knowledge required to carry it out. These are regarded as fraud factors for vulnerability, as a result. For example, milk is a fluid product with an intricate composition that is simple to adulterate because of its physical state. Furthermore, adulterated products will be more vulnerable to fraud if they cannot be identified through using straightforward techniques like visual recognition. Consequently, fraud opportunities are also influenced by how easy adulteration can be detected.

A particular food chain will be more vulnerable to fraud because some products in it are simple to adulterate or counterfeit, and because the expertise and technology to do so are widely available. For example, goods in a certain physical state, like liquids, are more prone to deception than other goods are (Jack, 2015). Liquids such as alcohol, vegetable oil, drinks and milk are typically more appealing to prospective adulterants because they can be easily contaminated, but are harder to detect (Power et al., 2021; Yang et al., 2020). Vegetable oil adulteration can be detected using a variety of techniques and technologies. However, these detections frequently require sophisticated laboratory testing, which takes substantial amounts of time and requires considerable labour (Ozulku et al., 2017). The general vulnerability to fraud is also affected by the presence or absence of detection mechanisms. Furthermore, current detection techniques can only identify known adulterants; they cannot identify new adulterants that are as yet undetectable. To lessen the susceptibility to fraud, more sophisticated analytical characterisation is required for specific characteristics and product groupings. Yang, Zhou, Wu, Zhang, Mo, Liu and Yang (2022) propose that China's current food safety risk assessment and sampling system places a greater emphasis on quality and safety issues than on adulteration, and does not use the various testing procedures in risk

monitoring for adulteration of vegetable oils as a result. Because of this, the potential technological means are facilitated for criminals to perpetrate adulteration.

Rezazade, Summers and Teik (2021) used the barrier analysis technique to identify one more dimension that may be included as an opportunity factor likely to increase the susceptibility to food fraud. The physical form of products was given as the description for this new dimension. According to quality assurance standard-setting organisations like the BRC (2015), physical product characteristics should be taken into account when looking for fraud opportunities. For instance, this occurs when the physical characteristics of a product are changed, as when beef is minced. Fraudsters have profited from the lack of a product traceability system in these instances. In light of this, authorities can only identify the provenance or species of the processed meat – and even then, not always – by setting up an elaborate system of laboratory testing. The results of the investigation have also supported the addition of two new viewpoints into the transparency of the supply chain network: ingredient outsourcing and a lack of supply chain visibility. These unexpected discoveries were mostly discovered in dairy, alcoholic, meat, and poultry goods. According to previous studies, complex supply chains are typically less transparent, providing fraudsters greater opportunity to operate (van Ruth et al., 2017).

This implies that a company's supply chain network may have an impact on how vulnerable it is to fraud (PwC, 2015; Stevenson & Busby, 2015; Wagner & Neshat, 2010). For instance, expanding the supply network and increasing outsourcing can both render food fraud more likely (Pettit et al., 2013). According to Rezazade, Summers and Teik (2021), dairy products are vulnerable because the supply chain is opaque. Their research showed how fraudsters either diluted the original milk product with water or partially replaced it with a subpar variety. They then moved this product using either public transportation or their own supply chain business, and sold it in the market using the name and label of the far more expensive product. These fraudulent activities were caused by increased supply chain vulnerabilities, brought on by a lack of supply chain transparency and a lack of supply chain integration (SSAFE, 2017; Sharma et al., 2021). The majority of incidents connected to these incidences originated in India, where impromptu midnight raids on unregistered homes used during nefarious transactions to evade suspicion in the first place led to the detection and monitoring of these instances.

2.3.1.2 Opportunities in time and space

When production and distribution operations are vulnerable to time- and place-based opportunities for fraud, such as access to product processing lines, access by unauthorised people, and a lack of physical safeguards, fraud vulnerabilities may also exist in addition to technical possibilities (Benson & Simpson, 2009). Transparency and positive chain supply relationships are essential for maintaining food integrity in a dynamic, complex supply chain (Ali & Suleiman, 2018; Trienekens, Wognum, Beulens & van der Vorst, 2012), and these aspects are consequently taken into account as factors influencing fraud vulnerability. A food product is likely to present fraud opportunities if there have been numerous reports of it being connected to fraud incidents. There are chances or vulnerabilities for food theft where thieves are able to gain legal access to places where they can commit fraud (van Ruth, Huisman & Luning, 2017). The same employees who operate in the real production processes are regularly used by fraudsters when they are able to access technologies to facilitate fraudulent actions (for instance, on the processing lines). (Stevenson & Busby, 2015). According to Abdullahi, Mansor and Nuhu (2015), an opportunity for organisational fraud is facilitated by the presence of inefficient controls or governance system. When the supply chain of a food product is ambiguous or extremely complex (Silvis et al., 2017), there are also opportunities in time and space. These elements increase the possibility of fraud occurring undetected. In addition to creating obstacles for supply chain integration, the complexity of the structure can render a company more vulnerable because the export channel lacks observability and effective control (Hoecht & Trott, 2014; PwC 2015; Stevenson & Busby, 2015).

Fraud may also be caused by other perceived opportunities, such as the presumption that the employer is unaware of the illicit activity, the lack of regular employee monitoring for policy violations, the belief that no one will notice, and the lack of consideration of the behaviour as a serious offence (Sauser, 2007). Opportunity, according to Rae and Subramanian (2008), refers to a systemic flaw where an employee has the authority or capacity to take advantage of the circumstances and make fraud possible. According to Hooper and Pornelli (2010), financial fraud is impossible to commit without an opportunity, even under conditions of extreme pressure. According to Abdullahi, Mansor and Nuhu (2015), opportunity has two main components: (i) the organisation's innate propensity for deception, and (ii) the internal circumstances that could lead to fraud. Furthermore, according to Srivastava, Mock and Turner (2005), a person cannot commit fraud, even if they have a motive, where there are no opportunities for it to happen. The conditions will be attractive for an employee to commit fraud, for instance, if there is poor job division, poor internal regulation, and audits are not conducted on a regular basis. Three proxies, based on TSAS 43, were used by Chen and

Elder (2007) and Fazli, Mohd and Muhammad (2014) to measure opportunity, including related party transactions, CEO duality, and difference between control and cash flow rights. By the same token, Moyes, Lin and Landry-Jr (2005) state that the existence of related party transactions is the second most common opportunity they encounter. Related party transactions were ranked third among the most common opportunities for fraud (Wilks & Zimbelman, 2004). In a similar vein, related party transactions were also used as a stand-in by Ming and Wong (2003) to assess opportunity. This is in line with Vance's (1983) findings that ineffective monitoring because of poor directorship in the public sector was another indicator of opportunity. The researcher further highlighted the point that a CEO's dominance reduces the board's ability to provide effective oversight of management activities.

Lack of supervision, insufficient job segregation, or absent or ineffective controls may all create opportunities for fraud (Kenyon & Tilton, 2006).This is corroborated by Lindquist and Singleton (2006), who noted that the 2004 Report to the Nation (RTTN) research by the Association of Certified Fraud Examiners showed that the majority of employees and supervisors who commit fraud have typically worked for the same organisation for a long period. The chance to seize the opportunity within the organisation is made possible by this. Employees and managers with years of experience are sufficiently aware of the internal control gaps, and they have enough expertise to successfully commit a crime without fear or stress, claim Ewa and Udoayang (2012). The vast majority of producers and merchants have integrated, open, and coordinated supply chains with extensive information exchange (SSAFE, 2017).

2.3.2 Motivation of food fraud vulnerability

The motivation for food fraud describes why swindlers would desire to break the law in the first place. This component includes the elements that render individuals more susceptible to food fraud and, as a result, more inclined to commit fraud themselves. When there is a high likelihood of financial gain, fraud is generally motivated, overall (Johnson, 2014). This is supported by Charlebois, Schwab, Henn and Huck (2016), who argue that food fraud occurs because food products can be easily tainted, and highly valuable compounds can be partially or completely replaced by similar but less expensive compounds. Depending on the intent, this could be considered as committing fraud or counterfeiting. However, thanks to more advanced and effective technology, it is now possible to verify food at retail sites and back along the supply chain. In addition to preventing commercial fraud, the goal is to evaluate the safety concerns associated with the illegal introduction of any ingredient to food that can be hazardous to some customers, such as allergens or poisonous substances. Safety issues are

unquestionably exacerbated when the outcome of the deception puts customers' health in danger.

Equally significant is SSAFE (2017), which asserts that fraud can occur at any point along the supply chain and be committed by both insiders and outsiders, including direct suppliers to the company and criminals who work for that company. Therefore, the three main sources of the drivers that lead businesses to commit fraud are the businesses themselves, other businesses in the distribution network, and the entire supply chain. Contrary to other food offences such as incidents involving food safety, food fraudsters typically have no malicious intent toward consumers. Instead, they aim to profit from their dishonest actions (Spink & Moyer, 2011). Several environmental elements that fraudsters exploit to conduct their crime for financial gain increase the susceptibility to food fraud. These factors are present in both the macro- and micro-environmental layers of the supply chain. While macro-elements, such as worldwide pricing, are those that are connected to the overall threat assessment of food fraud, micro-factors, such as business relationships, assist in understanding how and why a specific fraudster is driven to act (Moyer, DeVries & Spink, 2017). A key susceptibility driver for decision-making among those who commit food fraud is seen in the concept of macro- and micro-incentive factors. According to van Ruth, Huisman and Luning (2017), these micro- and macro-factors will financially encourage food fraudsters. They also have an influence on culture and behaviour.

According to Rezazade, Summers and Teik (2021), their barrier analysis results showed two more measures that should be included in the motivation factor for vulnerability to food fraud. These are potential price hikes that are driven by changes in the exchange rate and a nation's culture and religion. It was noted that, in some developing nations, the culture and religion of the detecting nation were particularly obvious. In Pakistan, for instance, where alcohol consumption is more freely permitted, the adulteration of alcoholic beverages has been reported more frequently than in other nations. In these instances, products that had been altered or disguised to avoid punishment or detection revealed the financial motivation of the fraudsters. Since consuming such products was frequently against the law in these nations, this dimension has proven difficult to research thus far.

The potential for price increases caused by currency fluctuations was the second element to be considered when determining the susceptibility factor for the motivation of food fraud. The literature research made it very evident that purposeful behaviour for financial benefit has always been the driving force behind food fraud. An excellent example of this dimension is the Iranian situation, when home-brewed alcoholic beverage consumption soared as a result of

the dramatic depreciation of the country's currency against the US dollar. People were unable to afford the product that was brought in illegally. In this instance, scammers profited from the consumers' gullibility to be duped by the price increase brought on by currency fluctuations.

2.3.2.1 Economic drivers

Economic causes of food fraud vulnerabilities include a variety of commercial and economic factors that can increase the possible return on the fraudsters' activities. Yang (2021) claims that, because food fraud is perpetrated with the intent to defraud consumers and make money, economic factors affecting the price of the product, such as the cost and availability of raw materials, the added value of the goods and the level of competition, may affect the vulnerability to the fraud. This takes place through encouraging offenders to boost their revenues. Before the 2008 melamine fraud episodes concerning infant formula in China, there was a higher demand for raw milk than there was a supply, which led to heated competition for raw milk among dairy processors and skyrocketing raw milk prices (Xiu & Klein, 2010). Furthermore, it might be challenging to accomplish financial goals if businesses in a sector are experiencing poor financial performance (Wang & Winton, 2012), which can have negative repercussions and encourage fraud. Numerous studies have been done on the fraudulent luxury goods market. Whether a product has been counterfeited is either known to the consumer or not, but it could be argued that the majority of food product counterfeits are acquired by uninformed customers. The general consensus is that consumers buying counterfeit goods benefit from low financial risks because the prices are generally favourable. Furthermore, since counterfeits are frequently less expensive than the genuine articles are, the quality expectation would not be comparable.

Food fraud is more likely to occur with a product that is more likely to be faked or tainted. The inclusion of value-added features in products is one instance of this factor (van Ruth, Huisman & Luning, 2017). The compositions of raw materials, such as the amount of protein present, industrial processes, or particular processing, such as handmade products, are examples of attributes that create value. As a result of their higher value and cost, products such as artisanal and organic goods are more prone to be misrepresented and faked (Silvis et al. 2017; van Ruth, Huisman & Luning 2017). The trends for healthy eating and the use of sweeteners and honey continue to surge, thus the European Union has increased imports of honey from third-world countries. According to the European commission, around 45% of the sampled imported honey were adulterated with sugar and extending honey with sugar syrups as the honey production were lagging from the high demand from consumers. This adulteration

activity by business operators was mainly for financial gains (Food Navigator Europe,2023). The commission also suspected that not only were the counterfeit from the third countries but that honey were produced in other countries, blended in the UK and then re-exported in the EU for more financial gains.

Food fraud is more common and causes more financial burdens in nations with weak economies, abundant competition, and pricing variations. Owing to regulatory variability and intense market competition, countries are more vulnerable to food fraud when there is price asymmetry. This will consequently render people more susceptible to food fraud. Financial strain on a supplier to meet the ever-increasing demands from customers will also render them more financially vulnerable to food fraud. If a supplier is heavily dependent on a particular customer, they might resort to fraud to satisfy the increased demand (Waters, 2011). However, the likelihood that a business would pick an EMA will surely climb if it is losing money or making a very little profit. Generally speaking, reputable businesses will select legitimate manufacturing techniques to earn profits because they are under pressure to increase profitability and minimise expenses (Luo et al., 2016). According to Yang, Zhou, Wu, Zhang, Mo, Liu and Yang (2022), the majority of producers and retailers agree that, possibly, the total vegetable oil business is currently at a mature development stage, with constant economic conditions and fiercer competition. Owing to the intense competition in both domestic and foreign markets, many firms, especially small- and medium-sized ones (SMEs), find it difficult to gain a price advantage and achieve their financial goals. This is consistent with the observations of Yan et al, (2020), that they are under increased pressure to commit fraud as a result.

2.3.2.2 Culture and behaviour

It is also known that cultural and behavioural factors can influence fraudsters' motivation (Silvis et al., 2017). Suppliers who have been comfortable with the idea of choosing to buy fake goods are one example of these factors. Because of their cultural heritage, their primary driving force behind their actions is a reluctance to pay full price for genuine goods (Hoecht & Trott, 2014).

According to Yang (2020), studies on crimes committed in formal and commercial contexts show unequivocally that organisational strategy and company structure may have an effect on potential criminals. In terms of organisational strategy, the objectives of the organisation and the means by which its members should achieve these objectives are discussed. This is consistent with Huisman's (2016) view that "business culture" describes the norms and values

as well as the expectations, attitudes and concepts that are shared by the majority of the organisational members. Undefined and difficult-to-implement organisational strategies may act as motivation for committing an occupational crime. Given that food fraud is a criminal act that takes place within organisations, this thought process is appropriate for it. The presence of unethical organisational behaviour render people more vulnerable to food fraud in an unethical business environment or culture (van Ruth et al., 2018). Lack of trust between parties, dismissing accusations of unethical behaviour, and employee discontent are a few examples of such problems (Kaptein, 2011). The plans and policies of food-producing firms have an impact on fraudsters' motivations, as do international issues. Businesses and their employees' behaviour can be constrained and influenced by both the environment and the business culture. Every business has a unique ethical work environment, which is defined as the prevailing beliefs regarding customary organisational procedures and practices that include an ethical component. While establishing a suitable ethical company culture is conducive to the avoidance of fraud, a weak culture is susceptible to widespread unlawful actions (van Ruth & de Pagter-de Witte, 2020).

Furthermore, companies that have previously committed fraud are more likely to do so in the future (Baucus & Near, 1991). Therefore, corporate crimes committed in the past could indicate future recurrence. Because a country's general level of corruption may serve as a proxy for enterprises making money unlawfully, it can have an impact on fraud risk (Martin, Cullen, Johnson & Parboteeah, 2007). In addition, certain offenders may think that committing deception to advance their goals is a regular and acceptable practice in countries with higher levels of corruption (Alibux, 2016). The degree of corruption, which acts as a proxy for the frequency of economic crimes, is an important element of fraud vulnerability. One such instance is the degree of corruption in a nation that is brought on by the geopolitical environment or the absence of a regulatory system for food safety (Spink & Moyer, 2011). This implies that companies in nations with higher rates of corruption, as measured by the Corruption Perception Index, are more likely to be exposed to unlawful or immoral activities that could lead to food fraud. Corruption and fraud are intricately intertwined, and the likelihood of fraud occurring can increase in a corrupt social environment. Furthermore, direct suppliers and customers who might have previously engaged in criminal activity are more likely to do so again in the future than those who have not previously broken the law (SSAFE, 2017). As a result, recidivist firms will face a higher risk of fraud. Moreover, it is said that a direct supplier is more likely to be defrauded if they had previously fallen victim to food fraud, endangering businesses as well. If illegal activity like food fraud has happened in the past, it is more likely that it will occur again in the future. The research has long recognised that this effect increases people's susceptibility to food fraud.

Rezazade, Summers and Teik (2021) noted that their study's findings also revealed two new perspectives into what is already known about the motivations of food fraudsters. These fresh perceptions concerned the degree of corruption in the nation under investigation and the availability and cost of raw materials. Their investigation revealed that the likelihood of and tolerance of corrupt business practices in the nations used for detection increased in direct proportion to the desire of fraudsters to perpetrate fraud. In many instances, the research of this dimension uncovered new information, including bribery as being the most significant action impeding the detection of food fraud in the supply chain, as well as authorities that permitted the counterfeit commodities to pass borders without being adequately inspected.

2.3.3 Control measures of food fraud vulnerability

The primary purpose of control measures is to lessen and mitigate the risks that fraud opportunities and motivations pose (van Ruth et al., 2017). According to Yang's (2021) theory, managerial and technical controls are used to help counteract the vulnerabilities brought on by opportunities and motivations. To combat food fraud, suitable countermeasures and competent guardians are required (Hoecht & Trott, 2014; Spink & Moyer, 2011; Ting & Tsang, 2014). The implementation of these countermeasures, though, is still difficult to achieve. Although there is now sophisticated technology and the infrastructure available to properly store food goods in warehouses (Marvin et al., 2016), the supply chain is increasingly susceptible to food fraud since some of these technologies, such as machine-readable technologies, are simple to copy illicitly (Stevenson & Busby, 2015). Two examples of these technologies for food packaging items, which can be reverse-engineered by swindlers to deceive consumers, are holograms and colour-shifting RFID tag ink. Two effective defences recommended in the literature to decrease susceptibility to food fraud are technical and management approaches. Technical controls or 'hard' control measures are related to the identification of occurrences of food fraud, whereas management controls or 'soft' controls are tied to proactive or preventive remedies (Silvis et al., 2017; Van Ruth, Huisman & Luning, 2017). Management and technological measures are covered in the section that follows.

2.3.3.1 Technical Measures

The phrase "hard control measures", which refers to a range of actions taken by companies or their direct suppliers to prevent fraud, includes information systems for controlling mass balance flows, traceability programmes for companies and their suppliers, and systems for

monitoring fraud in the supply chains of raw materials and finished goods. A scientifically solid, prompt, thorough, and integrated contingency for food fraud can significantly lessen the detrimental effects of internal and external fraud incidents on businesses. Ground spices and beef mince are examples of this kind of sensitivity because of their intricacy (BRC, 2015; Van Ruth, Huisman & Luning, 2017). Horsemeat that has been dishonestly substituted in beef mince can only be identified by DNA testing. Hard controls and other technical measures that collect, record, and analyse data about the raw ingredients and finished goods could effectively detect fraud.

Technical controls are the activities involved in testing or recording. An example of a technical control that enables producers to successfully manage logistics and respond swiftly in the event of a product recall, such as in the case of fraud, is a tracking and tracing system. Ultimately, a fraud monitoring system is needed to assess the product integrity of final goods by identifying the arrival of fraudulent raw materials (SSAFE, 2017). This type of monitoring programme may take the shape of a systematic, documentation-based verification of incoming raw materials, or a sample method to identify fraud, such as DNA analysis (SSAFE, 2017; van Ruth, Huisman & Luning, 2017). Secret shoppers and private detectives could also help in monitoring and spotting fake items (Berman, 2008). This idea could be used in the context of food fraud by instructing members of the distribution network's workforce to spot fake processed food goods and to notify the producer immediately when they do (Chaudhry & Zimmerman, 2009).

Businesses could reduce their susceptibility to food theft by using the appropriate information systems and traceability technologies. Systems can systematically collect and analyse data, such as the mass balance control of incoming raw materials and finished commodities, with the proper information (Everstine, Spink & Kennedy, 2013). A tracking system, such as Global Solution One, could be used to transmit information about a product's location (GS1). The GS1 traceability system is made up of the three processes of identification, information gathering, and information sharing between supply chains (GS1 US, 2011). Manufacturers mark products in this system with a GS1 data metrics code, such as a GS1 128 barcode or QR code, to aid consumers in product identification, supply chain tracking, and data sharing over an information network.

2.3.3.2 Managerial measures

Managerial controls are behaviour-influencing elements that might influence fraud vulnerability by reducing the incentives of employees, suppliers and other stakeholders to commit fraud. Organisational managerial controls include integrity checks on employees, whistle-blower systems, and ethical codes of conduct (SSAFE 2017; van Ruth et al., 2018). It has been demonstrated that having an appropriate business code of ethics results in less unethical behaviour (Kaptein, 2011). This makes it a potential fraud vulnerability factor. A well-established whistleblowing system with standardised protocols and whistle-blower protections could enhance the possibility that employees might report unethical behaviour, making it crucial for reducing food fraud (Soon & Manning, 2017). In terms of social control and transparency aspects, industrial rules, law enforcement, and external managerial controls are as vital to internal controls. Social control is the active or passive process by which a group manages itself in accordance with its beliefs and ideals. It is crucial to fraud controls as well. Any member operating in the food supply chain or a specific tier, such as organic farmers, may be referred to as a group in this context. Social control covers aspects such as making decisions, exchanging information, and maintaining your word (van Ruth et al., 2017).

According to Elliott (2014), preventing food fraud is not a high priority for legislation or enforcement. The majority of EU nations require food authorities to send potential criminal cases to the police, although only 12 of the 28 member states of the EU have departments exclusively tasked with preventing food fraud (Gussow, 2020). Social control, business direction, food integrity regulation, and enforcement are further elements in the fight against fraud. Integrity screening methods must be used when employing potential staff (van Ruth, Huisman & Luning, 2017). A test for integrity could help to prevent future employee dishonesty. It is imperative to have a firm code of conduct in place and to enforce businesses' zero-tolerance policies for food fraud (Silvis et al., 2017). Similar to this, Yang, Zhou, Wu, Zhang, Mo, Liu and Yang (2022) indicate that soft controls are tools that should be used to thwart supply chain and enterprise fraud. These might take the form of a code of ethics or guidelines, employee integrity checks, social control systems, fraud contingency plans, supply chain transparency and fraud prevention and control methods, and fraud prevention laws.

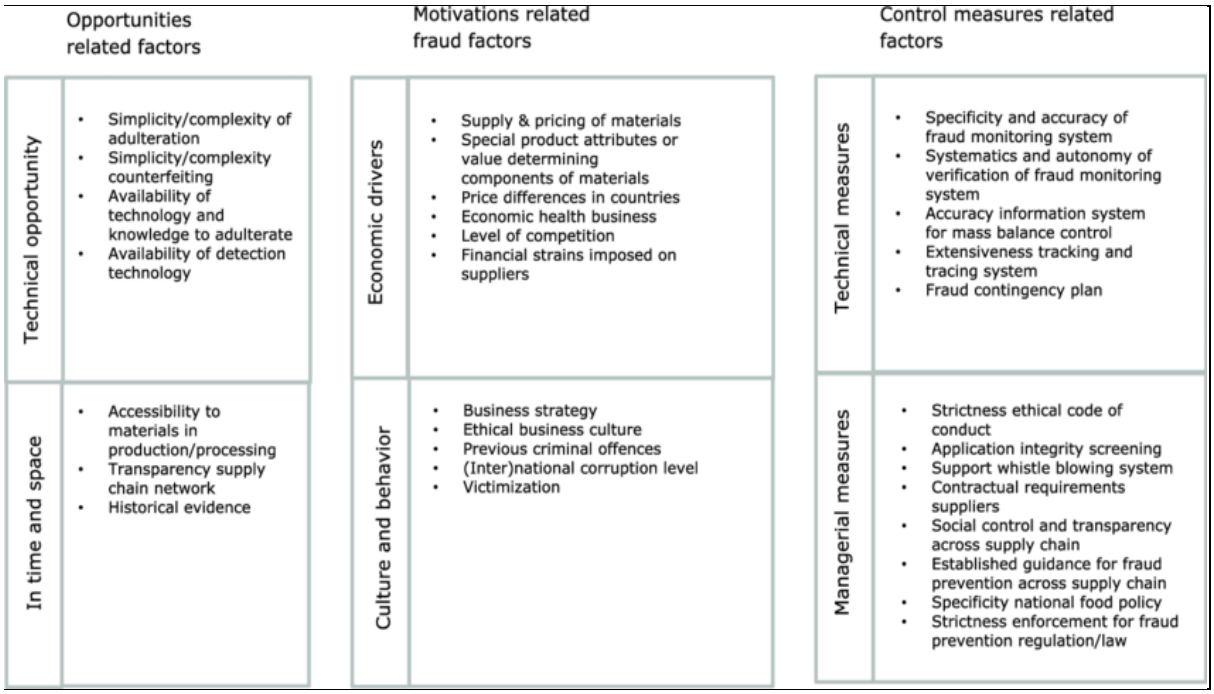
Through the use of a well-designed whistle-blowing system, businesses can provide their own employees with a secure environment in which to report suspicions of fraudulent conduct (SSAFE, 2017; van Ruth, Huisman & Luning, 2017). Creating a contingency plan with policies and supplier management measures is crucial for handling urgent and unforeseen food fraud events (Silvis et al., 2017). A science-based, frequently updated technique for addressing both

food safety and fraud risks constitutes a fraud risk management plan (SSAFE, 2017). Creating strong connections throughout the supply chain system can help to reduce fraud opportunities and the vulnerability of food producers to fraud (Manning & Soon, 2016; Spink et al., 2016). Effective connections and communication among supply chain actors have been found to support supply chain integration, competitiveness, and distribution network traceability (Juan Ding et al., 2014; Jie et al., 2013; Knoll et al., 2017). China's Guanxi system, which strives to strengthen relationships between participants in the supply chain, is one example (Hoecht & Trott, 2014). Personal networks, which demonstrate that channel members have strong emotional ties and are thus less likely to engage in fraud, are used to describe this system. Another strategy to strengthen linkages between supply chain networks is to sign binding contracts. The legal conditions of these contracts may be explicitly specified and may also act as a potent social check.

Because of low law enforcement and confusing domestic and international legislation, fraudsters might have more opportunities to commit crimes in some countries (van Ruth, Huisman & Luning, 2017). For instance, fraudsters are only symbolically penalised in China, where there is little enforcement of the law against them, allowing them to eventually continue their fraudulent activities. Another example is Chinese law's concept of "first to file". A business has no rights to a trademark unless it registers it, in accordance with the aforementioned statute (Harris, 2020). A fraudster can benefit in the Chinese market by registering a trademark before the original firm attempts to register it. In addition, because of poor regulatory law enforcement, there are several strategies that businesses can use to anticipate fraudsters' motivations. One such strategy is branding, which promotes supply chain integration and fosters a sense of shared purpose by encouraging open communication, a solid working alliance, and knowledge exchange (Walters & Glaser, 2008; Lewis et al., 2014). For instance, since China has the "first to file" law, pre-emptively registering a trademark there could prevent fraudsters from having any incentive to enter the Chinese market (Chaudhry & Zimmerman, 2009). Registration of a trademark, the use of transfer certificates, such as a traceability certificate, and implementing security features with customs authorities in the host country, such as China, is another tactic that could be used (Bai, Zhang & Jiang, 2013). This registration enables government agencies to seize counterfeit goods, and to identify them in online marketplaces.

The factors shown below are some of the examples of food fraud vulnerability main elements and shows a summary of events explained from section 2.3.1 above.

Figure 2.1: Summary of the food fraud vulnerability main elements and detailed factors



Source: Adapted from van Ruth, Huisman & Luning (2017)

2.4 UNDERPINNING THEORY

In order to assess the food fraud vulnerability variables in South Africa, this study used the notion of routine activity. According to the routine activity concept, crimes occur when (1) motivated criminals and (2) appropriate targets are gathered together at the same time and location, and (3) there are no capable guardians present (Miró, 2014). A routine activity approach seems particularly appropriate for the study of corporate crime, as it is committed at the workplace and thus directly arises out of the routines of everyday life. Corporate crime involves illegal acts committed by or on behalf of corporations, which operate in legitimate branches of industry (Clinard & Yeager, 1980). For these corporations this is, so to say, criminal business on the side. Since the majority of food fraud occurs in the regular supply chain, food fraud shows similarities with other corporate crimes (Lord, Flores Elizondo & Spencer, 2017). Therefore, the routine activity theory principles are fairly suitable to describe the concept of food fraud vulnerability in order to get insights into the 'what' and the 'who', but also especially the 'why' regarding food fraud. In accordance with the routine activity theory, food fraud vulnerability can be defined by the three elements: opportunities (suitable target),

motivations (motivated offender), and control measures (guardianship), as presented in Figure 2.2 below.

Figure 2.1: Schematic representation for food fraud vulnerability concept based on the routine activity theory

Source: Adapted from van Ruth, Huisman and Luning (2017)

The assessment of the food fraud vulnerability variables by using the routine activity theory allows for a comprehensive analysis of the underlying motivations, opportunities, and control strategies in the South African meat supply chain, because opportunities and incentives available for food fraud activities exist throughout the supply chain, as the market demand for the food product rises, the victims of food fraud increase. As such, proper control measures should be instituted as detection, deterrence, and prevention methods. The more control measures are implemented, the greater the reduction will be in food fraud vulnerability.
The different elements that make up the food fraud vulnerability blends well in helping in determination whether the vulnerability exists or not and to what extent, for as long as there is a motive on available opportunities and less representation of food fraud control measures the likeness of food fraud vulnerability is deemed higher. Each component was well illustrated in section 2.3 above.

2.5 A SUMMARY OF KNOWLEDGE GAPS

This chapter has reviewed the theories and concepts relevant to food fraud vulnerability. The incidents of food fraud emphasise the need to understand the vulnerability to fraud in food chains and to strengthen the ability of companies to minimise fraud within their own organisations and widely across their supply chain. More worrisome is the fact that food fraud is putting the lives of thousands of South Africans at risk daily because of the mushrooming trade in fake food.

For the incidence of food tampering or adulteration to be considered as food fraud, as evident from the literature, their definition specifies two essential characteristics. These requirements are: the act must be intentional; and it must be driven by a desire for financial advantage. Owing to their high market value, meat and meat products are often targets for food fraud, and

accordingly this study is focused on assessing the food fraud vulnerability factors particularly within the meat sector in South Africa.

Although South African authorities are trying their level best to devise prevention measures for tackling food fraud throughout the various food supply chains, events of food fraud are still being reported in the country. As such, it becomes imperative for the food business operators, as well as the competent authorities, to implement comprehensive strategies to mitigate, and where possible, prevent food fraud from occurring. Ensuring food safety should be a priority, as it has significant implications for food and nutrition security. In addition, addressing food safety would help to maintain and improve domestic and international trade to boost economic development. The methodological approaches that were employed in this study are discussed in the next chapter.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research methodology describes how data are collected for a research project (Håkansson, 2013). The methodology sets out an outline for the collection, measurement, and analysis of data, with the aim of achieving the objectives of a research project (Amaratunga, Baldry, Sarshar & Newton, 2002). In this chapter, the target population, the sampling method that was used, and an elaboration of the data collection method are explicitly discussed. Additionally, the researcher identifies the data analysis methods, the tests of the statistics, computer programmes and other technical information, as well as the validation for using a particular method. This chapter also discusses the data collection instrument that was employed in the study, the organisation of the research instrument, and the instrument's reliability and validity. Lastly, the different statistical tests that were conducted during data analysis are further explained in this chapter.

3.2 STUDY AREA

The study focused on Pretoria, a city in South Africa's Gauteng Province (see Figure 3.1). Pretoria, commonly referred to as the City of Tshwane, is situated 50 kilometres northeast of Johannesburg in South Africa. It is situated in a zone of transition between the low-lying Bushveld to the north and the Highveld plateau to the south. The city has a mild environment because it is located at an altitude of roughly 1,350 meters above sea level. A protected and productive valley surrounds the city in the Magaliesberg range of hills.

Tshwane food market ranges from Fresh produce wholesalers, Packaging wholesalers, Processing businesses, Housewives' Market, Fresh produce wholesalers, Meat retailer and a lot of Restaurants.

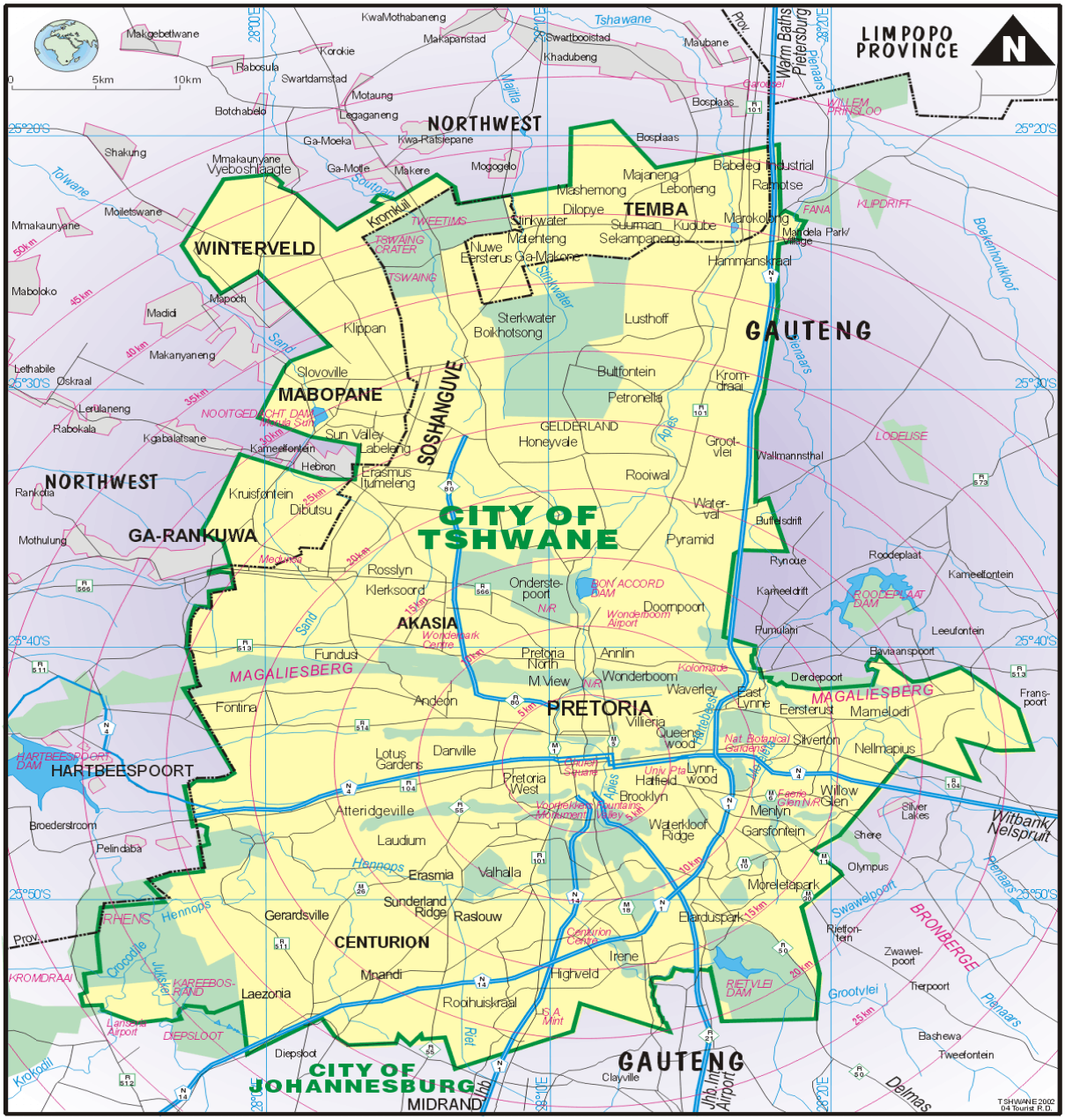


Figure 3.1: Map of Pretoria

Source: Travelsmaps (2022)

Aligned to the Industrial Development Cooperation's (IDC) mandate and the province's key focus areas, the City of Tshwane continues to prioritise the manufacturing sectors, which include the food and beverages subsector, e.g., processing and packaging of meat, fruit and vegetables; establishment of pack houses (Ngouapegne & Chinomona, 2018).

3.3 RESEARCH PARADIGM

Salehi and Golafshani (2010) state that, in order to formulate a suitable research strategy that explains how data will be collected and analysed and knowledge gained, a clear research paradigm should first be established. This is primarily because any philosophical assumptions regarding the topic of interest might impact upon how the phenomena can be understood, and therefore such assumptions must remain constant throughout the research exercise (Tashakkori & Creswell, 2007). Ponterotto (2005) describes a paradigm as a bent of theories and related assumptions shared among an association of researchers. According to Blumberg, Cooper and Schindler (2014), the two most renowned research paradigms are guided by positivism and interpretivism. Because of the nature of the study in hand, the positivist paradigm is considered to be preferable because, in relation to the research objectives, the positivism paradigm seems more suitable for solving the 'what' and 'how' questions relating to food fraud vulnerability factors in South Africa.

Emerging from the natural sciences, the positivist paradigm holds that there is a single existing reality and that it is the responsibility of the researcher to uncover that reality (Samy & Robertson, 2017). Thus, with the positivist paradigm, objectives are established from prevailing empirical evidence (e.g. food fraud vulnerability in South Africa). Through the measurement of social reality, the positivist paradigm undertakes a scientific method to knowledge development, and claims that only knowledge that is scientific is effective, certain, and precise (Ormston, Spencer, Barnard & Snape, 2014). Furthermore, data collection within the pure positivist paradigm follows a quantitative method containing the representation of holistic phenomena in variables that are measurable.

3.4 RESEARCH STRATEGY

Yin (2003) has recommended that a particular research strategy should be selected based on three conditions: the type of research question; the extent of control an investigator has over actual behavioural events; and the degree of focus on contemporary or historical events. There are various research strategies with distinctive characteristics available from which a researcher may select, based on the above criteria. Both Yin (2003) and Saunders and Lewis (2009) acknowledged that, although various research strategies exist, there are large overlaps among them and thus the important consideration would be to select the most advantageous strategy for a particular research study. Some of the common research strategies used in business and management are experiment, survey, case study, action research, grounded

theory, ethnography, and archival research (Saunders and Lewis, 2009). From these various strategies, this research adopted the survey research strategy as the appropriate approach to take for this research study.

A survey is a methodical way to collect data from a population by selecting a representative sample and extrapolating the characteristics of the population from this sample (Taherdoost, 2016). Baker and Foy (2003: 45) state that "a survey is concerned with fact finding by asking questions of persons representative of a population of interest to determine attitudes, opinions and help understand behaviour". It made logical sense to conduct a survey because the focus of this study was on presenting or explaining the food fraud vulnerability characteristics in South Africa. The "survey strategy is usually associated with the deductive approach. It is a popular and common strategy in economic related research and is most frequently used to answer who, what, where, how much and how many questions (Taherdoost, 2016). It therefore tends to be mostly used for descriptive research. Surveys are popular as they allow the collection of a large amount of data" from a sizeable population in a highly economical way.

3.5 SAMPLING

The stratified sampling strategy was used by the researcher (Sharma, 2017). Researchers divide a population into distinct subpopulations known as strata (plural of stratum) based on specific traits found in a stratified sample. There should only be one stratum for each person in the population being examined. In following the stratified technique, respondents were divided into two strata: (a) meat consumers, and (b) food specialists. Meat consumers who were chosen were selected on the basis of the regular inclusion of meat products in their diets. Food specialists were selected based on their expertise and knowledge on the preparation, storage, packaging, and distribution food products, as well as food processing safety procedures. Fortin (2022: 56) advances the view that "a food specialist studies the deterioration and processing of foods by using microbiology, engineering, and chemistry. They determine nutrient levels of food by analyzing its content. They look for new nutritional food sources and investigate avenues for making processed foods taste good, safe, and healthy". Taking into account time and budget constraints, the sample for the meat consumers was conveniently selected at butcheries located within a 20-Km radius from the Pretoria Central Business District (see Map in Figure 3.1). Convenience sampling can be defined as a type of non-probability sampling where participants are selected based on easy accessibility or availability, close geographic proximity, and participants' willingness to be a part of the study (Etikan, Musa & Alkassim, 2016). On the other hand, the food specialists were purposively

selected because of their expertise in food fraud vulnerability issues. A purposive sample is a non-probability sample that is chosen based on demographic attributes and the study's research goal. Convenience sampling differs from purposeful sampling, which is also known as judgmental sampling (Sharma, 2017). The gathering of the actual population number was difficult in this study, as it was challenging to find an exact database of meat consumers and food specialists in the Pretoria area. Accordingly, it would have been challenging to compile a sample that was representative of the greater population. Because the various items of data were gathered during the time when COVID-19 mobility restrictions were in effect, the sample was determined by the availability of respondents. In total, 100 people participated in the survey (80 for meat consumers and 20 for food specialists).

3.6 DATA COLLECTION INSTRUMENT

In keeping with the research objectives, structured questionnaires were designed and used to collect primary data from both the meat consumers and the food specialists. The content of the questionnaire included a mixture of both close-ended and open-ended questions to probe for further insights from respondents, as well as to give the respondents broader choices in the list of probable answers to select their answers from (Rantlo, 2018). The questions were written in clear and simple English. The survey questionnaire was pre-tested on 10 meat consumers and 5 food specialists. This pre-testing assisted the researcher to take note of the following: firstly, the pre-testing helped in that the researcher had the opportunity to improve the quality of questions. Secondly, the importance of time management helped to build a good rapport with respondents and gave respondents the assurance that their time would not be wasted. The questions posed to participants were aimed at retrieving insights from the meat consumer, food specialist for better understanding of food fraud conditions and incidents with the aim of better understanding control measures that are in place and that could be introduced for the future.

3.7 DATA ANALYSIS PROCEDURE

In a quantitative research study approach, data analysis refers to the method of breaking down the data collected into component parts, with the aim of answering the research objectives (Tashakkori, Teddlie & Teddlie, 1998.). Data analyses in this study included the editing and coding of data after collection, testing validity and reliability of the collected data, and the statistical analysis of the data. Hence, it involved reducing the accumulated data into a convenient size, developing summaries, observing patterns, and applying statistical

procedures. Carson, Gilmore, Perry and Gronhaug (2001) point out that the objective of analytic methods is to convert data into information required to make decisions. The selected methods of statistical analysis rely upon the type of questions to be answered, the number of variables, and the scale of measurement. The data were analysed by making use descriptive statistics. Collected data were analysed using the IBM Statistical Package for Social Sciences (SPSS) Version 27. The steps that the researcher took in analysing the data are explained in Sub-section 3.7.1 to 3.7.3.

3.7.1 Data editing

The various responses to each item of the research questionnaire were edited. According to Cooper, Schindler and Sun (2006), editing involves an in-depth and critical assessment of the completed questionnaire, in terms of compliance with the principles for collecting meaningful data, and in order to deal with any questionnaires not properly completed. Data editing detects mistakes and omissions, corrects them where applicable, and confirms that the minimum standards of data quality have been attained. As a result, the main purpose of data editing was to guarantee data accuracy and consistency with the intent of the question. The completed questionnaires were edited and organised to simplify the coding procedure.

3.7.2 Coding

Data coding involves assigning figures or other symbols to answers in order for responses to be grouped into a narrow number of categories (Cooper, Schindler & Sun, 2006). The classification of data into restricted categories loses some peripheral data, but is essential for efficient data analysis. The main purpose of data coding was to convert the answers of the respondents to survey questions into codes or symbols, which were easily entered into and read by SPSS. In preparing for the transformation of answers into a computer-friendly format, it is necessary to first think about the structure of the required result.

In this study, two approaches to coding were followed. The first was pre-coding, which involved assigning codes to response options before field work commenced, and which also informed the printing of the relevant codes on the questionnaire. Pre-coding was applied to all questions by assigning numbers to each alternative found in the questions. Secondly, final coding was conducted, during which the data was entered into Microsoft Excel so that it would be easily exported to SPSS.

3.7.3 Descriptive statistics

The use of descriptive statistics is mainly aimed at providing data description by investigating the distribution of scores for each single variable and by establishing whether the scores on different variables are relating to each other (Carson, Gilmore, Perry & Gronhaug, 2001). Descriptive analysis permits the researcher to present data in a way that can be interpreted easily, and this study made use of frequency tables, charts and graphs for descriptive statistics.

3.8 RELIABILITY

To ensure a high degree of reliability, the following aspects, as recommended by McKinnon (1988), were taken into consideration:

I. Carrying out an extensive review of literature – literature on food fraud vulnerability fraud will be analysed in Chapter 2;

II. Using key informants – lobbying the assistance of and researchers to offer insights into the more recent food fraud trends in South Africa;

III. Carrying out a pilot study – to test the measuring instruments, a pilot study was conducted.

3.9 LIMITATIONS OF METHODOLOGY

This dissertation, as with any research, is not free from limitations associated with the methodology (Shiu, Hair, Bush & Ortinau, 2009). The limitations, as they relate to this study, are as follows:

- ***Sample****:* a sample drawn from Pretoria was used in the study, thereby excluding other consumer groups. The results, therefore, may not necessarily be generalised to other consumer segments.
- ***Financial constraints****:* since the researcher had a limited budget to conduct the research, several aspects of the methodology had to be tailored in line with the budget. For instance, the choices of the sample and data collection techniques were greatly influenced by financial constraints imposed on the dissertation.

- ***Time constraints****:* in keeping with the requirements stipulated for this Master's Degree, this study had to be completed within a specified time frame. This, therefore, meant that certain research designs, such as longitudinal methodologies, could not be used.

The above-mentioned limitations apply to this research, and have been taken into consideration in discussing the findings.

3.10 ETHICAL CONSIDERATIONS

In compliance with the guidelines of the Research Ethics Committee at the Faculty of Natural and Agricultural Science, an application for ethical clearance was lodged prior to data collection. Upon approval, the researcher commenced with the data collection. Before commencing with the data collection, the researcher explained the consent form to the participants, highlighting and explaining in depth the elements of anonymity and confidentiality, as well as the voluntary nature of participation in the exercise.

A letter confirming informed consent had been given was issued to the participants before the commencement of the data collection process. This was done to ensure that all respondents participated in the study of their free will, with a clear understanding of what they were involving themselves in. A detailed explanation of the research purpose, processes and the rights of participants was provided to ensure a clear understanding.

The participants were linked to their information by excluding their names from the questionnaire and response sheets in order to recognise the ethical requirement of confidentiality. Data will not be revealed to anyone not involved in the study without the consent of participants. In this regard, it will be kept safely in a private place. Participants were not coerced into signing the informed consent letters to participate. When requesting information about someone's cultural views, religious practices, political allegiances, and so forth, the researcher took great care to avoid inflicting any bodily or emotional harm. The researcher thanked the respondents for helping to make the survey a success at the conclusion of the survey.

3.11 CHAPTER 3 SUMMARY

This chapter has described the research technique adopted for this study, which involved using a survey to gather primary data. The process used to gather primary data was extensively justified and explained throughout the chapter. The results of the data analysis are presented in the next chapter.

CHAPTER 4
RESEARCH RESULTS AND DISCUSSION

4.1 INTRODUCTION

The previous chapter discussed the study methodology, defined the target population, and discussed the sampling method used in the study. The research methodology was also explained, together with the methods used to analyse data. In doing so, various tests and other techniques were explained.

This chapter presents the results found through the research. In this chapter, data are analysed and integrated. Data analysis is the procedure of identifying the accurate data needed to answer a research objective, understanding the procedures underlying the data, ascertaining the significant patterns in the data, and then stating the results that have the greatest possible impact (Leek, 2011). This chapter also reports the response rates of the research questionnaire, as well as the reliability and normality of the data.

The findings are based on the empirical analysis of the data obtained from the research participants. Five stages were followed in analysing data, being validation, coding, data transcribing, data entry, and data cleaning. Several statistical data presentation instruments are used to analyse the data collected through using questionnaires. These statistical data presentation tools include cumulative frequency tables, pie charts, and bar graphs. The descriptive statistics include the mean and standard deviations, where appropriate.

4.2 RESPONSE RATE

Survey researchers have long held the view that attaining a high response rate is one of the best strategies for achieving objective study results (Fosnacht, Sarraf, Howe & Peck, 2017). The response rate achieved by the study is displayed in Table 4.1 below. A total of 100 legitimate research questionnaires (80 for meat consumers and 20 for food professionals) were returned, yielding a response rate of 100%, out of the 80 contacted meat consumers and the 20 food specialists. The higher percentage of respondents was due to the constant contact with respondents and it was mostly during lock down when respondents has very little to do but to participate in the survey, to keep busy from lock down non-events. Because of its high percentage, the response rate was deemed acceptable. All respondents participated with a

link to respond to which made it for responds to come through not forgetting all electronic reminders that were shared before due dates.

Table 4.1: Response rate

Description of Parameter	Number	
	Meat Consumers	Food specialists
Number of questionnaires distributed	80	20
Number of questionnaires returned	80	20
Unfeasible responses	0	0
Valid retained questionnaires	80	20
Response rate usable	100%	100%

4.3 THE NORMALITY OF THE DATA

The data was first examined for normalcy before a thorough analysis was performed. According to Coakes (2005), the Kolmogorov-Smirnov test and the Shapiro-Wilks test can be used to determine whether the data are normal (in case the sample size is below 100). Because the sample sizes for both the meat consumers (n=) and the food specialists (n=) were under 100, this study used the Shapiro-Wilks test. If one of these two tests has a significance level larger than 0.05, normality is taken for granted. The significance of the Shapiro-Wilks tests for this study was greater than 0.05 (meat eaters, p-value = 0.11; food experts, p-value = 0.09), indicating that it is safe to assume that the data are normal.

4.4 RELIABILITY TEST FOR THE QUESTIONNAIRE

The measurement reliability in this study was evaluated through using Cronbach's coefficient alpha. The internal consistency of all the items used to assess the same construct is gauged by using Cronbach's coefficient alpha index. To put it another way, "the reliability test of a questionnaire is a technique of measuring the quality of the measurement procedure used to collect data", according to Artino Jr, La Rochelle, Dezee and Gehlbach (2014: 12). A trustworthy measurement process is required before a result can be deemed genuine. One of the most significant reliability estimates for a measurement scale with multiple-point items is the Cronbach Alpha coefficient. The Cronbach's alpha coefficient ranges from 0 to 1, and the typical threshold is in the range of 0.700 to 0.999, which denotes the reliability of the

questionnaire (Cooper, Schindler & Sun, 2006). The acceptable Cronbach's coefficient alpha was used to examine the internal reliability of each continuous construct, with a higher Cronbach's coefficient alpha indicating higher measurement scale reliability. Table 4.2 below displays the results of scale reliability tests.

Table 4.2: Reliability test of the questionnaire

Variables	No. of items	Cronbach's Coefficient alpha
Consumer vulnerability perceptions	6	0.700
Food Fraud Vulnerability (the product)	10	0.804
Food Fraud Vulnerability (the company)	9	0.898
Food Fraud Vulnerability (the supplier)	10	0.889

The reliability of the scales is indicated by Table 4.2, where the Cronbach's alpha coefficients for all variables are equal to or above 0.700, and are within the acceptable range (AlHamad, 2020). The results of the reliability test show that the measuring scales produced reliability scores of 70% or higher across all scale variables.

4.5 DEMOGRAPHIC PROFILES OF RESPONDENTS

The demographics of the respondents (meat consumers and food specialists) are shown in Table 4.3 below. It can be noted in Table 4.3 that, in terms of gender, females comprised the highest proportion of respondents for the meat consumers group (59.3%), followed by male participants (39.5%), while the lowest proportion of respondents (1.2%) preferred not to answer. For the food specialists group, males recorded the highest proportion of respondents (70%), with the remaining participants (30%) being females.

In terms of age, a significant proportion of the total respondents (64.2%) fell within the age group 29–39 years for meat consumers. On the other hand, the same age group recorded the highest percentage, 65%, for food specialists participants, while the 40–50 years category recorded the lowest percentage of 15%, whereas the 50 years and above category recorded the lowest responses for the meat consumer participants.

Regarding the marital status of meat consumers, single participants recorded the highest percentage of 48.1%, followed by the married participants at a percentage of 44.4%, while the lowest proportion (2.5%) preferred not to answer. In contrast, the food specialists group

recorded the highest percentage of 85% as being married, with the remaining proportion of respondents within the same group (15%) being single.

Furthermore, of the meat consumer respondents, the highest proportion (65.4%) comprised between 4–6 people in a household, and only 1.2 % had 10 and above people, corresponding with the lowest number of respondents (as indicated in Table 4.3). The same trend was witnessed across the food specialists category, as the highest proportion (65%) comprised between 4–6 people in household, and the lowest proportion (5 %) of the participants had 10 and above people in household.

In terms of occupation, for the meat consumers, the employed category was characterised by the highest proportion of respondents (60.5%), while the self-employed category recorded the lowest proportion of 8.6 %. Following a similar pattern, the food specialists group recorded the highest proportion of respondents (70%) under the employed group, while the self-employed category recorded the lowest proportion of 5 %. Furthermore, the meat consumers group recorded a student representation of 13.6%, while food specialists had none.

Regarding years of employment, most respondents in the meat consumers group (70.4%) had been employed for 1–10 years, while the lowest proportion of respondents (2.5%) had been employed for periods from 31 years and above. The food specialists group recorded figures almost the same as for the meat consumers group, with the highest proportion of respondents (65%) having been employed for 1–10 years, and the lowest number of participants (10%) having been employed for between 21 and 30 years.

Table 4.3: Demographic Profile of the Sample

Demographic characteristic		Percentage (%)
		Meat consumers
Gender	Female	59.3
	Male	39.5
	Prefer not to answer	1.2
Age	18-28yrs	24.7
	29-39yrs	64.2
	40-50yrs	7.4
	50+yrs	3.7
Marital status	Single	48.1
	Married	44.4
	Divorced	1.2
	Cohabiting	3.7
	Prefer not to say	2.5
People in household	1-3	19.8
	4-6	65.4
	7-9	13.6
	10+	1.2
Employment Status	Unemployed	17.3
	Employee	60.5
	Self-employed	8.6
	Student	13.6
Years of employment	None	12.3
	1month-11months	3.7
	1-10yrs	70.4
	11-20yrs	7.4
	21-30yrs	3.7
	31+yrs	2.5
Education level	No formal education	1.2
	Primary	1.2
	Secondary	2.5
	Tertiary	95.1
Area of specialisation	Agriculture	
	Food Safety & Quality Control	
	Food science	
	Research	
	Manufacturing and distribution	

Table 4.3 also indicates that, of the total meat consumers, 95,1% had reached the tertiary level of education, with the lowest proportion of respondents (1.2%) having received no formal education, and another 1.2% highlighting primary level as being their highest level of education. On the other hand, all the food specialists (100%) reported having reached the tertiary level of education. Lastly, the food specialist participants were asked in an open-ended question to reveal their area of specialisation. Upon coding their responses, 20% were specialised in agriculture, 45% in food safety and quality control, 15 % in food science, 5 % in research, and another 15% in manufacturing and distribution, which implies that most of the food specialists specialised in food safety and quality control.

4.6 CONSUMER PERCEPTIONS

This section discusses the information gathered from participants (meat consumers) regarding their perceptions towards food fraud. In particular, the participants were asked to share their knowledge about food fraud, as well as about how common food fraud is pertaining to meat and meat products in South Africa.

4.6.1 Knowledge about food fraud

The respondents were questioned about their knowledge of food fraud in this part of the questionnaire. The researcher specifically wanted to determine what people knew about food fraud. The results of the responses are shown In Figure 4.1 below.

Figure 4.1: Knowledge about food fraud

The majority of respondents (58%) had some knowledge of food fraud to some extent, as shown in Figure 4.1, while 42% said they knew nothing at all about it in South Africa. This conclusion is supported by a report by Decernis (2019), who found that most customers are aware of food fraud because of the increase in South African media coverage of fake food, expired food, and contaminated items.

4.6.2 Prevalence of food fraud in meat and meat products in South Africa

As a follow up to the earlier question regarding participants' knowledge concerning food fraud, the respondents were further asked to indicate their perceptions regarding the prevalence of food fraud in meat and meat products in South Africa.

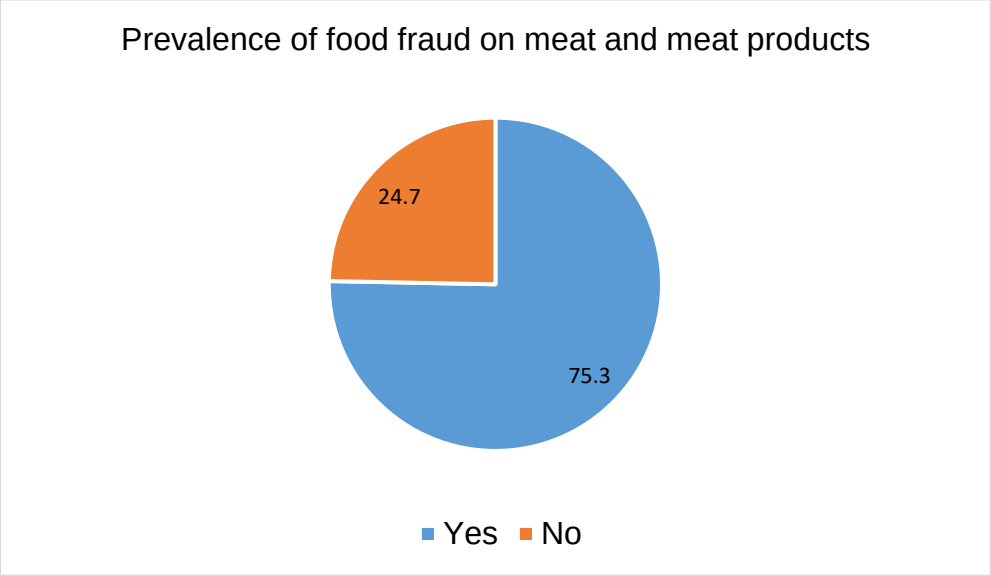


Figure 4.2: Prevalence of food fraud in meat and meat products

As depicted in Figure 4.2 above, 75.3 % of the respondents perceived food fraud in meat and meat products as being prevalent in the country, and 24.7 % had the perception that food fraud in meat and meat products was not prevalent in South Africa. According to Edwards, Manley, Hoffman and Williams (2021), meat fraud in South Africa has of late been rampant, and locals might avoid eating a variety of meat products because the country's meat industry has been engulfed by meat scandals that go right to the heart of consumer trust. The National Department of Health's Food Control Directorate, however, noted that it was difficult to quantify the prevalence of food fraud in meat and meat products, as even internationally, the extent of the problem is not known or quantified (Packaging SA, 2017).

4.7 MEAT AND MEAT PRODUCTS AFFECTED THE MOST

Consumers of meat were asked to rate the meat products that they thought were most affected by food fraud in South Africa in this section of the questionnaire. Meat fraud was shown to primarily affect seven different types of meat. This was accomplished by critically analysing a number of factors from earlier studies on meat fraud (e.g. Chappalwar, Pathak, Goswami, Sharma, Singh & Mishra, 2020; Farag, Alagawany, Abd El-Hack, Tiwari & Dhama, 2015; Amaral, Meira, Oliveira & Mafra, 2016). Fish, goat, lamb, pork, game meat, poultry, and beef were the seven types of meat. The various meat kinds were ranked according to a Likert scale, which allowed respondents to rate their level of agreement or disagreement on a scale from 1 to 6 (Stea & Pickering, 2019). An evaluation of these meat varieties can be made from the output of the analysis of descriptive statistics, as presented in Figure 4.3 below.

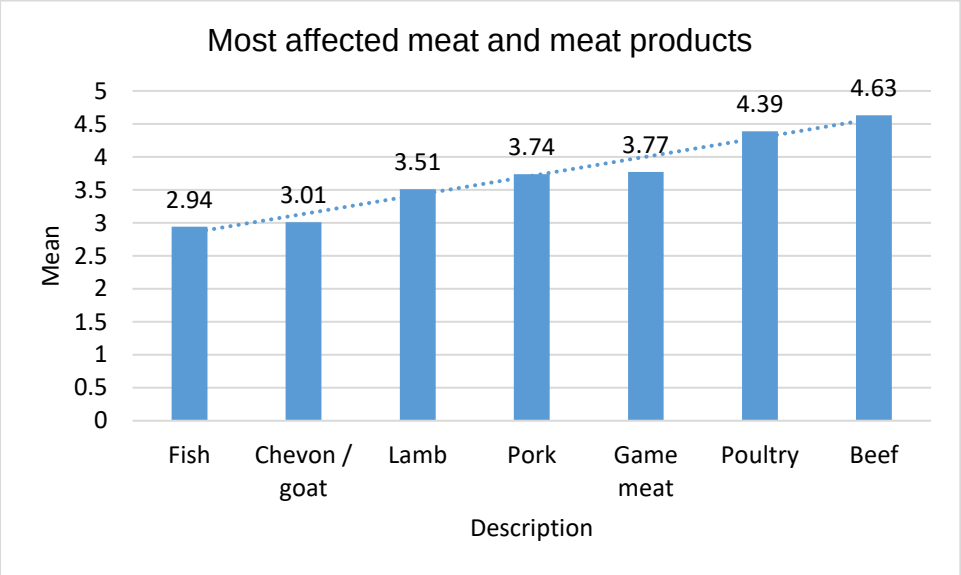


Figure 4.3: Meat and meat products affected the most

Analysing the descriptive statistics shown in Figure 4.3 shows that beef and its related products have the highest weighted mean (M = 4.643), implying that beef is perceived to be the most vulnerable to fraud related to meat and meat products in South Africa. The type of meat and meat products least affected, as revealed by the participants, is fish (M = 2.94). These findings are consistent with the results from a paper published in the Food Control Journal that monitored alerts from the Rapid Alert System for Food and Feed (RASFF) and Horizon Scan databases between 1997 and 2017, which noted an extensive history of beef-related fraud, globally (Footprint, 2020).

Counterfeiting was reported as the most common fraud type in the beef industry, accounting for 42.9% of all responses provided. In 2013, the Dutch authorities made a shocking recall involving 50,000 tons of meat, which had been sold as beef across Europe, because it was suspected to contain horsemeat (Bindt, 2016). According to De Waal (2013), South Africa's meat sector is facing its own food fraud crisis, as researchers have discovered beef products that incorporate local products such as buffalo, donkey, pig, or goat meat, but which are not listed on the labels. According to reports, the majority of food fraud in the global beef supply chain involves the fraudulent processing of beef without inspection (Robson et al., 2020). Food safety risks associated with illegal meat production put consumers' health and faith in their food supply in jeopardy.

4.8 FAMILIARITY WITH FOOD FRAUD TERMS

Food fraud, as indicated in Chapter 2 above, encompasses a variety of terms that need to be known to consumers. As such, it became imperative for this study to further enquire from the respondents whether they were familiar with terms such as 'adulteration', 'counterfeit', 'addition', and 'substitution'. The results are presented in Figure 4.4 below.

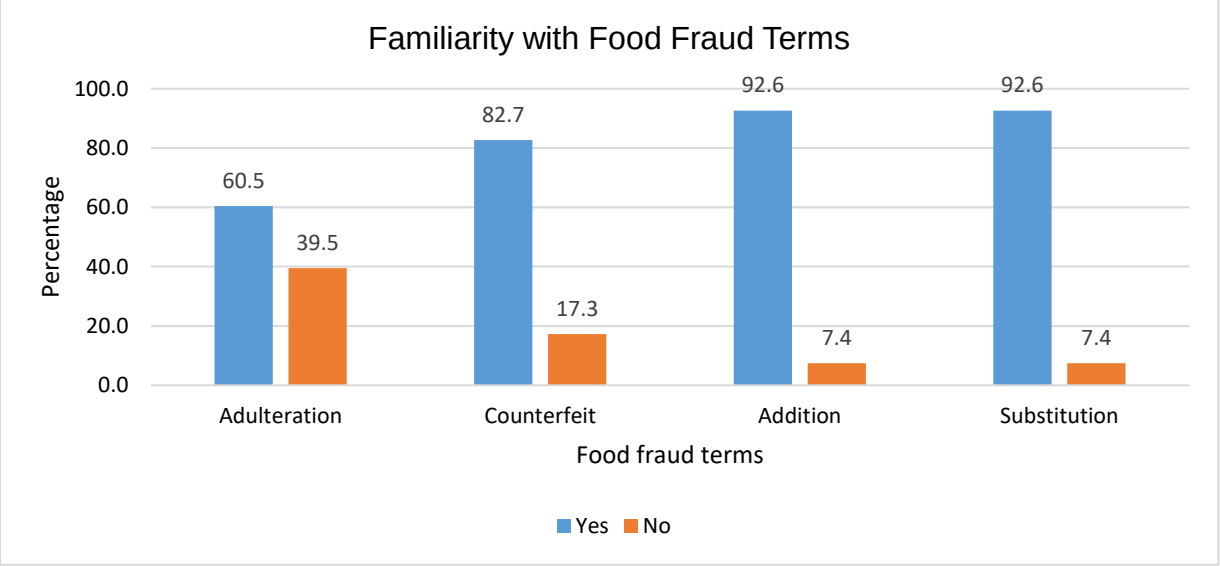


Figure 4.4: Familiarity with food fraud terms

The results shown in Figure 4.4 indicate that respondents were familiar with all the food fraud terms. Most respondents (92.6 %) were familiar with the terms 'addition' and 'substitution', while the lowest percentage of the total respondents (60.5 %) indicated being familiar with the term 'adulteration'. A study by Cawthorn, Steinman and Hoffman (2013) confirmed that both the addition and substitution of processed meats were common in South Africa, which not only

violated food regulations, but also posed economic, religious, ethical and health concerns. Besides being the least familiar term to consumers, food adulteration, according to Robson, Dean, Brooks, Haughey and Elliott (2020), is not a rare occurrence as it is estimated that, globally, around 22 % of foods produced are adulterated every year.

Regarding counterfeiting, Lana van Zyl, a director in charge of company and intellectual property investigations at the Department of Trade and Industry (DTI), has reported that Gauteng, the Western Cape and KwaZulu-Natal are South Africa's counterfeit capital regions, where staples such as rice, baked beans, maize and masala are sold on street corners and flea markets under false labels (News24, 2014). This demonstrates how food fraud has been in operation for song in South Africa. A spokesman for the South African Department of Trade and Industry has said that South Africa is regarded as a top 'dumping' destination for counterfeit and illegally imported goods because of the high demand created by local consumers. In 2013 alone, SARS conducted more than 25 000 seizures and confiscated counterfeit goods valued at R2.6 billion (News24, 2014).

4.9 FOOD FRAUD VULNERABILITY ASSESSMENT

In order to understand the viability of control measures available within the supply chain to address meat fraud opportunities, the Food Fraud Vulnerability Assessment conducted in this section aimed to identify the potential opportunities and motivations that are present for businesses and suppliers to illicitly participate in fraudulent activities related to meat and meat products. Food fraud vulnerability threats may come from both the internal and external environments of a business, according to van Ruth, Huisman and Luning (2017). As a result, several vulnerability factors need to be taken into account at various environmental levels, such as the level of the business itself, its suppliers, and the larger value chain.

Accordingly, the vulnerability in this sector was evaluated based on the respondent food specialists' understanding of potential food fraud threats related to enterprises, suppliers, and the meat industry, as well as items associated with meat. Participants were asked to fill out certain grids with descriptions of low, medium, and high vulnerability circumstances for a specific element (See Appendix B, sections 3 to 5). After the surveys were finished, the responses from the participants were converted to a score system to enable a frequency analysis to be performed. Low, medium, and high vulnerability were represented by scores of 1, 2, and 3, respectively.

A high vulnerability situation for the opportunities and motivations corresponds to a score of 3 (e.g. the knowledge required for adulteration is generally available). A medium vulnerability situation attracts a score of 2 (e.g. advanced technologies, methods, facilities and knowledge are required to adulterate the raw materials). A low vulnerability situation corresponds to a score 1 (i.e. technologies and/or methods to adulterate the raw materials are not available, known, or reported). For the control measures, a score of 1 is assigned to high vulnerability situation (i.e. no specific fraud focus in control), a score of 2 to a medium vulnerability situation (e.g. some basic/simple fraud related measures in place), and 3 to answers linked to a low vulnerability situation (e.g. fraud dedicated measures in place). For all the questions related to vulnerability assessment, the most frequently given answer (i.e. the mode) to a certain situation (and corresponding score) was determined.

4.9.1 Food fraud vulnerability opportunities – the product

In this sub-section, participants (food specialists) were requested to indicate their food fraud vulnerability assessments related to food products to enable the researcher to gain an understanding of the meat fraud opportunities presently available in South Africa (refer to Appendix B, section 3). Figure 4.5 below depicts the participants' responses.

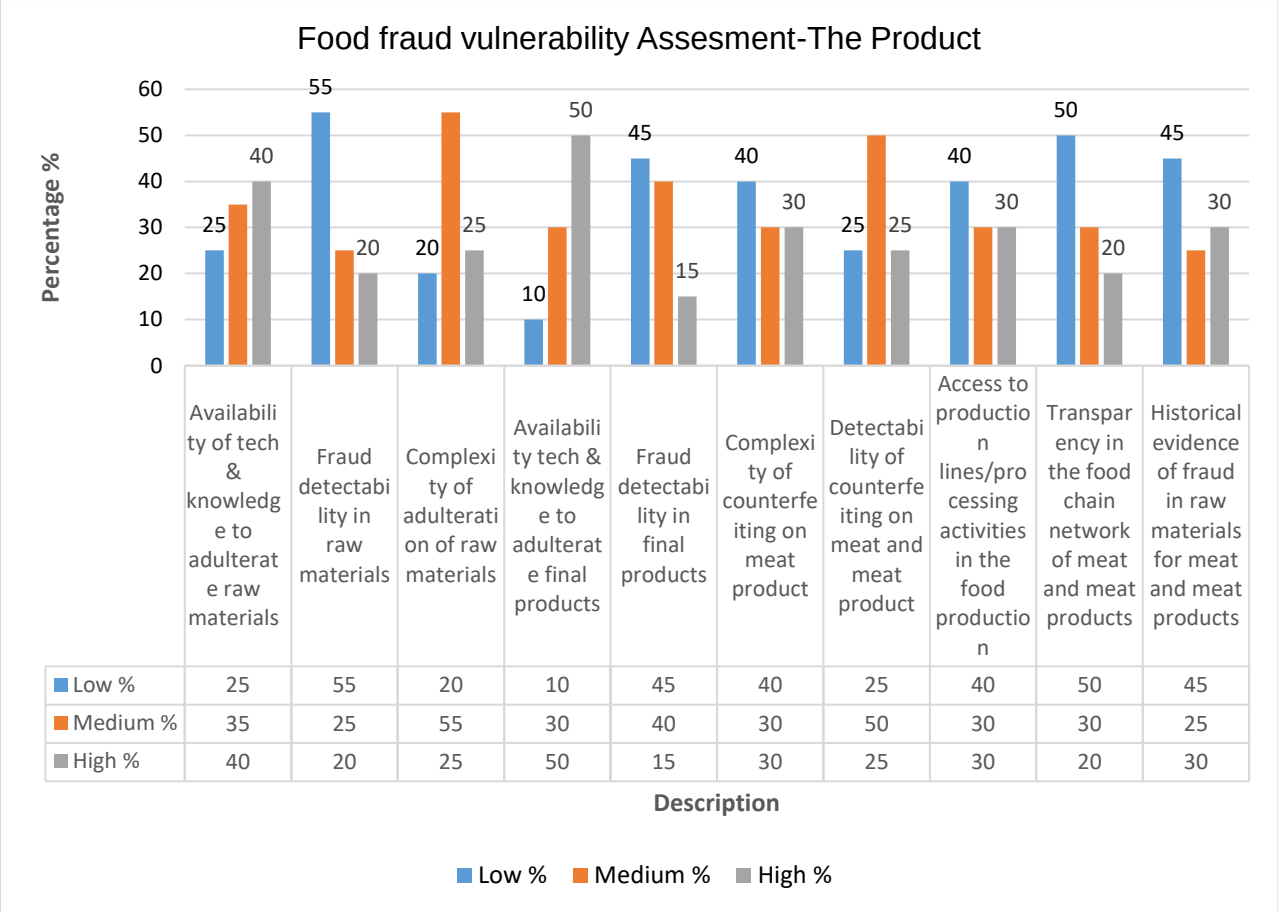


Figure 4.5: Food Fraud vulnerability assessment – the product

The majority of participants (40%) responded in the affirmative to the question about whether technology and knowledge are currently widely available in South Africa to adulterate raw materials, and it can be seen in Figure 4.5 above that this belief is supported by the data. Most participants (55 %) furthermore noted that fraud detectability in raw materials was low, indicating that there is an opportunity for meat fraud perpetrators to deceive consumers through various forms of meat fraud, such as those depicted in Figure 4.5 above. Regarding the complexity of adulteration of raw materials, a significant proportion of the total respondents (55 %) indicated a medium complexity of adulteration. On the other hand, the highest proportion of participants (50 %) indicated that there is a high availability of technology and knowledge to adulterate final products. The results in Figure 4.5 above indicate that most participants (40 % and 45 %) were of the view that the complexity of counterfeiting in meat products is low and that fraud detectability in final products is also low. When asked to indicate whether there was enough access to production lines/processing activities in the food production, the majority of respondents (40 %) indicated a low access to production lines, thus indicating that food processing companies in South Africa may allow enough opportunities to fraudsters to perpetrate food fraud because of the lack of external monitoring. This is evident

as most food specialists (50 %) further revealed that there was low transparency in the food chain network of meat and meat products. Regarding the historical evidence of fraud in raw materials for meat and meat products, most participants (45 %) indicated that there was little evidence in this regard. This demonstrates that, despite the prevalence of meat fraud in South Africa, it is difficult to detect the source of such fraud.

4.9.1.1 Most fraud vulnerable phase in food production

As a follow up to ascertaining product-related food fraud vulnerability, the food specialist respondents were further asked to give details, according to their opinion, of the phase of the food chain in which food fraud vulnerability was most likely to take place in meat and meat products. The results are depicted in Figure 4.6 below.

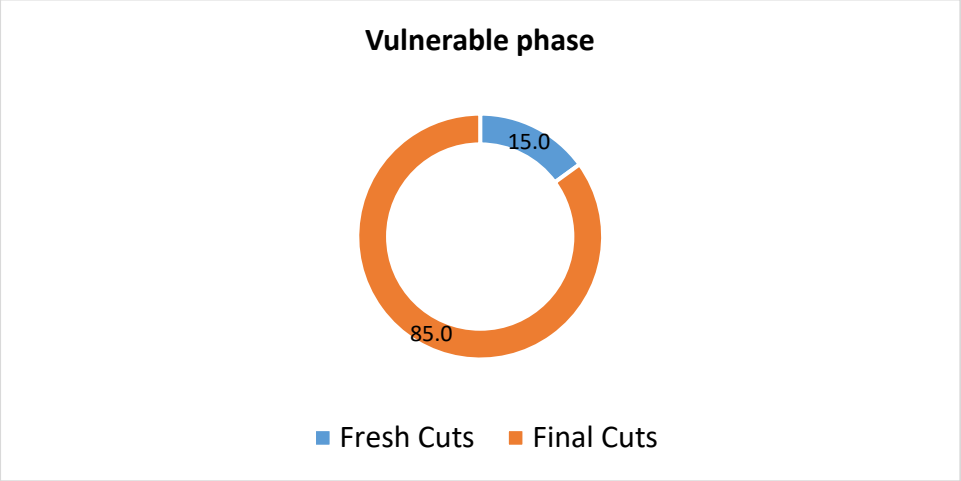


Figure 4.6: Meat fraud vulnerable phase

The results presented in Figure 4.6 above indicate that, of the food specialists who participated in this study, most (85 %) indicated that meat fraud mainly occurred during the 'final cuts' phase, while the lowest proportion of participants (15 %) believed that meat fraud was mainly rife at the 'fresh cuts' phase. Fresh cuts involve the meat carcasses that are usually chilled immediately after slaughter, while final cuts relate to the processed and packaged meat. Despite the mixed views, the results imply that, in South Africa, the majority of meat fraud cases occur during the final cuts phase of the supply chain.

4.9.2 Food fraud vulnerability motivations – Company

In order to establish the motivations available for companies to participate in fraudulent activities linked to meat and meat products, the views of the food specialist respondents were assessed, based on various statement related to food fraud vulnerability linked to their respective companies. The participants' responses are depicted in Figure 4.7 below.

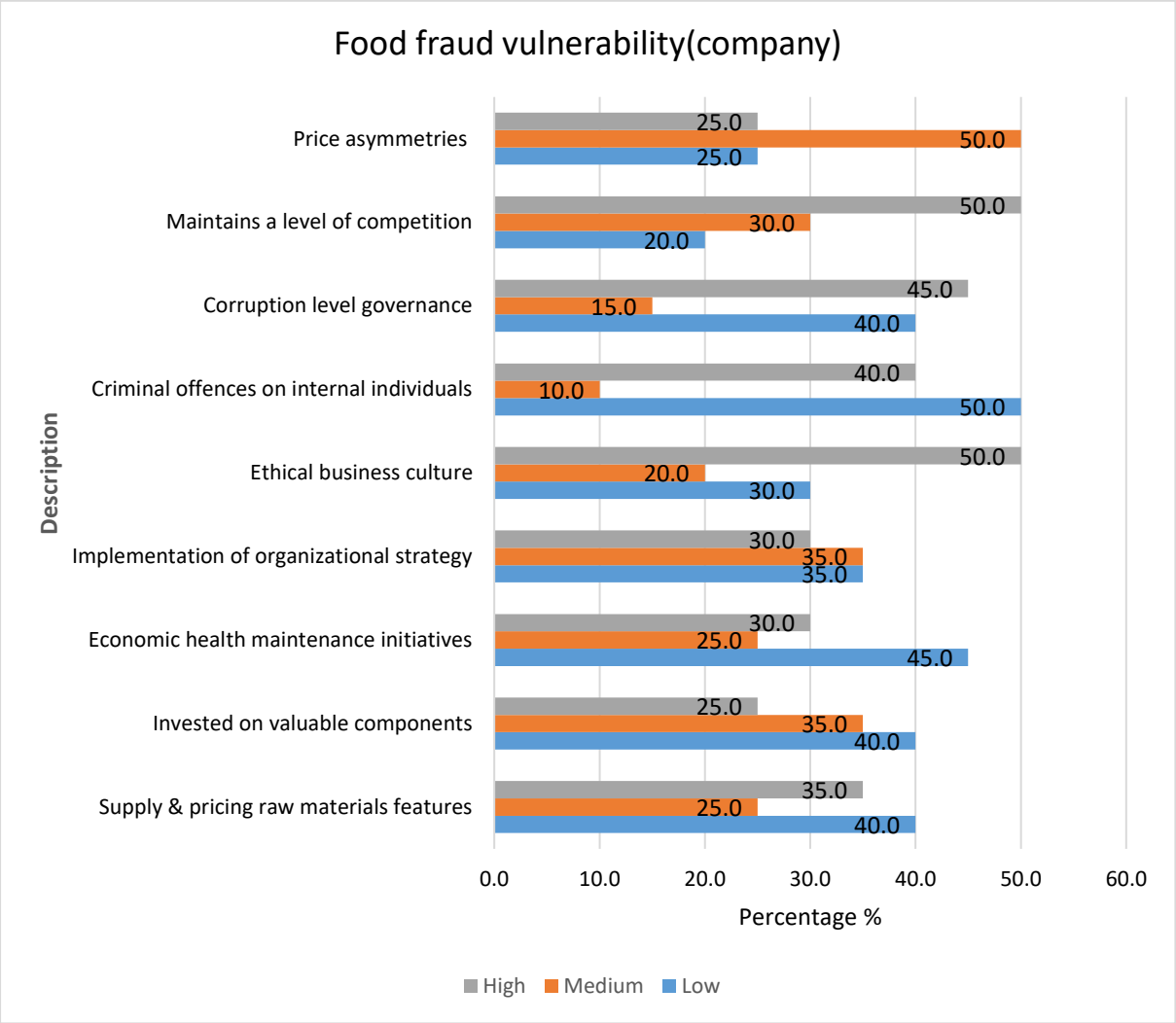


Figure 4.7: Food fraud vulnerability – company

The results depicted in Figure 4.7 above indicate that, regarding the existence of price asymmetries in incidences of food fraud events for meat and meat products, the majority proportion of responses (50 %) scored medium. Regarding companies that apply corruption-level governance effectively against food fraud events for meat and meat products, a significant proportion of the total food specialists (45 %) were in approval, indicating that the food industry is striving to tackle food fraud corruption. Conversely, the highest proportion of participants (50 %) indicated that their companies were not doing enough in terms of

sanctioning employees found responsible for food fraud events related to meat and meat products.

The results in Figure 4.7 above also indicate that most participants (50 %) returned an aggregate high scoring and were of the view that their companies had an ethical business culture in terms food fraud regarding meat and meat products. This demonstrates their efforts in managing food fraud vulnerability in South Africa. To the contrary, the results in Figure 4.7 above attest to a greater extent of food fraud vulnerability within the South African meat industry and greater motivations for food fraud perpetrators, as evident from the highest percentage of participants returning low scores across factors, such as the company having economic health maintenance initiatives(healthcare) to determine food fraud in meat and meat products (n = 45 %); the company having invested in valuable components to detect food fraud in meat and meat products (n = 40 %); and the company recording the supply and pricing of raw material features (freshness, cuts, origin) of their meat and meat products (n = 40 %).

4.9.3 Food fraud vulnerability control measures – Supplier

In this sub-section, participants (food specialists) were requested to assess the food fraud vulnerability related to the food suppliers in order to gain an understanding of the control measures available within the supply chain for tackling the meat fraud opportunities presently available in South Africa. Table 4.4 below and the spider graph shown in Figure 4.8 below depict the participants' respective responses.

Table 4.4: Food Fraud Vulnerability – Supplier

Description	Low (%)	Medium (%)	High (%)
Fraud monitoring system of and on raw materials of meat and meat products to fight food fraud	55.0*	30.0	15.0
Verification of fraud monitoring system of and on raw materials to control food fraud for meat and meat products	30.0	60.0*	10.0
Fraud monitoring system of final products to control food fraud on meat and meat products	40.0*	35.0	25.0
Verification of fraud monitoring system of final products to control food fraud for meat and meat products	40.0	55.0*	5.0
Tracking and tracing food system of own company to control food fraud for meat and meat products	50.0*	20.0	30.0
Integrity screening on own employees to control food fraud for meat and meat products	45.0*	30.0	20.0
Fraud monitoring system on suppliers to control food fraud for meat and meat products	30.0	55.0*	15.0
Information system on supplier to control food fraud for meat and meat products.012	25.0	55.0*	20.0
Tracking and tracing system of supplier to control food fraud for meat and meat products	20.0	60.0*	20.0
Social control of food chain network to avoid food fraud for meat and meat products	35.0	60.0*	5.0

***** depicts highest proportion of responses per each assessment

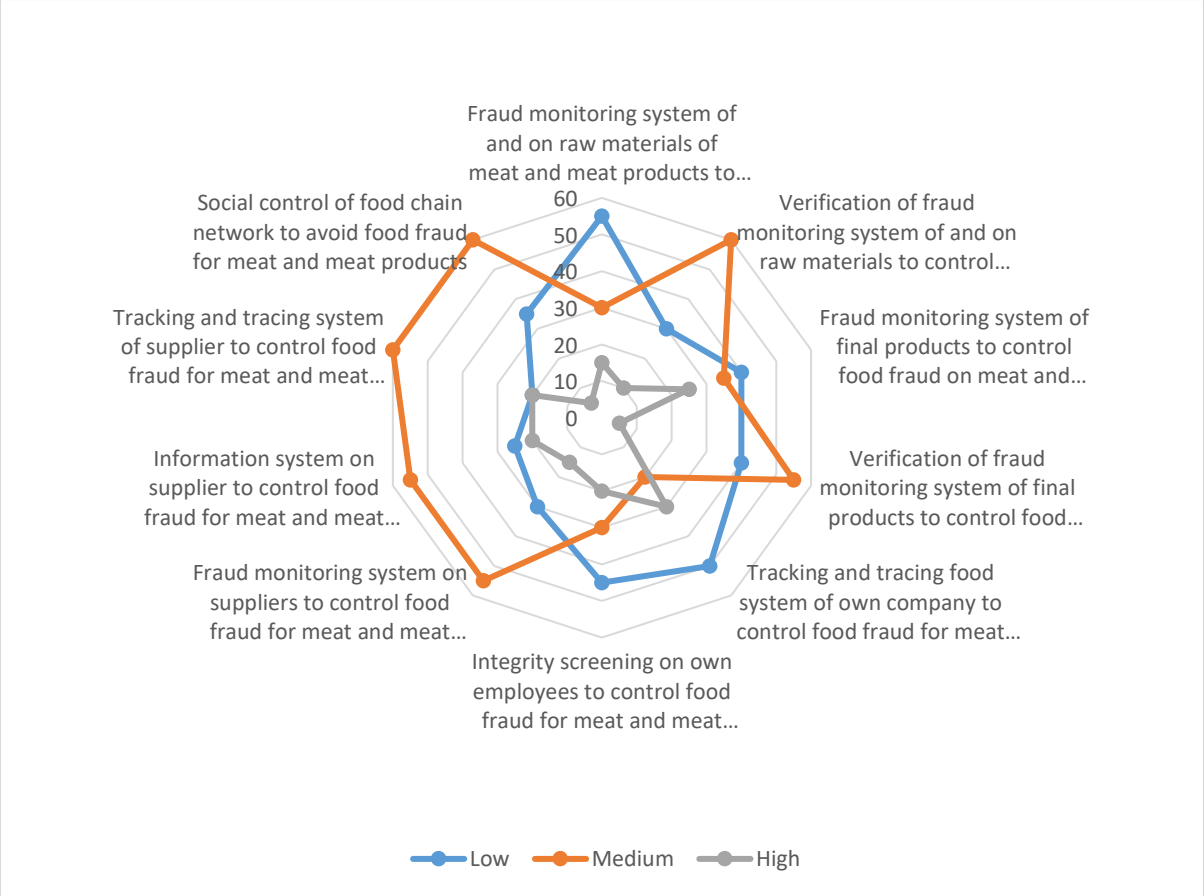


Figure 4.8: Spider web graph for control measures

Analysing the results depicted in Table 4.4 above shows that, in terms of fraud monitoring systems in place to fight food fraud regarding raw meat materials and meat products, the greatest proportion of participants (55 %) were of the opinion that there are low levels of fraud monitoring systems currently in place in South Africa. A significant proportion of participants (60 %) noted further that the verification of fraud monitoring system of and on raw materials to control food fraud for meat and meat products was at a medium level, implying that it was neither low nor high.

The same sentiments are evident from the medium scores that were indicated across various factors, such as: verification of fraud monitoring systems of final products for controlling food fraud for meat and meat products (n = 60 %); fraud monitoring systems for suppliers to control food fraud for meat and meat products (n = 55 %); information systems for suppliers to control food fraud for meat and meat products (n = 55 %); tracking and tracing systems of suppliers for controlling food fraud for meat and meat products (n = 60 %); and social control of food chain networks to avoid food fraud for meat and meat products (n = 60 %). The rest of the factors scored low values regarding food fraud vulnerability assessments related to the food suppliers. For instance, fraud monitoring systems of final products for controlling food fraud

on meat and meat products (low; n = 40 %); tracking and tracing food system of own company for controlling food fraud for meat and meat products (low; n = 50 %); and integrity screening of own employees for controlling food fraud for meat and meat products (low; n = 45 %).

This continuum of low to medium scores implies that there are still insufficient control measures available within the supply chain to adequately tackle meat fraud opportunities in South Africa. The results give grave concern about how the nation's meat supply chain is operating. Despite the fact that South Africa has numerous rules in place to control the supply of meat, the issue is that they are not being administered regularly and uniformly. As a result, producers who prioritise profit over people, as well as criminal elements, put the entire sector at danger (Ndlela & Murcott, 2021). On the supply side, Sarpong (2014) avers that complicated food supply chains encourage some form of fraud where foods products are exchanged one receiver to another, thus complicating the tracking and tracing of fraudulent events.

4.10 FRAUD INCIDENCE OCCURRENCES

This section discusses information that was gathered from respondents (both meat consumers and food specialists) regarding their awareness about food fraud incidences. In particular, the participants were asked to indicate whether South Africa had ever faced any food fraud incidents regarding meat and meat products they were aware of in their lifetime. Figure 4.9 below depicts the responses.

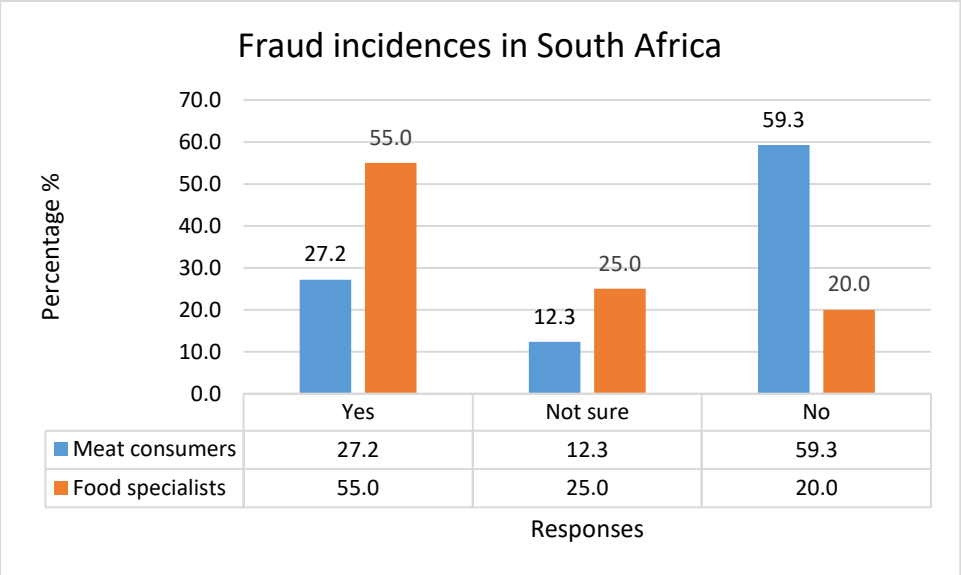


Figure 4.9: Fraud incidences in South Africa

It can be noted from Figure 4.9 above that, in terms of fraud incidences in South Africa, the majority of food specialists (55 %) reported being aware that there are meat fraud incidences in South Africa, while the lowest proportion of respondents (20 %) replied in the negative. For the meat consumers group, those who reported in the negative recorded the highest proportion of respondents (59.3 %), with the lowest proportion of participants (12.3 %) reporting that they were not sure. Only 27.2 % of the meat consumers indicated that there were meat fraud incidences in South Africa.

4.10.1 TYPES OF FOOD FRAUD INCIDENCES

In order to ascertain the participants' awareness and knowledge pertaining to food fraud incidences in South Africa, the participants were further asked to highlight any food incidents that they recalled. Figure 4.10 below presents the information that was collected from participants (both meat consumers and food specialists) regarding food fraud incidents in South Africa.

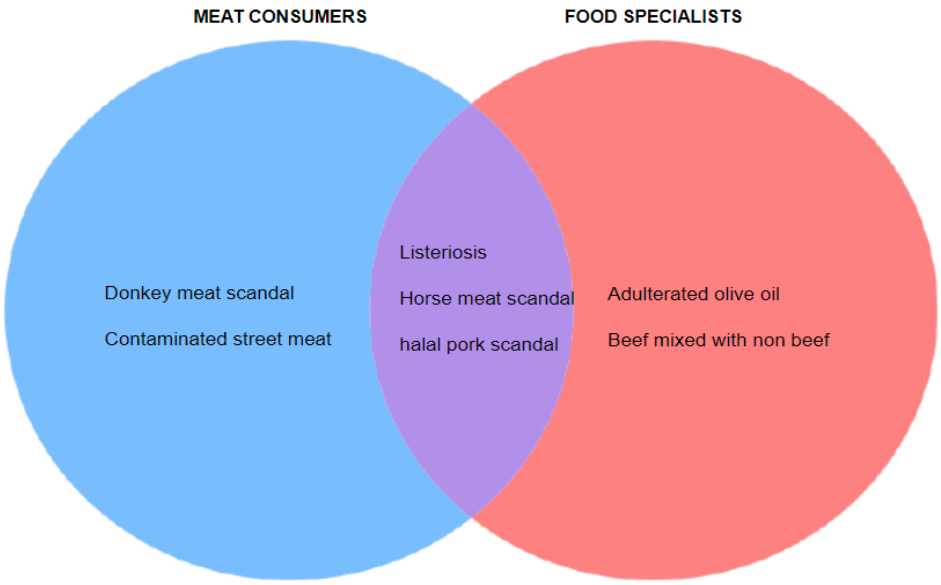


Figure 4.10: Types of food fraud incidences in South Africa

In terms of the knowledge of the participants regarding the types of food fraud incidences that have occurred in South Africa, both the meat consumers and food specialists shared a common view, as depicted in Figure 4.10, regarding the occurrences of three major food fraud incidences. These include the listeriosis food safety scandal, the horse meat scandal, and the Halal pork scandal. Some of the meat consumers also noted the donkey meat scandal and

the contaminated street meat scandal, while some of the food specialists pointed out fraud linked to adulterated olive oil, as well as beef being mixed with non-beef.

4.10.1.1 Donkey meat scandal

This scandal was uncovered by a study conducted by Prof. Hoffman, who is recognised as the world's leading authority on the subject of game meat, which was published by a South African university (Stellenbosch University) in 2013. The investigation found meat from animals that included donkeys, goats and water buffaloes in a variety of meat products. The results showed that 99 of 139 samples tested included meat from species that were not listed on the product labels. The extent of meat product mislabelling was assessed by the researchers through using a variety of DNA-based molecular techniques. Furthermore, the research ascertained that soya, gluten and chicken were included but not stated in 23% and 28% of the products examined, respectively. These products were primarily sausages, burger patties, and deli meats. Prof. Hoffman stated that the findings raised serious questions about how the nation's meat supply chain is operating. He went on to say that, although the nation has laws protecting its residents from being sold food that has been misrepresented, these policies nevertheless need to be thoroughly implemented (Cawthorn et al., 2013).

4.10.1.2 Contaminated street meat

This was brought to public attention by a study, which was led by Dr Mpinda Edouard Tshipamba at the North-West University, of 115 samples of contaminated meat sold in Johannesburg and its connection to food poisoning. According to his team's report, a vast variety of bacterial species was identified in the samples of the street meat. This indicated that the people who consumed that meat might be at risk of contracting food poisoning. The samples were taken from several locations near the Johannesburg Central Business District, and the meat samples contained 15 different bacterial species. Furthermore, the survey found that 91%, 77%, and 69% of the food vendors exposed their meat to dust and flies, while 94%, 92%, and 86% of the vendors handled money while delivering the food. Stagnant water was discovered at 21.9% and 55.6% of the vending places in Hancock Street and at the MTN taxi rank, but not in Bree Street (Tshipamba et al., 2018).

4.10.1.3 Listeriosis

An outbreak of food poisoning occurred in South Africa between 2017 and 2018, which was caused by Listeria monocytogenes infections which was more on the food safety alarm on cold meats. The outbreak was caused by contaminated processed meat being made in Polokwane by Enterprise Foods. There were around 216 fatalities and 1060 confirmed cases throughout the pandemic. This turned into the worst listeriosis outbreak in recorded history. After nine seriously ill, five-year-old Soweto children were taken to Chris Hani Baragwaneth Hospital in the middle of 2018, it was ascertained that infected polony was the most likely cause of the outbreak and that the sources of the infection were at Enterprise Foods facility. A positive test result for samples of the factory's chicken polony directed investigators to the infected producing facility (Thomas et al., 2020).

4.10.1.4 Halal pork scandal

This was the subject of a scandal that broke in South Africa in 2011. This resulted from the nation’s largest meat importer improperly designating pork as being halal. The importer was also accused of rebranding water buffalo meat from Australia and India as halal, even though the Muslim Judicial Council (MJC), South Africa’s halal certification body, had not authorised it. Orion Cold Storage, the business accused of these activities, claimed that it had been the victim of a smear campaign by other businesses. The accusing companies were successful in obtaining a court order preventing Orion from using the halal label, and the MJC stopped dealing with the firm. In response, Orion charged two rival businesses with extortion, blackmail, and sabotage (Rive, 2013).

4.10.1.5 Adulterated olive oil

This is connected to a controversy in 2001 in which more expensive virgin olive oil was mixed with less expensive edible oil and then sold by the accused business, known as Ital Distributors. Mr. Guido Costas, together with The Olive Growers Association, AgriInspec, and South Africa Police Services investigated the situation, while scientists at the University of the Free State in Bloemfontein proved the adulteration. This is to show that food fraud does occur in other food sectors, thus food actors need to be aware.

4.10.2 YEARS DURING WHICH FOOD FRAUD OCCURRED

In order to ascertain the years during which food fraud was prevalent in South Africa, respondents were asked to give their understanding of when the country had faced food fraud incidences, specifically for meat and meat products. This was an open-ended question, which was later coded and analysed. The results from the analysis are displayed in Table 4.5 (meat consumers) and Table 4.6 (food specialists), respectively.

Table 4.5: Year of food fraud occurrence (meat consumers)

		Frequency	Valid Percent	Cumulative Percent
Valid	2018	6	7.4	7.4
	Not sure	67	82.7	90.1
	2019	1	1.2	91.4
	2012	1	1.2	92.6
	2013	5	6.2	98.8
	2017	1	1.2	100.0
	Total	81	100.0	

Analysing both Table 4.5 and Table 4.6 reveals that the majority of respondents in the meat consumers category (82.7 %) were not sure of the exact years, while a greater proportion of respondent food specialists (40 %) shared similar sentiments. Despite most participants in both groups seemingly being unsure of the actual year, 2018 recorded the highest responses of those respondents who were sure (7.4 % for meat consumers; 25 % for food specialists). Furthermore, it can be concluded from the results that food fraud is not new to South Africa, as two food specialists (10 %) listed the year 2007 as having recorded food fraud cases.

Table 4.6: Year of food fraud occurrence (food specialists)

		Frequency	Valid Percent	Cumulative Percent
Valid	2017	1	5.0	5.0
	2020	1	5.0	10.0
	2013	2	10.0	20.0
	2018	5	25.0	45.0
	Not Sure	8	40.0	85.0
	2007	2	10.0	95.0

	2016	1	5.0	100.0
	Total	20	100.0	

According to the participants, 2018 had experienced the most instances of food fraud. A report by Food Focus (2019) ascertained that 2018 had been a busy year for food fraud, both internationally and in South Africa, and so lends support to this finding of the study. The problem became more well known as 'phony' food and 'outdated' food, and mentions of contaminated products appeared more frequently in South African media reports.

The consequent uproar in the community demonstrates how consumers find these methods to be abhorrent, and how this could negatively affect the reputation of food manufacturers' brands. For instance, the South African Liquor Brand Owners Association expressed concerns about illicit alcohol, asserting that, since illicit alcohol dealers compete in the market illegally, in disregard of the law, and do not pay taxes, the competition would not be fair, and it would cause losses for those selling legitimate goods in legitimate ways. Recently another product quality crisis obliged Tiger Brands, South Africa's largest food producer, to recall millions of canned vegetable items (BIZI NEWS, 2021). Following the listeriosis incident referred to above, which significantly damaged the finances and reputation of the company involved, the company's once highly regarded JSE counter is facing yet another challenge. Since the outbreak, the company has been embroiled in litigation and has opted to go to court rather than to negotiate a settlement.

4.10.3 Government measures to prevent food fraud

In order to assess government's involvement in tackling food fraud, respondents were asked to highlight measures that the South African government has put in place to prevent Food Fraud. The respondents' responses, from both meat consumers and food specialists, are depicted in Table 4.7 below.

Table 4.7: Government measures to prevent Food Fraud

Responses	
Meat Consumers	**Food specialists**
Shutting down of factories	Banning of company products
Competition Commission	Government Gazette measures, such as R1283 of 04 October 2019, regulations for processed meat products
Enforcing display of expiry date	Penalties for the conflicted companies
Recalling products	Fines and imprisonment
Destroying fraudulent products	DNA testing and laboratory analysis of meat

Inspection of food factories or retailers/butcheries	Strict rules on Food Safety Management Systems.
Imprisonment and fines	Regular Inspections conducted by Department of Health; Department of Agriculture, & consumer council
Confiscating fraudulent meat and meat products	Safety standards in abattoirs
Enforcing Consumer Protection Act	Establishment of councils such as the consumer goods council
Regulating meat production and processing	Consumer Protection Act
Food safety policies	
Labelling products to inform consumers of ingredients.	
Always monitor the shops to check if they are selling the right product	
Quality control certification has been put in place	
Closing factories down until investigation is over	
Halting imports of meat	
Quarantine	

As seen in Table 4.7, both groups of participants identified several measures that have been implemented by the government to prevent food fraud in South Africa. Some of the common measures mentioned across the two groups include enforcing the Consumer Protection Act, 68 of 2008, and imposing penalties, fines and imprisonment on the companies responsible, as well as shutting down factories responsible for contraventions. From the results depicted in Table 4.7 above, it is evident that the most common government measures implemented to prevent food fraud, as expressed by both meat consumers and food specialists, include:

- Enforcing the Consumer Protection Act, 68 of 2008;
- Imposing imprisonment and fines;
- Imposing penalties for the conflicted companies;
- Conducting regular inspections by the Department of Health, the Department of Agriculture, and the Consumer Council.

4.10.4 Tackling fraud besides giving fines, imprisonment or seize of products

In this sub-section of the questionnaire, respondents (both meat consumers and food specialists) were asked how food fraud could best be dealt with, besides imposing fines, imprisonment or the seizure of fraudulent products. The rationale was to gain further insights from participants concerning measures for tackling food fraud, besides the usual controls

enforced by the government. Table 4.8 below reflects the most common opinions reported by the respondents.

Table 4.8: Measures to address fraud besides fines, imprisonment or seize of products

Responses	
Meat Consumers	**Food specialists**
Thorough monitoring during food production phase	Closing down fraudulent food factories
	Recalling distributed food products when detected
Food inspection and testing	Conduct regular random DNA analyses of food samples
Permanent shutting down and revoking of perpetrators' business licences	Thorough research and investigation within universities
Employing more quality control inspectors to conduct adequate inspections and identification of fraud within the food chain through regular random inspection and monitoring at processing and packaging facilities	Ante-mortem inspection and post-mortem inspections by registered Meat Inspectors and Vets.
	Samples sent to labs for proper identification
Adequate consumer awareness and education about food fraud through social media, newspapers, television and radio awareness adverts	Enforcement of strict measures, such as compliance with FSSC 22000
	Blacklisting perpetrators
Making sure that the price is affordable for good quality meat; this will encourage people to buy from reliable stores	Establishing provincial Fraud Risk Management Committees
Naming and shaming perpetrators	Integrating Computer Imaging and Analysis and Data Mining fraud detection tools
Enforcing strict compliance measures to ensure food safety and protection of consumers	Assessing vulnerable areas
Putting barriers in trading so as to reduce the importation of meat products	Strict compliance
Deploying 'mystery shoppers' to detect food fraud cases	
Facilitate registration of small-scale food producers	

Analysing the results depicted in Table 4.8 above shows that, besides imposing fines or imprisonment, or seizing products, the government, as expressed by the participants, could take further measures that include: the naming and shaming perpetrators; integrating computer imaging and analysis together with data mining fraud detection tools; instructing regular random inspections and monitoring at processing and packaging facilities; fostering thorough research and investigation by universities; establishing provincial fraud risk

management committees; and facilitating the registration of small-scale meat and meat product producers. From the results reflected in Table 4:8 above, it is apparent that measures for tackling food fraud, besides imposing fines or imprisonment, or seizing illicit products, should also include, as expressed by both meat consumers and food specialists:

- the permanent shutting down and revoking the business licences of perpetrators;
- the enforcement of strict compliance with measures that would ensure food safety and the protection of consumers;
- sending samples to laboratories for proper identification, such as through DNA analysis of food samples.

4.11 CONCLUSION

The data analysis and interpretation of the results of this study have been presented in this chapter. Each section has summarised the investigation's principal conclusions. The conclusions of the study are presented in Chapter 5 below, along with suggestions for practical application and additional research. The primary goal of this study was to assess the vulnerability variables relating to food fraud in South Africa. The following specific objectives were also taken into account in order to achieve the primary goal: a) to determine the extent of food fraud vulnerability within the meat South Africa's vulnerability to food fraud in Tshwane metropolitan area; b) to determine the key opportunities for food fraud vulnerability in South Africa in the Tshwane metropolitan area; c) to determine the key drivers of food fraud vulnerability in South Africa, with special interest in the Tshwane metropolitan area; and d) to determine the key mitigation strategies. As is evident from the findings presented above, the objectives of this study have been achieved.

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

Food fraud is an increasing global threat, with negative effects on both public health and the economy. The commentary noted in the literature regarding instances of food fraud demonstrate how pervasive it is in Africa, how harmful it is to health, and how it needs an immediate response. In order to combat the problem of food fraud, creative and approachable solutions must be developed through partnerships between the food sector, researchers, and governmental organisations. The size of the unregulated food market, where many vendors lack licences or recognised addresses, continues to be a major obstacle. Policymakers and regulators play a crucial role in this situation, since it is simpler to prevent food fraud than to identify it.

The major purpose of this study was to evaluate South Africa's food fraud vulnerability factor, focusing on participants from the Gauteng Province area. The literature reviewed emphasised the need to investigate supply chain management issues in order to comprehend their causes and to develop strategies for avoiding and minimising their detrimental consequences on the food industry's performance. Furthermore, it became clear from the literature that, despite playing a significant role, the food-processing sector still has a number of challenges to address. This study fills knowledge gaps in the literature on food fraud, and aims to offer useful contributions and advice for meat suppliers, retailers, governments, and consumers about how to lessen the vulnerability to food fraud. The results and the theoretical contributions to the study issues are discussed in the following section.

5.2 DISCUSSION OF THE RESEARCH QUESTIONS

This dissertation has evaluated the vulnerability variables relating to South African food fraud. The study objectives included: a) determining the degree of food fraud vulnerability in South Africa (Tshwane metropolitan area), which was then discussed in relation to the research topics provided in the dissertation; b) identifying the key opportunities for food fraud vulnerability in South Africa (Tshwane metropolitan area); c) identifying the key drivers of food fraud vulnerability in South Africa (Tshwane metropolitan area); and d) identifying the key mitigation strategies. The goals were attained, and conclusions were drawn, through the use

of justified procedures and approaches. The following subsections go over the specific research goals.

5.2.1 Extent of food fraud in meat and meat products in South Africa

Regarding the prevalence of food fraud in meat and meat products, the majority of meat consumers who were surveyed perceived food fraud in meat and meat products as being highly prevalent in the country. The results of the study indicate that 75.3 % of these respondents perceived food fraud in meat and meat products as being prevalent in South Africa. This might be driven by the lack of visibility of the monitoring procedures being put in place to mitigate food fraud in the country. Both the meat consumers and the food specialists surveyed agreed that the three significant fraud incidences reported in the country were the outbreak of listeriosis caused by infected polony, the horse meat crisis, and the halal pork scandal. The other incidences that were stated by meat consumers include the donkey meat controversy and the tainted street meat scandal, while some of the food specialists drew attention to fraud involving adulterated olive oil, and to beef that was combined with non-beef products.

The year 2018 was considered to have recorded the highest number of food fraud occurrences in the country. According to descriptive data, beef is considered as being the most susceptible to food fraud, when compared with other meat products. On the other hand, fish was rated as constituting the protein and protein product that was least impacted on by food fraud. The study also ascertained that the majority of participants were aware of or familiar with most of the terminology related to food fraud, such as adulteration, counterfeit, addition, and substitution. This study confirmed the importance of economic reasons and price surges as constituting a driving force behind fraudulent activities identified in the literature review. When there is economic pressure on the availability and cost of raw materials and/or food products, there is a vulnerability to food fraud as a result of the reduced supply and increased pricing of materials, because food fraud is always perpetrated with the purpose of generating money (SSAFE, 2017; Yang, 2021).

5.2.2 Food fraud opportunities

Relating to the assessment of food fraud vulnerability, the respondent food specialists were asked to report their assessment of food fraud vulnerability related to the food products under survey in order for the researcher to gain an understanding of the meat fraud opportunities

presently existing in South Africa. Most participants agreed that the following are the major opportunities that exist for food fraud related to meat and meat products in South Africa.

- Readily available technology and knowledge for adulterating raw materials and final products,
- Low fraud detectability in raw materials and raw materials,
- Inadequate access by external parties to production lines/processing activities in the food production sector,
- Lack of transparency in the food chain network of meat and meat products, and
- Inadequate available historical evidence of fraud in raw materials for meat and meat products.

In terms of the availability of technology and expertise used to adulterate raw materials, it should be noted that the majority of the participants were of the view that South Africa currently had a high availability of both. The majority of participants also noted that it was difficult to detect fraud in raw materials, indicating that a potential exists for meat fraud of many kinds to be perpetrated to deceive consumers. Similarly, the majority of participants stated that an abundance of technology and knowledge is available for tampering with processed food products. This is in line with reports in the literature, such as Silvis et al. (2017), who highlight the point that certain products are rendered more prone to food fraud by virtue of their basic product composition and the ease by which fraudsters can obtain the information and technology required to tamper with food products.

When asked to assess whether there was sufficient access by monitoring authorities to production lines or processing activities in food production, the majority of respondents stated that such access to production lines was insufficient, indicating that South African food processing companies may, unwittingly perhaps, allow sufficient opportunities to fraudsters to engage in food fraud. The findings of this dissertation align with those of the investigations conducted by van Ruth et al. (2017). According to previous studies, complicated supply chains are typically less transparent, thereby providing fraudsters with greater opportunities to operate in. This is clear from the fact that the majority of the respondent food specialists noted that scant openness existed in the network of the food supply for meat and animal products. Most participants (45%) said there was little historical evidence of fraud in the raw ingredients used to produce meat and meat products. This shows that, in addition to the widespread nature of meat fraud in South Africa, it is challenging to identify the origin of such fraud.

5.2.3 Food fraud motivations

In order to ascertain what the possible motivations are for businesses to engage in fraudulent actions related to meat and meat products, the opinions of food specialists were examined, based on a number of statements associated with food fraud vulnerability linked to their particular organisations. The results showed that the majority of respondents believed that the following reasons could be used to summarise food fraud involving meat and animal products within their companies:

- Inadequate economic health maintenance (healthcare) initiatives to determine food fraud in meat and meat products;
- Lack of investment in valuable components for detecting food fraud in meat and meat products;
- Inadequate supply and pricing raw materials features (e.g. freshness, cuts, origin and composition) of meat and meat products; and
- Inadequate enforcement of criminal offences against internal individuals involved in food fraud events related to meat and meat products.

The majority of food specialists said that businesses were not doing enough to prosecute internal people involved in food fraud involving meat and meat products. This was in regard to how effectively companies sanctioned employees found to be responsible for food fraud events related to meat and meat products. The results of the companies' risk assessments also point to a lack of investments in components that could be used to detect food fraud in meat and meat products, as well as a lack of economic health maintenance (healthcare) activities to do so. This therefore implies that motivations do exist for internal individuals to perpetrate food fraud practices within their respective companies and businesses that are extremely susceptible to food fraud. It was encouraging to note, however, that most participants concurred that their businesses were making efforts to combat food fraud and corruption, and were striving to implement an ethical business culture in terms food fraud in meat and meat products.

The majority of food specialists indicated that South Africa currently experiences low usage of fraud monitoring systems for raw materials of meat and meat products, which could be used to prevent food fraud. This means that fraudsters have many opportunities to commit food fraud because of the inadequate monitoring systems. In addition, most participants remarked

that the effectiveness of the food tracking and tracing system used by the company itself, the integrity screening of its own workers, and the fraud monitoring system of final goods used to control food fraud in meat and meat products were all poor. These findings suggest that there are still not enough supply chain controls in place to effectively combat meat fraud opportunities in South Africa. This suggests that a company's supply chain network may affect how susceptible they are to fraud (Stevenson & Busby, 2015). This is consistent with research suggesting that increasing supply chain vulnerabilities brought on by a lack of supply chain transparency and a lack of supply chain integration were the root causes of fraudulent operations (Sharma et al., 2021).

The literature emphasised the need to investigate supply chain management issues in order to comprehend their causes and develop strategies for avoiding and minimising their detrimental consequences on business performance. Furthermore, it became clear from the literature that, despite playing a significant role in the South African economy, the food-processing sector still has a number of challenges to address. The results cause grave concern about how the nation's meat supply chain is operating. Despite the fact that South Africa has numerous rules in place to control the supply of meat, the issue is that they are not being administered regularly and uniformly. This is consistent with research such as that by Vance (1983), who found that ineffective monitoring attributable to inadequate directorship in the public sector was another sign of opportunity to commit fraud.

5.2.4 Control measures for food fraud vulnerability in South Africa

The study findings raised significant concern regarding the functioning of the meat supply chain in the country, as it established the fact that insufficient control measures were in place within the supply chain to adequately tackle meat fraud opportunities and motivations in South Africa. Specifically, the majority of food specialists in Tshwane metropolitan area noted the following:

- Inadequate fraud monitoring system of and on raw materials of meat and meat products to fight food fraud,
- Inadequate tracking and tracing food system of own company to control food fraud for meat and meat products, and
- Poor integrity screening of own employees to control food fraud in meat and meat products.

However, the following control measures were regarded as neither adequate of inadequate:

- Fraud monitoring systems of suppliers to control food fraud in meat and meat products,
- Information systems of supplier to control food fraud in meat and meat products,
- Tracking and tracing systems of suppliers to control food fraud in meat and meat products, and
- Social controls of food chain networks to avoid food fraud in meat and meat products

Although South Africa has many rules in place to regulate the supply of meat, the problem is that they are not consistently and properly applied. Implementing various technical solutions, such as fraud surveillance systems, information systems, and traceability systems, might reduce the exposure to food fraud (van Ruth, Huisman & Luning, 2017). Participants were asked an open-ended question on what the government has done to combat food fraud. The results revealed that the government has established a number of measures as well as other methods to combat food fraud in South Africa. Various sanctions under the Consumer Protection Act and the Food Safety Regulations, as well as factory closures, fines and other penalties, are some of the measures that can implemented against those involved in food fraud experienced on the side of meat consumers. The steps recommended by the food specialists included corporate product prohibitions, DNA testing of products, laboratory analysis, and content safety standards in abattoirs,

5.3 IMPLICATIONS OF THE RESEARCH

5.3.1 Implications for the literature

This dissertation offers a distinctive viewpoint on food fraud and the prevalence of it in South Africa. Furthermore, the importance of monitoring systems and the susceptibility to food fraud have been emphasised in this dissertation. The findings of this dissertation will add to the sparse body of research relevant to the industry and the sector as a whole, supporting the claims made in earlier studies about the vulnerability to and monitoring of food fraud. The meat business appears to be the most affected in South Africa, according to surveys, as the misrepresentation of meat products has become a habit for most merchants, and customers are unwittingly consuming both unidentified animal and plant leftovers more frequently than before. The results of this dissertation will add to the points made in prior studies about food fraud vulnerabilities, notably within the meat business, and will supplement the scant body of research pertinent to the industry and the sector at large. The results might help to develop

strategies that would advance consumer protection and ethical competition in the food business by offering explanations and solutions as to why food fraud has become so common in South Africa.

5.3.2 Implications for further research

There are a number of further research studies that could be undertaken to advance research on assessing the food fraud vulnerability factors in Tshwane metropolitan area. These practical recommendations are based on the previous limitations identified to ensure congruency and scalability of the current study. Future studies, for instance, could investigate the particular businesses that have fallen prey to internal or external food fraud. Future research might examine the relationship between demographic traits, experience in dealing with fraud, cultural variations, and their tactics for assessing the vulnerability to food fraud. This would go beyond the scope of the current study. The extent and kind of impacts, such as those on food safety, public health, and finance, could be quantified through longitudinal studies with food manufacturers to examine the impact of such assessments. As respondents' perspectives would inevitably vary, based on their environment, similar studies could be carried out in various cities or areas across South Africa. Furthermore, in addition to the food processing industry, future studies might investigate other business sectors. Food fraud can be seen as both a temporal and spatial problem. As an example, donkey meat fraud cases were detected in South Africa in 2013 only after the meat had entered the retail market and had been consumed by customers. A suggestion would be to track the longitudinal extensiveness (forward and backward tracking) of the food fraud vulnerability incidents like these donkey meat incidents in order to determine the specific proactive measures that could have been imposed for the specific area of vulnerability.

5.3.3 Policy Implications

The government should be receptive to the use of academic research as a tool for achieving informed decision-making and transformation because it is able to play a crucial role in the creation of policy, reforms, and amendments. This study was successful in identifying governmental and policy-related variables that limit the competitiveness of the wool and mohair sector. These include tax laws, public funding, and a lack of confidence in elected leaders. This work has significant policy implications, particularly as to the need to legislate not only against international criminal conspiracies, but also against everyday ordinary organised food frauds. Low criminal penalties are ineffective at deterring these offences, which

the government should regard more seriously, in some cases, as major crimes. Furthermore, when developing food laws, rules and regulations, greater consideration should be given to how supply chains in the food industry could be better protected from predatory criminal actions. There are also practical implications and outcomes, most notably for our adaptation and development of an investigative framework based on illegal business models. In order to take into account the additional dimensions of vulnerability discovered in this research, governments and standard-setting organisations should evaluate existing policies in regard to the detection and identification of food fraud. To enable authorities to apply the proper legal remedies to fraudsters, these regulations must be more prescriptive in defining what constitutes and does not constitute fraudulent behaviour.

The first factor that influences the perpetration of fraudulent activity comprises the estimated expenditures and anticipated financial advantages of the illicit activity (i.e. probability of getting caught and the penalty if the perpetrators are caught cheating). Among these factors, the effectiveness of detection techniques and processes (i.e. their utility) and the management of social dynamics have an impact on the likelihood of being discovered. Government policy and other circumstances, such as how many people were implicated, have an impact in determining the sentence. Because of the major alluring effect of anticipated financial rewards for businesses in committing food fraud, the government should increase the fine for being caught and convicted, so that the economic costs of food fraud are increased to a level sufficient to change the psychological expectation for economic returns on food fraud. From the standpoint of social co-governance, it should not only be the government that puts in place such a system of fiscal penalties. Partner companies (such as suppliers or buyers) could, for example, contractually impose a fiscal penalty approach, while consumers could do so by collectively foregoing purchases.

The success of food regulation in South Africa will largely depend on raising consumer knowledge of the risks of food fraud. In order to successfully implement food safety legislation, there should be better coordination among the organisations responsible for it. Small- and medium-sized businesses (SMEs) should be encouraged to form associations in order to make it easier for the government to support them through education and awareness raising. Consumer demands should always come first for business, government, and law enforcement. This implies that food safety and crime prevention should be given top priority over all other goals. Investigations and prosecutions must be well managed and coordinated, and the public interest must be taken seriously in order for there to be robust enforcement and severe penalties imposed for serious food offences. Furthermore, a reliable food supply depends on fair law enforcement and solid science. To further safeguard a constant supply of

food products that are secure and wholesome for people's health and quality of life, new laws and regulations must be periodically passed. Once rules are passed, they must be upheld to guarantee that the whole food sector, including businesses directly or indirectly involved in the production, labelling, packing, transportation, distribution and retail sales of food, complies. Last but not least, the adoption of systematic countermeasures would reduce opportunities for food fraudsters in the supply chain. One example of such a countermeasure measure is evidence-based sampling to detect food fraud.

5.4 SHORTCOMINGS OF THE RESEARCH

The limitations of this study stem from the fact that only residents of the province of Gauteng were included in the sample size for the study. This limits the study's potential to be generalised to other areas. The second research constraint relates to the study's intrinsic limits to finding and is contextual in nature. The results could have been enhanced by examining the expertise of supply chain and food industry experts to gain a deeper and richer understanding of the problems associated with food fraud vulnerability. These additional insights might have made it possible to identify the study's most useful practical contributions.

The following list of restrictions applies to this study:

I. Sample: Pretoria-based participants made up the study's sample, leaving out other participants from other cities within South Africa.

II. Financial restrictions: Several components of the research approach taken had to be adjusted to fit the budget, because the researcher had a limited amount of money to complete the study. For instance, financial restrictions on the dissertation had a significant impact on the sample selection and data-gathering methods.

III. Time restrictions: This study was required to be finished within a certain amount of time in order to meet the criteria for the Master's degree. The use of some study designs, such as longitudinal techniques, was consequently prohibited.

IV. Measurement tool: Only structured questions were used as the measurement tool, and respondents could only choose from a predetermined range of options.

V. Food specialists as th erepresentatives sample size was smaller and renders some concerns of the larger population of food value chain actors that may have had an impact on the study and other food value chain actors.

VI. Over 60% of consumers were aware of food fraud terms (Figure 4.4) which tallied with the finding on Table 4.3 where 95% of consumers had tertiary education. This implies that the sample only captured the elite and left out most consumers with varying education levels thus the representativeness of the broad spectrum of meat consumers was limited in the study.

5.5 RECOMMENDATIONS

The recommendations stated here are relevant to stakeholders, particularly those involved in the South African beef supply chain and are based on the findings of the study. Nevertheless, as the study was being conducted, particularly during interviews with both meat consumers and food specialists, other factors that add to and corroborate the findings were noted.

5.5.1 Suppliers

For meat suppliers, it is necessary to use visible identification methods for the proper identification of live animals; barcodes, numbered ear tags and/or tattoos can typically be used as a form of visible identification. Computerised central databases should be set up to record information that could assist in dealing with some local food safety or food quality issues. The data that should be made available for the effective use of such a computerised system are: farm location, the type of farm and the practices on the farm, owners of the animals, animal stock, movements of animals, the means of transport, documentation, authorities involved and their obligations, as well as information on the establishments where the animals are sold (Wognum et al., 2011). It is important that these databases are kept consistent and up to date for quick and accurate responses to try to counter or stop the damage done by quality or food fraud incidents. Meat suppliers also need to adopt new approaches, strategies and services to meet current compliance standards, and expedite their access to the meat market. A predominant approach to this involves ensuring meat quality assurance through effective meat quality testing. The integration of the latest technology by meat suppliers in their meat quality control system, which includes the tracking of the entire process, identifying whether any deviations occur, and the verification and maintenance of a standard procedure would eliminate, reduce or prevent food safety hazards. With the timely quality testing of meat and

meat products, a systematic verification according to regulations could be done, and corrective actions could be taken whenever there is a deviation from the set standards.

5.5.2 Meat and meat product retailers

As is evident from the study findings, the majority of meat fraud occurs during the final cuts stage, and these cuts are mostly supplied to retailers for sale to the general public; hence, it is important for meat and meat product retailers to be cautious of possible meat fraud involved in the supply chain. Retailers should be vigilant regarding the possibility of receiving meat or ingredients from suppliers that have been misrepresented in some way to increase economic gain. Firms should develop an effective meat fraud prevention programme in order to offer protection against being implicated in a food fraud incident. One way in which firms develop meat fraud prevention programmes is to conduct a vulnerability assessment of all meat supplies. As part of this assessment, meat-processing firms should identify the source of their meat supplies, as well as the ingredients involved in processing meat products such as boerewors, mincemeat, biltong and polony, to determine whether they come from potentially high-risk geographic areas or suppliers. Other considerations include whether economic considerations exist that would increase the incentive for fraud. The firms could then use this information to categorise their supplies as potentially having a low, moderate, or high vulnerability. Once they understand their vulnerabilities, retailers could develop a food fraud mitigation plan appropriate to the vulnerability level, which might include audit measures, laboratory testing, tracing or other strategies. It is also important to understand where meat and product supplies are sourced from, the amount of upstream suppliers, and what upstream controls are in place. Retailers should also invest in ascertaining consumer insights more than ever before, as such insights are critical for companies to bring innovation, convenience, health and value to the meat case.

5.5.3 Government

Government and the meat sector have been at odds over regulation for years. Consumer confidence in meat decreases as a result of the failure to protect consumer safety. The increase in meat fraud cases demonstrates the necessity for regulation of the business in order to win back the trust of consumers. The purpose of the government is to safeguard the interests of the people, yet in South Africa, it is worrying that government regulators do not prioritise consumer protection over business interests. As a result, the government would be advised to take the following actions:

- The government should collect detailed information about how much fake meat and meat products are being sold, taking into account the variety of counterfeiting methods and the associated health hazards;
- There is a need for government to recruit more numbers of quality controllers to monitor and control meat fraud activities;
- Government should increase transparency at border controls, redoubling commitment to instruct municipal environmental health inspectors so they would be able to undertake proper food testing of the products of formal and informal retailers and producers; and
- The government needs to address the obstacles that smaller producers face when trying to enter the meat industry legally, as well as the strict enforcement of the Consumer Protection Act.

5.5.4 Consumers

As mentioned earlier, consumers suffer welfare losses through the presence of food fraud, which might include harm to their health where foods have been adulterated during fraudulent activities. As such, it is important for consumers. To ensure that the meat or meat product that they are purchasing is of high quality, buyers should always look for a seal of quality, which is similar to an official seal of approval. Frequently, these seals are placed on the product packaging so that consumers are able to notice them immediately. However, this is not something that most consumers would actively look for when buying meat or meat products, although this is very important. Reputable brands and sources will typically use a seal that guarantees their quality and authenticity, and as such, consumers should research the image of the seal itself to familiarise themselves with it. Consumers also need to understand the difference between prices that are “too good to be true” and those that are significantly discounted. They should be wary of meat and meat products that are outrageously discounted from market prices. According to Stanziani (2009), a fair market price reflects quality and care, while products that are priced too cheaply could mean that the chances of the products being adulterated are high.

REFERENCES

Agriorbit. 2020. The South African cattle and sheep market – Part 2: Demand. [Online]. Available at: https://agriorbit.com/the-south-african-cattle-and-sheep-market-part-2-demand/

Ahmed, F.E.E.M., 2016. Meat and milk fraud vulnerability assessment in Khartoum State, Sudan (Doctoral dissertation, Alzaeim Alazhari University).

Alamprese, C., Amigo, J.M., Casiraghi, E. and Engelsen, S.B., 2016. Identification and quantification of turkey meat adulteration in fresh, frozen-thawed and cooked minced beef by FT-NIR spectroscopy and chemometrics. Meat Science, 121, pp.175-181.

AlHamad, A.Q.M., 2020. Acceptance of E-learning among university students in UAE: A practical study. International Journal of Electrical and Computer Engineering, 10(4), p.3660.

Ali Meerza, S.I. & Gustafson, C.R. 2018. Consumer Response to Food Fraud. Selected paper for 2018 Agricultural & Applied Economics Association Annual Meeting.

Ali Meerza, S.I., Giannakas, K. & Yiannaka, A. 2018. Optimal policy response to food fraud. Selected Paper for 2018 Agricultural & Applied Economics Association Annual Meetings.

Ali, M. H. & Suleiman, N. 2018. Eleven shades of food integrity: A halal supply chain perspective. *Trends in Food Science & Technology, 71*, 216-224.

Alibux, A.N. 2016. Criminogenic conditions, bribery and the economic crisis in the EU: A macro level analysis. *European Journal of Criminology, 13*(1):29-49.

Amaral, J., Meira, L., Oliveira, M.B.P.P. and Mafra, I., 2016. Advances in authenticity testing for meat speciation. In *Advances in food authenticity testing* (pp. 369-414). Woodhead Publishing.

Amaratunga, D., Baldry, D., Sarshar, M. and Newton, R., 2002. Quantitative and qualitative research in the built environment: application of “mixed” research approach. *Work study*.

Ang, S.H., Cheng, P.S., Lim, E.A.C. & Tambyah, S.K. 2001. Spot the difference: consumer responses towards counterfeits. Journal of Consumer Marketing, 18(3):219-235.

Apostolidis, C. and McLeay, F., 2016. Should we stop meating like this? Reducing meat consumption through substitution. Food policy, 65, pp.74-89.

Artino Jr, A.R., La Rochelle, J.S., Dezee, K.J. and Gehlbach, H., 2014. Developing questionnaires for educational research: AMEE Guide No. 87. Medical teacher, 36(6), pp.463-474.

Bai, J., Zhang, C. & Jiang, J 2013. The role of certificate issuer on consumers' willingness-to-pay for milk traceability in China. *Agricultural Economics*, 44(4-5):537-544.

Baker, M.J. and Foy, A., 2003. Business and management research. *How to complete your research project successfully. West-burn publishers Ltd, Scotland. 403pp*.

Ballin, N.Z. and Lametsch, R., 2008. Analytical methods for authentication of fresh vs. thawed meat–A review. Meat Science, 80(2), pp.151-158.

Baltic, M.Z. and Boskovic, M., 2015. When man met meat: meat in human nutrition from ancient times till today. Procedia Food Science, 5, pp.6-9.

Baucus, M. S., & Near, J. P. 1991. Can illegal corporate behaviour be predicted? An event history analysis. *Academy of Management Journal*, 34(1):9-36.

BBC, 2011. South African Muslims furious at 'halal pork' scandal. [Online]. Available at: https://www.bbc.com/news/world-africa-15753835

Benson, M.L. and Simpson, S.S., 2009. *White collar crime: An opportunity perspective*. Routledge.

Berman, B. 2008. Strategies to detect and reduce counterfeiting activity', *Business Horizons,* Vol. 51(3):191-199.

Bindt, V., 2016. Costs and benefits of the food fraud vulnerability assessment in the Dutch food supply chain. *The Netherlands: Wageningen University. Available online at Retrieved from http://edepot. wur. nl/390258*.

Blumberg, B., Cooper, D. and Schindler, P., 2014. EBOOK: Business Research Methods. McGraw Hill.

Boatemaa, S., Barney, M., Drimie, S., Harper, J., Korsten, L. and Pereira, L., 2019. Awakening from the listeriosis crisis: Food safety challenges, practices and governance in the food retail sector in South Africa. *Food Control*, *104*, pp.333-342.

Bouzembrak, Y., Steen, B., Neslo, R., Linge, J., Mojtahed, V. and Marvin, H.J.P., 2018. Development of food fraud media monitoring system based on text mining. Food Control, 93, pp.283-296.

BRC. 2015. Understanding vulnerability assessment 2015. available at: https://www.siroccoconsulting.com/wp-content/uploads/2017/12/UNDERSTANDING-VULNERABILITY-ASSESSMENTBRC-2017.pdf (accessed December 2020).

Brooks, C., Parr, L., Smith, J.M., Buchanan, D., Snioch, D. and Hebishy, E., 2021. A review of food fraud and food authenticity across the food supply chain, with an examination of the impact of the COVID-19 pandemic and Brexit on food industry. Food Control, 130, p.108171.
Carson, D., Gilmore, A., Perry, C. and Gronhaug, K., 2001. *Qualitative marketing research*. Sage.

Cawthorn, D.M., Steinman, H.A. and Hoffman, L.C., 2013. A high incidence of species substitution and mislabelling detected in meat products sold in South Africa. Food control, 32(2), pp.440-449.

Chappalwar, A.M., Pathak, V., Goswami, M., Sharma, B., Singh, P. and Mishra, R., 2020. Recent novel techniques applied for detection of meat adulteration and fraudulent practices. Indian J Vet Public Hlth, 7(1), pp.1-6.

Charlebois, S., Schwab, A., Henn, R. & Huck, C.W. 2016. Food fraud: An exploratory study for measuring consumer perception towards mislabeled food products and influence on self-authentication intentions. *Trends in Food Science & Technology*, *50*:211–218.

Chaudhry, P.E. & Zimmerman, A. 2009. *The economics of counterfeit trade: Governments, consumers, pirates and intellectual property rights*. Springer Science & Business Media.

Cohen, L. & Felson, M. 1979. Social change and crime rate trends: A routine activity approach. *American Sociological Review*, 44:588-608.

Coleman, J. W. 1987. Toward an integrated theory of white-collar crime. *American Journal of Sociology, 93*(2):406-439.

Cooper, D.R., Schindler, P.S. and Sun, J., 2006. Business research methods (Vol. 9, pp. 1-744). New York: McGraw-Hill.

Cressey, D. R. 1953. Other People's Money. Montclair, NJ: Patterson Smith, pp.1-30.

D'Amato, M.E., Alechine, E., Cloete, K.W., Davison, S. and Corach, D., 2013. Where is the game? Wild meat products authentication in South Africa: a case study. Investigative genetics, 4(1), pp.1-13.

De Waal, M. 2013. The great meat fraud, SA edition. https://www.dailymaverick.co.za/article/2013-02-27-the-great-meat-fraud-sa-edition/

Dean, N., Murphy, T.B. and Downey, G., 2006. Using unlabelled data to update classification rules with applications in food authenticity studies. Journal of the Royal Statistical Society: Series C (Applied Statistics), 55(1), pp.1-14.

Downey, G. and Beauchêne, D., 1997. Discrimination between fresh and frozen-then-thawed beef m. longissimus dorsi by combined visible-near infrared reflectance spectroscopy: A feasibility study. Meat Science, 45(3), pp.353-363.

Edwards, K., Manley, M., Hoffman, L.C. and Williams, P.J., 2021. Non-destructive spectroscopic and imaging techniques for the detection of processed meat fraud. *Foods*, *10*(2), p.448.

Elliott, C. 2014. *Elliott Review into the Integrity and Assurance of Food Supply Networks*. London: Department for Environment, Food & Rural Affairs.

Erasmus, S.W. and Hoffman, L.C., 2017. What is meat in South Africa? *Animal Frontiers*, *7*(4), pp.71-75.

Etikan, I., Musa, S.A. and Alkassim, R.S., 2016. Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, *5*(1), pp.1-4.

Europol. 2019. “Over €100 million worth of fake food and drinks seized in latest Europol-Interpol operation.” Press release, June 19. Europol, The Hague, The Netherlands. https://www.europol.europa.eu/newsroom/news/over-%E2%82%AC100-million-worth-of-fake-food-and-drinks-seized-in-latest-europol-interpol-operation.

Everstine, K., Spink, J. & Kennedy, S. 2013. Economically motivated adulteration (EMA) of food: 494 Common characteristics of EMA incidents. *Journal of Food Protection*, 76(4), 723-735.

Ewa, U.E. & Udoayang, J.O. 2012. The Impact Of Internal Control Design On Banks' Ability To Investigate Staff Fraud, And Life Style And Fraud Detection In *Nigeria International Journal of Research in Economics & Social Sciences,* 2(2):32-44.

Farag, M.R., Alagawany, M., Abd El-Hack, M.E., Tiwari, R. and Dhama, K., 2015. Identification of different animal species in meat and meat products: trends and advances. Adv. Anim. Vet. Sci, 3(6), pp.334-346.

Fazli, S.A. Mohd T.I. & Mohamed M.Z. 2014. Fraud Risk Factors of Fraud Triangle and the Likelihood of Fraud Occurrence: Evidence from Malaysia*. Information Management and Business Review* 6, (1):1-7.

Food 24. 2014. SA bakeries to remove controversial ADA additive from its bread. [Online]. Available at: https://www.food24.com/sa-bakeries-to-remove-controversial-ada-additive-from-its-bread/

Food Navigator Europe. Sugar contamination stings honey imports in Europe. available at: https://www.foodnavigator.com/Article/2023/04/03/Food-fraud-Sugar-contamination-stings-EU-honey-imports. April 2023.

Fortin, N.D., 2022. Food regulation: law, science, policy, and practice. John Wiley & Sons.

Grundy, H.H., Kelly, S.D., Charlton, A.J. & Collin, M.J. 2012. Food authenticity and food fraud research: achievements and emerging issues. *Journal of the Association of Public Analysts*, 40:65-68.

Gussow, K.E. 2020. Finding food fraud: Explaining the detection of food fraud in the Netherlands. PhD, Vrije Universiteit Amsterdam.

Håkansson, A., 2013. Portal of research methods and methodologies for research projects and degree projects. In The 2013 World Congress in Computer Science, Computer Engineering, and Applied Computing WORLDCOMP 2013; Las Vegas, Nevada, USA, 22-25 July (pp. 67-73). CSREA Press USA.

Harris, D 2020. *How and why to trademark in China,* China Law Blog. https://harrisbricken.com/chinalawblog/how-and-why-to-trademark-in-china/ Accessed February 2022.

Hollis, M.E, Fejes, Z.L, Fenoff, R & Wilson, J 2015, 'Routine activities and product counterfeiting: a research note', *International Journal of Comparative and Applied Criminal Justice,* Vol. 39, no.3, pp. 257- 272.

Hollis, M.E. & Wilson, J. 2014. Who are the guardians in product counterfeiting? A theoretical application of routine activities theory. *Crime Prevention and Community Safety,* 16(3):169-188.

Hooper, M.J, & Pornelli, C.M. 2010. Deterring and detecting financial fraud: A platform for action. http://www.thecaq.org/docs/reports-and-publications/deterring-and-detecting financial-reporting-fraud-aplatform-for-action.pdf? Retrieved on 2 August 2022.

Huck, C.W., Pezzei, C.K. & Huck-Pezzei, V.A.C. An industry perspective of food fraud. *Current opinion in food science,* 10: 32-37.

Huisman, W. 2016. Criminogenic organizational properties and dynamics. In S. R. Van Slyke, M. L. Benson, & F. T. Cullen (Eds.), The Oxford handbook of whitecollar crime (pp. 435e462). Oxford: Oxford University Press.

IOL, The Shadow Economy: The rise of 'fake' food in South Africa,available at https://www.iol.co.za/news/south-africa/the-shadow-economy-the-rise-of-fake-food-in-south-africa-c339ed4e-f275-4ea5-bf0d-9f3c72c66686. August 2023.

Ingelfinger, J.R., 2008. Melamine and the global implications of food contamination. New England Journal of Medicine, 359(26), pp.2745-2748.

Jack, L., 2015. Risk modelling of food fraud motivation: 'NSF fraud protection model' intelligent risk model scoping project FS 246004.

Jie, F., Parton, K.A. & Cox, R.J. 2013. Linking supply chain practices to competitive advantage: an example from Australian agribusiness. *British Food Journal,* 115(7):1003-1024.

Johnson, R. 2014. Food fraud and 'economically motivated adulteration' of food and food ingredients. Congressional Research Report R43358.

Juan Ding, M, Jie, F.A, Parton, K.J & Matanda, M. 2014. Relationships between quality of information sharing and supply chain food quality in the Australian beef processing industry. *The International Journal of Logistics Management,* 25(1):85-108.

Kaptein, M. (2011). Understanding unethical behavior by unraveling ethical culture. Human Relations, 64(6):843-869.

Kelly, P. and Hartley, C. A. 2010. Casino gambling and workplace fraud: a cautionary tale for managers. *Management Research Review,* 33(3):224-239.

Kenyon, W. & Tilton, P.D. 2006. Potential red flags and fraud detection techniques: A Guide to Forensic Accounting Investigation, First Edition, John Wiley & Sons, Inc, New Jersey.

Knoll, S., Marques, C., Liu, J., Zhong, F., Padula, A. & Barcellos, J. 2017. The Sino-Brazilian beef supply chain: mapping and risk detection. *British Food Journal*, 119(1):164-180.

Lord, N., Flores Elizondo, C. J., & Spencer, J. 2017. The dynamics of food fraud: The interactions between criminal opportunity and market (dys) functionality in legitimate business. *Criminology and Criminal Justice, 17(5),* 605-623.

Luo, J., Wang, X., Li, H., Xiao, S., Gao, Y., & Li, L. 2016. Analysis of motivation and reason for Economically Motivated Adulteration in food company. *Science and Technology of Food Industry, 37*(5).

Mail & Guardian. 2013. Major supermarkets exposed in meat-label scandal. [Online]. Available at: https://mg.co.za/article/2013-04-14-major-supermarkets-exposed-in-meat-label-scandal/
Manning, L. & Soon, J.M. 2014. Developing systems to control food adulteration. *Food Policy*, 49: 23-32.

Manning, L. and Soon, J.M., 2016. Food safety, food fraud, and food defense: a fast evolving literature. Journal of food science, 81(4), pp.R823-R834.

Mansor, N. & Abdullahi, R. 2015. Fraud triangle theory and fraud diamond theory. Understanding the convergent and divergent for future research. *International Journal of Academic Research in Accounting, Finance and Management Science*, 1(4):38-45.

Martin, K.D., Cullen, J.B., Johnson, J.L. & Parboteeah, K.P. 2007. Deciding to bribe: A cross-level analysis of firm and home country influences on bribery activity. *Academy of Management Journal*, 50(6):1401-1422.

Marvin, H.J.P., Bouzembrak, Y., Janssen, E.M., Van der Fels- Klerx, H.J., van Asselt, E.D. & Klete, G.A. 2016. A holistic approach to food safety risks: Food fraud as an example. *Food Research International, 89*.

McElwee, G., Smith, R. & Lever, J. 2017. Illegal activity in the UK halal (sheep) supply chain: Towards greater understanding. Food Policy, 69: 166-175.

Ming, J.J. & Wong, T.J. 2003. Earnings management and tunnelling through related party transactions: Evidence from Chinese corporate groups. EFA 2003 *Annual Conference*, Paper No.549.

Miró, F., 2014. Routine activity theory. *The encyclopedia of theoretical criminology*, pp.1-7.

Mofokeng, N.E.M., 2018. Safeguarding township tourism in South Africa from counterfeit consumable products through consumer-oriented technological solutions. *Afr. J. Hosp. Tour. Leis*, *7*, pp.1-23.

Moyane, J.N., Jideani, A.I.O. and Aiyegoro, O.A., 2013. Antibiotics usage in food-producing animals in South Africa and impact on human: Antibiotic resistance. African Journal of Microbiology Research, 7(24), pp.2990-2997.

Moyer, D.C., DeVries, J.W. & Spink, J. 2017. The economics of a food fraud incident Case studies and examples including Melamine in Wheat Gluten. Food Control, 71: 358-364.

Moyes G., Lin, P. & Landry-Jr, R. 2005. Raise the red flag: Internal Auditor, October: 47-51.

Murphy, P.R. & Free, C. 2016. Broadening the fraud triangle: Instrumental climate and fraud. *Behavioral Research in Accounting, 28*(1):41–56.

Naila, A., Flint, S.H., Sulaiman, A.Z., Ajit, A. and Weeds, Z., 2018. Classical and novel approaches to the analysis of honey and detection of adulterants. Food Control, 90, pp.152-165.

Nakyinsige, K., Man, Y.B.C. and Sazili, A.Q., 2012. Halal authenticity issues in meat and meat products. Meat science, 91(3), pp.207-214.

News24. 2010. Frozen chicken horror. [Online]. Available at: https://www.news24.com/News24/Frozen-chicken-horror-20101219-2

News24, 2005. Sudan Red scare spreads. https://www.news24.com/News24/Sudan-Red-scare-spreads-20050421.

News24, 2013. SA consumers face food-labelling scare. https://www.news24.com/news24/sa-consumers-face-food-labelling-scare-20150430

News24, 2014. Foods that are faked and how it's done. [online]. Available at: https://www.news24.com/health24/Diet-and-nutrition/Food-safety/Foods-that-are-faked-and-how-its-done-20140909

Ngouapegne, C.N.M. and Chinomona, E., 2018. The influence of buyer-supplier trust and buyer-supplier commitment on supply chain relationship longevity in the food retail industry in Gauteng province. *Journal of Contemporary Management*, *15*(1), pp.198-223.

Nguegan Nguegan, C.A., 2017. *Perceptions of supply chain professionals on the relationship between supply chain challenges and business performance in the food industry in Gauteng province* (Doctoral dissertation, Vaal University of Technology).

Nyaga, G. N., Whipple, J. M. & Lynch, D. F. 2010. Examining supply chain relationships: Do buyer and supplier perspectives on collaborative relationships differ? Journal of Operations Management, 28(2):101-114.

Oirere, S. 2019. Meat consumption rising in South Africa. [Online]. Available at: https://www.world-grain.com/articles/12371-meat-consumption-rising-in-south-africa

Onyeaka, H., Kalane, M.S., Guta, A.T. and Tamasiga, P., 2022. Food fraud amid COVID-19 in Sub-Saharan Africa. Public Health, 3, p.100234.

Onyeaka, H., Ukwuru, M., Anumudu, C. and Anyogu, A., 2022. Food fraud in insecure times: challenges and opportunities for reducing food fraud in Africa. *Trends in Food Science & Technology*.

Ormston, R., Spencer, L., Barnard, M. and Snape, D., 2014. The foundations of qualitative research. *Qualitative research practice: A guide for social science students and researchers*, *2*(7), pp.52-55.

PackagingSA, 2017. Food Fraud A Risky Business. https://www.packagingsa.co.za/2017/08/07/food-fraud-a-risky-business/

Patricios. O. (2013). SA's meat fraud and the betrayal of consumer trust. [Online]. Available at:

Payne, K., 2019. Rapid differentiation of South African game meat using portable near-infrared (NIR) spectroscopy (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Ponterotto, J.G., 2005. Qualitative research in counseling psychology: A primer on research paradigms and philosophy of science. *Journal of counseling psychology*, *52*(2), p.126.

Power, A. C., Jones, J., NiNeil, C., Geoghegan, S., Warren, S., Currivan, S., & Cozzolino, D. 2021. What's in this drink? Classification and adulterant detection in Irish whiskey samples using near infrared spectroscopy combined with chemometrics. *Journal of the Science of Food and Agriculture, 101*(12), 5256–5263.

Pratt, T. & Holtfreter, K. & Reisig, M.D 2010. Routine online activity and internet fraud targeting: extending the generality of Routine Activity Theory. *Journal of Research in Crime and Delinquency*, 47(3):267-296.

PWC. 2015. Take the food fraud vulnerability assessment. available at: http://www.pwc.com/gx/en/services/food-supply-integrity-services/publications/food-fraud.html (accessed Jun 2022).

Rae, K. & Subramaniam, N. 2008. Quality of internal control procedures: Antecedents and moderating effect on organisational justice and employee fraud. *Managerial Auditing Journal*, 23(2):104-124.

Rantlo, A.M., 2018. Integration of small-scale mohair farmers into the commercial agricultural economy in Lesotho: A new institutional economics approach. *Research report*.

Rezazade, F., Summers, J. and Teik, D.O.L., 2021. Identifying food fraud vulnerability factors in food fraud incidents–a review of global incidents 2000–2018. *British Food Journal*.

Rive, L., 2013. Meat labelling and the protection of religious consumers: a critical and comparative study between south africa and the united kingdom. *Responsa Meridiana.*

Robson, K., Dean, M., Brooks, S., Haughey, S. and Elliott, C., 2020. A 20-year analysis of reported food fraud in the global beef supply chain. Food Control, 116, p.107310.

Salehi, K. and Golafshani, N., 2010. Commentary: Using mixed methods in research studies: An opportunity with its challenges. *International journal of multiple research approaches*, *4*(3), pp.186-191.

Sammut, J., Gopi, K., Saintilan, N. and Mazumder, D., 2021. Facing the challenges of food fraud in the global food system. In Food Authentication and Traceability (pp. 35-63). Academic Press.

Samy, M. and Robertson, F., 2017. From positivism to social constructivism: an emerging trend for CSR researchers. *Handbook of research methods in corporate social responsibility*, pp.437-462.

Saunders, M., Lewis, P. and Thornhill, A., 2009. *Research methods for business students*. Pearson education.

Sharma, G., 2017. Pros and cons of different sampling techniques. *International journal of applied research*, *3*(7), pp.749-752.

Sharma, S.K., Srivastava, P.R., Kumar, A., Jindal, A. & Gupta, S. 2021. Supply chain vulnerability assessment for manufacturing industry. Annals of Operations Research.

Sibanyoni, J.J., Tshabalala, P.A. and Tabit, F.T., 2017. Food safety knowledge and awareness of food handlers in school feeding programmes in Mpumalanga, South Africa. Food Control, 73, pp.1397-1406.

Silvis, I. C. J., van Ruth, S. M., van der Fels-Klerx, H. J. & Luning, P. A. 2017. Assessment of food 602 fraud vulnerability in the spices chain: An explorative study. Food Control, 81:80-87.

Simpson, S. S. (2011). "Making sense of White -Collar Crime: Theory and Research " Ohio State Journal of Criminal Law **8:481**: 481-402.

Singleton, T.W. Bologna, G.J. Lindquist, R.J. & Singleton, A.J. 2006. Fraud auditing and forensic accounting, 3rd Ed., John Wiley & Sons, Inc, New Jersey.

Smith, R. and McElwee, G., 2021. The “horse-meat” scandal: illegal activity in the food supply chain. *Supply Chain Management: An International Journal*.

Smith, R., Manning, L. & McElwee, G. 2017. Critiquing the inter-disciplinary literature on food fraud. International Journal of Rural Criminology, 3(2): 250-270.

Smith, R., McElwee, G. & Somerville, P. 2017. Illegal diversification strategies in the farming community from a UK perspective. Journal of Rural Studies, 53:122-131.

Somerville, P., Smith, R., McElwee, G. 2015. The dark side of the rural idyll: Stories of illegal/illicit economic activity in the UK countryside. Journal of rural studies, 39: 219-228.

Song, C. & Zhuang, J. 2017. Modeling a government-manufacturer-farmer game for food supply chain risk management. Food Control, 78: 443-455.
Soon, J. M. & Manning, L. 2017. Whistleblowing as a countermeasure strategy against 816 food crime. *British Food Journal*, *119*(12):2630-2652.

Soon, L. M. J. M. (2014). "Developing systems to control food adulteration." Food Policy **49**: 1401-1422.

Spink, J. & Moyer, D.C. 2011. Defining the public health threat of food fraud. *Journal of Food Science*, 76(9):157-163.

Spink, J., Fortin, N.D., Moyer, D.C., Miao, H & Wu, Y. 2016. Food fraud prevention: Policy, strategy, and decision-making implementation steps for a government agency or industry. CHIMIA International Journal for Chemistry, 70(5): 320-328.

Spink, J., Ortega, D. L., Chen, C. and Wu. F. 2017. Food fraud prevention shifts the food risk focus to 621 vulnerability. *Trends in Food Science & Technology*, 62:215-220.

Srivastava, R. P., Mock T. J., & Turner, J. L. (2005). Fraud Risk Formulas for Financial Statement Audits. *Australian National University Business and Information Management Auditing Research* Workshop and from Gary Monroe, Lei Gao and Lili Sun. pp. 1-48.

SSAFE (2017). SSAFE Food fraud vulnerability self-assessment tool. Retrieved from. http://www.ssafe-food.org/. [Last accessed 15 Jun. 2022].

Stanziani, A., 2009. Information, quality and legal rules: Wine adulteration in nineteenth century France. *Business History*, *51*(2), pp.268-291.

Stea, S. and Pickering, G.J., 2019. Optimizing messaging to reduce red meat consumption. Environmental Communication, 13(5), pp.633-648.

Stevenson, M. & Busby, J. 2015. An exploratory analysis of counterfeiting strategies. *International Journal of Operations and Production Management*, 35(1):110-144.

Taherdoost, H., 2016. Sampling methods in research methodology; how to choose a sampling technique for research. *How to choose a sampling technique for research (April 10, 2016)*.

Tashakkori, A. and Creswell, J.W., 2007. The new era of mixed methods. *Journal of mixed methods research*, *1*(1), pp.3-7.

Tashakkori, A., Teddlie, C. and Teddlie, C.B., 1998. *Mixed methodology: Combining qualitative and quantitative approaches* (Vol. 46). sage.

Tembe, D., Mukaratirwa, S. and Zishiri, O.T., 2018. Undeclared meat species in processed meat products from retail franchises in the Durban Metropole, KwaZulu-Natal Province, South Africa, using species-specific DNA primers. *Food Protection Trends*, *38*(6), pp.440-449.

The bovine, 2008. Nestle ordered to recall melamine-tainted baby formula in South Africa. [Online]. Available at: https://thebovine.wordpress.com/2008/11/27/nestle-ordered-to-recall-melamine-tainted-baby-formula-in-south-africa/

Thomas, J., Govender, N., McCarthy, K.M., Erasmus, L.K., Doyle, T.J., Allam, M., Ismail, A., Ramalwa, N., Sekwadi, P., Ntshoe, G. and Shonhiwa, A., 2020. Outbreak of listeriosis in South Africa associated with processed meat. *New England Journal of Medicine*, *382*(7), pp.632-643.

Ting, S.L. & Tsang, A.H.C. 2014. Using social network analysis to combat counterfeiting. *International Journal of Production Research, 52*(15):4456–4468.

Trienekens, J. H., Wognum, P. M., Beulens, A. J. M., & van der Vorst, J. G. A. J. 2012. Transparency in complex dynamic food supply chains. *Advanced Engineering Informatics, 26*(1):55-65.

Tshipamba, M.E., Lubanza, N., Adetunji, M.C. and Mwanza, M., 2018. Molecular characterization and antibiotic resistance of foodborne pathogens in street-vended ready-to-eat meat sold in South Africa. *Journal of food protection*, *81*(12), pp.1963-1972.

van Ruth, S. M., & Liu, N. (2019). How organic is organic milk? Can we have a quick check? NIR news, 30, 18-21.

van Ruth, S. M., Huisman, W., & Luning, P. A. (2017). Food fraud vulnerability and its key factors. Trends in Food Science and Technology, 67, 70-75.

van Ruth, S. M., Luning, P. A., Silvis, I. C. J., Yang, Y., & Huisman, W. (2018). Fraud vulnerability in six food supply chain networks and their tiers. Food Control, 84, 375-381.

van Ruth, S.M. & Pagter-de Witte, L. 2020. Integrity of organic foods and their suppliers: Fraud vulnerability across chains. Foods, 9,188.

Vance, S. 1983. Corporate leadership: Boards, directors and strategy. New York: McGraw-Hill.

Victor, B., & Cullen, J. B. 1988. The Organizational bases of ethical work climates. *Administrative Science Quarterly, 33*(1):101–125.

Visciano, P. and Schirone, M., 2021. Food frauds: Global incidents and misleading situations. *Trends in Food Science & Technology*, *114*, pp.424-442.

Wagner, S.M. & Neshat, N. 2010. Assessing the vulnerability of supply chains using graph theory', *International Journal of Production Economics*, 126(1):121-129.

Walters, D. & Glaser 2008. The role of branding in the value chain. *International Journal of Physical Distribution & Logistics Management*, 38(9):726-736.

Wang, F., Zhang, H., Zang, H. & Ouyang, M. 2005. Purchasing pirated software: an initial examination of Chinese consumers. Journal of Consumer Marketing, 22(6):340-351.

Wang, T. Y., & Winton, A. 2012. Competition and corporate fraud waves. Paper presented at *the 7th Annual Conference on Empirical Legal Studies*. November 9-10, 2012, Stanford, CA.

Waters, D. 2011. Supply chain risk management: Vulnerability and resilience in logistics. London: Kogan Page Publishers.

Wilks, T. J., & Zimbelman, M. F. 2004. Decomposition of Fraud-Risk Assessments and Auditors' Sensitivity to Fraud Cues. *Contemporary Accounting Research*, 21(3):719-745.

Xiu, C. & Klein, K.K. 2010. Melamine in milk products in China: Examining the factors that 874 led to deliberate use of the contaminant. *Food Policy,* 35:463-470.

Yan, J., Erasmus, S. W., Toro, M. A., Huang, H., & van Ruth, S. M. 2020. Food fraud: Assessing fraud vulnerability in the extra virgin olive oil supply chain. *Food Control, 111*, Article 107081.

Yang, Z., Zhou, Q., Wu, W., Zhang, D., Mo, L., Liu, J. and Yang, X., 2022. Food fraud vulnerability assessment in the edible vegetable oil supply chain: A perspective of Chinese enterprises. *Food Control*, *138*, Article109005.

Yin, R. K. 2003. *Case study research: Design and methods*, 3rd edition. London, SAGE Publications.

Zhou, X., Taylor, M.P., Salouros, H. and Prasad, S., 2018. Authenticity and geographic origin of global honeys determined using carbon isotope ratios and trace elements. Scientific reports, 8(1), pp.1-11.

APPENDIX A: QUESTIONNAIRE (MEAT CONSUMER)

Consent

You are invited to participate in a web-based online survey on assessing the food fraud vulnerability factors in South Africa.

The objective of the survey is to assess the factors affecting food fraud vulnerability factors in South Africa, to assess consumer perception towards food fraud for meat and meat products and finally to determine government response to food fraud in South Africa. This is a research project conducted by **Vhutshilo Nelwamondo,** a MSc. student from the department of Agricultural Economics, Extension and Rural Development, faculty of Natural and Agricultural Sciences, University of Pretoria. The survey should take approximately **15 minutes** to complete.

Participation

Kindly note that your participation in this survey is voluntary, feel free to refuse to take part in the research or exit the survey at any time without penalty. You are free to decline to answer any question you do not wish to answer for any reason.

Risks

There are minimal possible risks or discomforts in this survey. You may express your discomfort at any time as you answer the survey questions.

Confidentiality

Your responses and data will be kept secure using a password protected files, encryption when sending information over the internet. The survey will not collect identifying information such as your name, email address, or IP address. No identifying information would be included in any publications or presentations based on these data, and your responses to this survey will remain confidential.

Contact Information
If you have questions at any time about the study or the procedures, you may contact my research supervisor, **Dr Daniel Jordaan** via phone at 083 785 2857, Email at danie.jordaan@up.ac.za

If you feel you have not been treated according to the descriptions in this form, or that your rights as a participant in research have not been honoured during the course of this survey, or you have any questions, concerns, or complaints that you wish to address to someone other than the investigator, you may contact the Head of department of Agricultural Economics, Extension and Rural Development, faculty of Natural and Agricultural Sciences, **Prof Sheryl Hendriks** , Email: Sheryl.hendriks@up.ac.za.

Electronic consent: Please select your choice below. on the “Agree” button indicates that you have read the above information and you voluntarily agree to participate.

- Disagree
- Agree

Section 2

(To be completed by key informant respondents working in the meat and meat products industry)

HOUSEHOLD DEMOGRAPHIC INFORMATION

Participants demographics

2.1 Number of people in the household? .....

2.2 What is your gender?

- Male
- Female
- Prefer not to say

2.3 What is your gender?

2.4 What is your education level

- No formal education
- Primary
- Secondary
- Tertiary

2.5 What is your occupation

- Retired
- Unemployed
- Employee
- Self employed
- Student/Learner

2.6 Please specify the years of employment.

2.7 Field of specialisation.

2.8 What is your Marital status?

- Single
- Married
- Divorced

- Widow/widower
- Separated/Entanglement
- Cohabiting

Section B: CONSUMER PERCEPTION

(To be completed by meat ad meat products consumers)

3.1 Do you have any prior knowledge about food fraud?
(Food fraud occurs when food or drink is sold in a way that deliberately misleads consumers or customers for financial gain in the food supply chain. eg on ingredients, raw materials, final food product)

- Yes
- No

3.2 Do you think food fraud on meat and meat products in South Africa is common

- Yes
- No

4. Ranking types of meat and meat product

Which meat products are mostly affected by Food fraud, please rank the meat type on a scale of 1 to 6. 1 is least affected and 6 is most affected

4.1 Fish

- 1
- 2
- 3
- 4
- 5
- 6

4.2 Beef

- 1
- 2
- 3
- 4
- 5
- 6

4.3 Poultry

- 1
- 2

- 3
- 4
- 5
- 6

4.4 Pork

- 1
- 2
- 3
- 4
- 5
- 6

4.5 Chevon (goat)

- 1
- 2
- 3
- 4
- 5
- 6

4.6 Lamb

- 1
- 2
- 3
- 4
- 5
- 6

4.1Game meat (Venison)

- 1
- 2
- 3
- 4
- 5
- 6

5.Familiarity with Food Fraud terms

5.1 Adulteration (Adulterate can be defined as to prepare for sale food items by replacing more valuable ingredients with cheaper/less valuable ingredients)

- Yes
- No

5.2 Counterfeit (similar word for counterfeit is replicate, imitate or replace original form)

- Yes
- No

5.3 Addition (any chemical substance that is added to food during preparation or storage and either becomes a part of the food. eg colouring, sweeteners)

- Yes
- No

5.4 Substitution (to resemble/replace a common food in appearance, texture, taste and smell and is intended to be used as a complete or partial replacement for the food it resembles)

- Yes
- No

6. RANKING

Tick the most appropriate answer for the statements below

6.1 The meat products I often buy comprises herbs, spices and sauces

- Disagree strongly
- Disagree
- Neutral
- Agree
- Agree strongly

6.2 The meat product is pre-sealed or pre-packed*

- Disagree strongly
- Disagree
- Neutral
- Agree
- Agree strongly

6.3 The packaging has detailed labelling on origin of meat or meat product

- Disagree strongly
- Disagree

- o Neutral
- o Agree
- o Agree strongly

6.4 The price of the meat and meat products is relatively stable

- o Disagree strongly
- o Disagree
- o Neutral
- o Agree
- o Agree strongly

6.5 I am aware of laws regarding Food Fraud and they are highly enforced

- o Disagree strongly
- o Disagree
- o Neutral
- o Agree
- o Agree strongly

6.6 Certification of the meat and meat products quality is satisfactory

- o Disagree strongly
- o Disagree
- o Neutral
- o Agree
- o Agree strongly

7. Governance Measures

Based on your opinion as a consumer:

7.1 Has South Africa ever faced any Food Fraud incidents for meat and meat products. If yes what was the incident?

7.2 When did South Africa face food fraud incidence specific for meat and meat products that you are aware of?

7.3 What measures has the government put in place to prevent Food Fraud that you are aware of?

7.4 In your opinion, how best can food fraud be dealt with, besides giving fines, imprisonment or seize of products?

APPENDIX B: QUESTIONNAIRE (FOOD SPECIALISTS)

Section 1

1. Survey Form :Food specialist

This form should be administered to Food specialist.

You are invited to participate in a web-based online survey on assessing the food fraud vulnerability factors in South Africa.

The objective of the survey is to assess the factors affecting food vulnerability in South Africa, to assess consumer perception towards food fraud for meat and meat products and finally to determine government response to food fraud in South Africa. This is a research project is conducted by **Vhutshilo Nelwamondo,** a MSc. student from the department of Agricultural Economics, Extension and Rural Development, faculty of Natural and Agricultural Sciences, University of Pretoria. The survey should take approximately **15 minutes** to complete.

Participation

Kindly note that your participation in this survey is voluntary, feel free to refuse to take part in the research or exit the survey at any time without penalty. You are free to decline to answer any question you do not wish to answer for any reason.

Risks

There are minimal possible risks or discomforts in this survey. You may express your discomfort at any time as you answer the survey questions.

Confidentiality

Your responses and data will be kept secure using password protected files, encryption when sending information over the internet. The survey will not collect identifying information such as your name, email address, or IP address. No identifying information would be included in any publications or presentations based on these data, and your responses to this survey will remain confidential.

Contact Information

If you have questions at any time about the study or the procedures, you may contact my research supervisor, **Dr Daniel Jordaan** via phone at 083 785 2857, Email at danie.jordaan@up.ac.za

If you feel you have not been treated according to the descriptions in this form, or that your rights as a participant in research have not been honoured during the course of this survey, or you have any questions, concerns, or complaints that you wish to address to someone other than the investigator, you may contact the Head of department of Agricultural Economics, Extension and Rural Development, faculty of Natural and Agricultural Sciences, **Prof Sheryl Hendriks**, Email: Sheryl.hendriks@up.ac.za.

Electronic consent: Please select your choice below. on the “Agree” button indicates that you have read the above information and you voluntarily agree to participate.

- Disagree
- Agree

Section 2

- **(To be completed by key informant respondents working in the meat and meat products industry)**

  HOUSEHOLD DEMOGRAPHIC INFORMATION

  Participants demographics

  2.1 Number of people in the household? .....

  2.2 What is your gender?
  - Male
  - Female
  - Prefer not to say

  2.3 What is your gender?

  2.4 What is your education level
  - No formal education
  - Primary
  - Secondary
  - Tertiary

  2.5 What is your occupation
  - Retired
  - Unemployed
  - Employee
  - Self employed
  - Student/Learner

  2.6 Please specify the years of employment.

  2.7 Field of specialisation.

  2.8 What is your Marital status?

- Single
- Married
- Divorced
- Widow/widower
- Separated/Entanglement
- Cohabiting

Section 3

Food Fraud Vulnerability (the product**)**

(Food fraud occurs when food or drink is sold in a way that deliberately misleads consumers for financial gain in the food supply chain. eg on ingredients, raw materials, final food product). We now ask questions on Food fraud vulnerability assessment related to: the food

product. Tick most appropriate rating according to the food product (P). We look at the opportunities available.

3.1 Based on your opinion there is availability of technology and knowledge to adulterate raw materials on meat product (Adulterate can be defined as to prepare for sale food items by replacing more valuable ingredients with less valuable ingredients. With Low - rated as less technology available, Medium rated as there is average technology available and High – rated as there is plenty of technology available to adulterate raw materials on meat product).

- Low
- Medium
- High

3.2 Based on your opinion there is Fraud detectability in raw materials for meat and meat products (Detectable/traceable in form of appearance, smell, taste or measured by machine)

- Low
- Medium
- High

3.3 Based on your opinion there is Complexity of adulteration of raw materials for meat and meat products (Adulterate can be defined as to prepare for sale food items by replacing more valuable ingredients with less valuable ingredients)

- Low
- Medium
- High

3.4 Based on your opinion there is Availability technology and knowledge to adulterate final products for meat product in the food chain

- Low
- Medium
- High

3.5 Based on your opinion there is Fraud detectability in final products for meat product

- Low
- Medium
- High

3.6 Based on your opinion there is Complexity of counterfeiting on meat product (similar word counterfeit is replicate, imitate or replace original form)

- Low
- Medium
- High

3.7 Based on your opinion there is Detectability of counterfeiting on meat and meat product

- Low
- Medium
- High

3.8 Based on your opinion there is Access to production lines/processing activities in the food product of meat and meat products

- Low
- Medium
- High

3.9 Based on your opinion there is Transparency in the food chain network of meat and meat products (Food chain is the series of processes by which food is grown or produced, sold, and eventually consumed.)

- Low
- Medium
- High

3.10 Based on your opinion there is Historical evidence of fraud in raw materials for meat and meat products

- Low
- Medium
- High

3.11 Based on your opinion in what phase of the food chain is food fraud vulnerability (risk) most likely to take place for meat and meat products

- Low
- Medium
- High

Section 4

4.1 Based on your opinion, your company has Supply and pricing raw materials features (freshness, cuts, origin) of meat and meat products

- Low
- Medium
- High

4.2 Based on your opinion, your company has invested on Valuable components to detect food fraud for meat and meat products

- Low
- Medium
- High

4.3 Based on your opinion, your company has an Economic health maintenance (healthcare) initiative to determine food fraud on meat and meat products

- Low
- Medium
- High

4.4 Based on your opinion, your company's Organizational strategy on food fraud is well implemented

- Low
- Medium
- High

4.5 Based on your opinion, your company has an Ethical business culture in terms food fraud on meat and meat products

- Low
- Medium
- High

4.6 Based on your opinion, your company applies Criminal offences on internal individuals involved on food fraud events related to meat and meat products

- Low
- Medium
- High

4.7 Based on your opinion, your company applies Corruption level governance effectively for individuals involved in food fraud events on meat and meat product

- Low
- Medium
- High

4.8 Based on your opinion, your company maintains a Level of competition branch of same industry it operates in of meat and meat products

- Low
- Medium
- High

4.9 Based on your opinion, your company has Price asymmetries (price changes) in case of food fraud events for meat and meat products

- Low
- Medium
- High

Section 5

5. Food Fraud Vulnerability (Supplier)

We now ask questions on food fraud vulnerability assessment related to: the supplier. Tick most appropriate rating according to the Supplier(S). We look at the control measures available.

- Low
- Medium
- High

5.1 Based on your opinion there is: Fraud monitoring system of and on raw materials of meat and meat products to fight food fraud

- Low
- Medium
- High

5.2 Based on your opinion there is: Verification of fraud monitoring system of and on raw materials to control food fraud for meat and meat products

- Low
- Medium
- High

5.3 Based on your opinion there is: Fraud monitoring system of final products to control food fraud on meat and meat products

- Low
- Medium
- High

5.4 Based on your opinion there is: Verification of fraud monitoring system of final products to control food fraud for meat and meat products

- Low
- Medium
- High

5.5 Based on your opinion there is: Tracking and tracing food system of own company to control food fraud for meat and meat products

- Low
- Medium
- High

5.6 Based on your opinion there is: Integrity screening on own employees to control food fraud for meat and meat products

- Low
- Medium
- High

5.7 Based on your opinion there is: Fraud monitoring system on suppliers to control food fraud for meat and meat products

- Low
- Medium
- High

5.8 Based on your opinion there is: Information system on supplier to control food fraud for meat and meat products

- Low
- Medium
- High

5.9 Based on your opinion there is: Tracking and tracing system of supplier to control food fraud for meat and meat products

- Low
- Medium
- High

5.10 Based on your opinion there is: Social control of food chain network to avoid food fraud for meat and meat products

- Low
- Medium
- High

Section 6

Governance Measures

Based on your opinion:

6.1 Has South Africa ever faced any Food Fraud incidents for meat and meat products. If yes what was the incident?

6.2 When did South Africa face food fraud incidence specific for meat and meat products that you are aware of?

6.3 What measures has the government put in place to prevent Food Fraud that you are aware of?

6.4 How was the issue resolved?

6.5 In your opinion, how best can food fraud be dealt with, besides giving fines, imprisonment or seize of products?