Exploring consumers' procedural knowledge and perception of genetically modified (GM) food products and the factors that influence their purchasing decision

by

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DEDICATION

To my beloved parents, thank you for all your support, encouragement and love. I am truly grateful for everything you have done and sacrificed for me.

DECLARATION

I, Soné van Zuydam, hereby declare that the dissertation (Exploring Consumers' Procedural Knowledge and Perception of Genetically Modified (GM) Food Products and the Factors that Influence their Purchasing Decision), which I hereby submit for the degree of Master of Consumer Science at the University of South Africa, is my own work and has not previously been submitted by me for a degree at this or any other institution.

I declare that the dissertation does not contain any written work presented by other persons, whether written, pictures, graphs or data or any other information, without acknowledging the source.

I declare that when words from a written source were used, the words were paraphrased and referenced. When exact words from a source were used, the words were placed inside quotation marks and referenced.

I declare that I have not copied and pasted any information from the Internet without specifically acknowledging the sources and inserting appropriate references to those sources in the reference section of the dissertation.

I declare that during my study I adhered to the research ethics policy of the University of South Africa. I also received ethics approval, prior to the commencement of data gathering, and have not acted outside the approval conditions.

I declare that the content of my dissertation has been submitted to an electronic plagiarism detection program before the final submission for examination.

Student signature: Date: *December 2019*

Soné van Zuydam

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ABSTRACT

This quantitative study explores procedural knowledge, perception of GM food products and factors that influence the purchasing decision of 326 respondents by means of a questionnaire. Recruitment of the respondents was done by approaching various businesses and Schools in Mooi River to which the questionnaire was distributed to their respective personnel. The respondents' showed that they were not very knowledgeable of GM food products, but were not particularly ignorant either. The results also showed that they did not look for any GM-related information from various sources and believed that scientists were the most credible source of GM-related information. In general, the respondents did not perceive GM food products as having any nutritional benefits; did not perceive GM food products to provide an economic benefit, except to increase food supplies by boosting the economy through the implementation of biotechnology; and perceived longer shelf life as a beneficial GM food product quality. The respondents also feared the susceptibility to cancer, toxicity, allergic reactions, alterations in kidney functions, immune malfunction and especially infertility problems after consumption of GM food products. The respondents did not show particular fear towards the ethical aspects of GM food products, except in that GM food products are produced in an unethical manner. Fear was also not shown towards the consumption aspects of GM food products including scepticism towards the safety GM food products and possible threats to living things. The respondents indicated that increased food supplies through the production of GM food products, possible cancer development after consumption, allergenicity, reduced usage of pesticides and harmful effect on the environment were GM-related factors that would influence their purchasing decision of GM food products. The general GM-related barriers that influenced the respondents purchasing decision of GM food products included not looking out for GM food products in particular, knowing too little about GM food products, not having a particular interest in GM food products and never knowing if a product contains a GM component or not.

KEY TERMS

Genetically modified food products; procedural knowledge; perception; purchasing decisions.

ISISHWANKATHELO

Esi sifundo, nesiqhutywa ngokuqwalasela amanani ezenzeko, saphanda ngolwazi lwendlela ebonwa ngayo inkqubo yeemveliso zokutya zeGM (iimveliso ezinyangwe ngobuchule obaziwa ngelesiNgesi elithi *genetically modified)* kwakunye neemeko eziphembelela izigqibo zokuthenga ezi mveliso, zigqibo ezo zathathwa ngabathathi nxaxheba abangama-326 nabathi baphendula uluhlu lwemibuzo. Ukuloba/ukurhwebesha abathathi nxaxheba kwenziwa ngokucela uncedo kumashishini nezikolo eziseMooi River. Abathathi nxaxheba baveza ukuba abanalwazi kakuhle ngeemveliso zokutya zeGM, kodwa banalo ufifana. Iziphumo zadiza ukuba azange baphande ulwazi olumalunga nonyango lweemveliso kwaye babekholelwa ukuba iingcali zenzululwazi zizo ezaziyimithombo yolwazi ethembekileyo malunga nalo mbandela. Ngokuthe gabalala, abathathi nxaxheba babengaziboni ziluncedo kwisondlo okanye kuqoqosho ezi mveliso zokutya zeGM, kwaye babelindele ukuba ezi mveliso zandise ukutya okuveliswayo ngokukhuthaza ezoqoqosho ngokusebenzisa ubuchwepheshe bezendalo, (i*biotechnology*). Babecinga ukuba uphawu olululuncedo lokutya okuveliswe ngeendlela zeGM kukuba kuhlala ixesha elide, akonakali msinya. Abathathi nxaxheba babesoyika ukuba bangasifumana lula isifo somhlaza, bangafumana ukutyhefeka kokutya, ukusoleka (i*allergy*), ukuchaphazeleka kokusebenza kwezintso, ubuthathaka bamajoni omzimba, okanye ubuthathaka benzala emva kokutya iimveliso zokutya zeGM. Abazange babonakalise uloyiko olumandla malunga nombandela weenqobo zesimilo ezayanyaniswa neemveliso zokutya zeGM, ngaphandle kokuba ezi mveliso ziveliswa ngendlela engenasimilo sisulungekileyo. Kwakhona, abazange babonakalise loyiko malunga nokutya iimveliso zokutya zeGM, bengazange bakrokrele ukungakhuseleki kwezi mveliso okanye ukuba yingozi kwazo kwezinye izidalwa. Abathathi nxaxheba baxela ukuba izigqibo zabo zokuthenga iimveliso zokutya zeGM zingaphenjelelwa kukucinga ngokwanda kokutya okuveliswayo, ukuvela komhlaza emva kokuzitya, ukusolwa, ukucutha ukusebenzisa izibulali zinambuzane kunye neziphumo ezinobungozi kwindalo esingqongileyo. Imiqobo jikelele engqamene nonyango lweGM neyaphembelela izigqibo zabathathi nxaxheba malunga nokuthenga iimveliso zokutya zeGM ziquka ukwazi kancinci ngeemveliso zokutya zeGM, kukungabi namdla kwiimveliso zokutya zeGM nokuba ubani angabi nalwazi lokuba imveliso ethile inalo na unyango lweGM okanye ayinalo.

AMAGAMA APHAMBILI

Iimveliso zokutya ezinyangwe ngobuchule obaziwa ngelesiNgesi elithi *genetically modified*; ulwazi lweenkqubo; indlela yokubona into; izigqibo zokuthenga.

NGAMAFUPHI

Lolu cwaningo olugxile kwinani luye lwaphenya ulwazi olumayelana nolwazi lwengqubo, umqondo omayelana nenhlobo yokudla okuguquliwe (GM food) kanye nezinto ezinomthelela phezu kwesinqumo sokuthenga sabaphenduli bemibuzo abanga-326, lokhu kwenziwe ngokusebenzisa umbhalo oqukethe imibuzo. Abaphenduli bemibuzo batholwe ngokunxenxa amabhizinisi kanye nezikole ezihlukahlukene endaweni yaseMooi River. Abaphenduli bemibuzo bakhombisile ukuthi babenganalwazi ngemikhiqizo yokudla eguquliwe (GM), kanti laba baphenduli abazange bakhombise ukungabambisani nalolu cwaningo. Imiphumela iyakhombisa ukuthi abaphenduli abazange bafune ukuthola noma yiluphi ulwazi olumayelana Nokudla kwe-GM kwimithombo eyahlukahlukene kanti baye bakholwa ukuthi ososayensi bayimithombo yolwazi ethembekayo. Empeleni, abaphenduli abazange baqonde imikhiqizo yokudla kwe-GM njengokudla okunenzuzo yomsoco noma inzuzo yezomnotho kanti bebelidele le mikhiqizo ukuba yongeze inani lokudla elithunyelwayo ngokuxhasa umnotho ngokusebenzisa uhlelo lwe--*biotechnology*. Bakholelwa ekutheni umkhiqizo uhlale isikhathi eside emasheluvini, lokho okuyinzuzo kwikhwalithi yemikhiqizo yokudla kwe-GM. Abaphenduli baye besaba ukungenwa yisifo somdlavuza, ushevu, ukuguliswa yinhlobo yokudla okuthile, ukushintshana kokusebenza kwezinso, ukungasebenzi kahle kwamasosha omzimba kanti ikakhulu izinkinga zokwehluleka ukuzala ngemuva kokudla imikhiqizo yokudla kwe-GM. Abaphenduli abazange bakhombise ukwesaba mayelana nokuziphatha kwimikhiqizo yokudla kwe-GM, ngaphandle kokuthi nje le mikhiqizo ikhiqizwa ngendlela ephambene nomthetho. Abaphenduli abazange futhi bakhombise ukwesaba mayelana nodaba lokudliwa komkhiqizo wokudla kwe-GM,kuxutshwa phakathi ukuthandabuza mayelana nokuphepha kwale mikhiqizo kanye nalokho okungahle kuphazamise izinto eziphilayo. Abaphenduli baye bakhombisa ukuthi imizamo yokuthi kube nokudla okuningi ngokukhiqiza imikhiqizo yokudla kwe-GM, amathuba wokuphathwa yisifo somdlavuza ngemuva kokudla lokho kudla, ukungathandwa wukudla okuthize, ukunciphiswa kwezinga lokusebenziswa kwezibulalizinambuzane kanye nomphumela oyingozi phezu kwemvelo bekuyizinto ezihlobene nokudla kwe-GM lokho okuzoshintsha indlea yabo yokuthenga imikhiqizo yokudla kwe-GM. Izihibhe ezejwayelekile ezihlobene ne-GM eziye zashintsha isinqumo sabaphenduli sokuthenga imikhiqizo yokudla kwe-GM bekuxuba phakathi ukuphuma bayofuna ikakhulu imikhiqizo yokudla kwe-GM, luncane kakhulu ulwazi abanalo ngemikhiqizo yokudla kwe-GM, kuxuba ukungathandi imikhiqizo yokudla kwe-GM kanye nokungazi ukuba ngabe umkhiqizo wequkethe umkhakha we-GM noma akunjalo.

AMAGAMA ASEMQOKA

Imikhiqizo yokudla okuguquliwe; ulwazi lwengqubo; umqondo; izinqumo zokuthenga.

The supervisors and author of this dissertation cannot confirm the correctness of the two translated abstracts.

SUMMARY

The genetically modified (GM) food industry is growing rapidly (Deng *et al.* 2019) as the production of GM crops are being adopted by increasingly more countries around the globe (Gouse *et al*. 2016). One of the major benefits of producing GM food products is to increase food supplies which will aid in preventing food shortages (Cui & Shoemaker 2018). However, the GM food industry does not know enough about consumers' procedural knowledge and perception of GM food products as well as the factors that influence their purchasing decision, and therefore has a need for these to be explored and investigated in order to ensure that GM food products are purchased and consumed by consumers which will ultimately boost the production of GM food products and assist with food shortages.

Since procedural knowledge affects consumers' attitudes, opinions and purchasing decision, it becomes essential to understand the extent of knowledge that consumers have of GM food products (Mandal & Paul 2012). It is also important to determine which sources of information consumers use to acquire GM-related information to allow marketers to focus their advertising schemes on those respective sources. Exploring consumers' perception of GM food products is also important as perception shapes the beliefs and opinions of consumers, thereby influencing their purchasing decisions (Schiffman & Wisenblit 2019) and purchasing behaviour (Eneh *et al*. 2016). Visual perception also affects purchasing decisions as it allows consumers to gather and absorb information regarding a particular product (Miltgen *et al.* 2016), such as GM food products. By understanding consumers' procedural knowledge and perception, it will aid marketers in advertising GM food products more effectively. Furthermore, by establishing which factors influence consumers purchasing decision of GM food products, it could also allow marketers to use these factors in their advertising schemes in order to persuade and encourage consumers to increase their usage of GM food products. More information could also be provided on the factors that emerge in this study in order to further substantiate how the consumer feels, to rectify any misunderstandings on behalf of the respondents or to negate any negativity or concerns.

The aim of the study was to explore consumers' procedural knowledge and perception of GM food products as well as the factors that influence their purchasing decision, in which the Schiffman and Wisenblit (2019) consumer decision-making model was used to determine the decision-making process of consumers with regards to GM food products. The conceptual framework for this study was also based on the Schiffman and Wisenblit (2019) consumer decision-making model. A quantitative study was designed which incorporated an exploratory

and survey research design, in which non-probability sampling methods were applied namely purposive and snowball sampling, which gathered data by means of a questionnaire and included 326 respondents.

The respondents were not very knowledgeable about GM food products, although the respondents knew what the term “genetically modified” meant in terms of food products. The respondents had heard about GM food products and knew that GM food products were available to purchase in supermarkets, but were not sure which products had been genetically modified. The respondents also knew that maize had been genetically modified, but were not sure if soybean and rice had also been genetically modified. Overall, the respondents did not have a sound general knowledge of GM food products. Furthermore, the respondents did not have the need to look for any GM-related information from any source and were not sure which source was the most credible, although more belief was placed on the information presented by scientists.

There were no particular nutritional aspects of GM food products that the respondents showed a positive perception towards, but instead did not know how to perceive these aspects. The respondents showed fear towards the health-related aspects of GM food products such as possible cancer development, toxicity, allergic reactions, alterations in kidney functions, immune malfunction and infertility problems after consuming GM food products. Regarding the socio-economic aspects of GM food products, the respondents showed a positive perception towards the production of GM-related food products having the ability to increase food supplies, boosting the economy and using less pesticides. The respondents also perceived GM food products to have a longer shelf life. The respondents did not show fear towards the technological advancements that are used to produce GM food products, but did fear the altered genetic make-up of GM food products which could lead to having a harmful effect on the environment. Regarding the consumption-related aspects of GM food products, the respondents did not show fear towards the threat of it being risky and dangerous to all living things and scepticism towards the safety of GM food products.

The respondents highlighted that increased food supplies through the production of GM food products, possible cancer development after consumption, allergenicity, reduced usage of pesticides and harmful effect on the environment were all GM-related factors that would influence their purchasing decision of GM food products. The general GM-related barriers that influenced the respondents purchasing decision of GM food products included not looking out for GM food products in particular, knowing too little about GM food products, not having a

particular interest in GM food products and never knowing if a product contains a GM component or not.

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TERMINOLOGY LIST

This section provides the definitions of terms used in the dissertation in order to clarify the exact application of these terms when referred to in this study.

Artic Apple

A genetically modified apple containing a non-browning trait (Maxmen 2017).

Aqu Advantagea

A genetically modified Atlantic salmon (Benessia & Barbiero 2015).

***Bacillus thuringiensis* (Bt)**

A naturally occurring bacterium, commonly used as a biological pesticide (Kotey *et al*. 2016).

Biodiversity

Variety of plant and animal life on Earth (Garcia-Yi *et al.* 2014).

Biotechnology

Is a technology used to manipulate the genetic material of crops or organisms for a pre-identified purpose (Gastrow *et al*. 2018).

Climate Change

A change that occurs in climate patterns, often resulting in extreme temperature and weather conditions (Qaim & Kouser 2013).

DNA

Deoxyribonucleic acid, present in all living things (Puhan 2018).

Ecosystem

A community of living organisms living together in a specific area (Garcia-Yi *et al.* 2014).

Environmental Health

Refers to the condition of the environment, particularly regarding diversity or pollution (Dinneny 2018).

Erwinia Uredovora

A type of bacteria that is pathogenic to plants (Kramkowska *et al.* 2013).

Flavour Saver Tomato

A genetically modified tomato which was the first food product to be genetically modified for human consumption (Zhang *et al.* 2016).

Food Production Systems

Food production systems refer to the production system which includes all processes and infrastructure involved in feeding a population such as growing, harvesting, processing, packaging, transporting, marketing, consumption and disposal of food and food-related items (Ruben *et al.* 2019)

Food Security

Having a sufficient amount of affordable and nutritious food available to consumers (Qaim & Kouser 2013).

Genetic Modification

An organism or crop consisting of genetic material that has been altered in order to possess a specific characteristic (Zhang *et al.* 2018).

Golden Rice

A genetically modified variety of rice which contains high levels of vitamin A and iron (Qaim & Kouser 2013).

Macronutrient

A substance that is required in large amounts in a diet (Hefferon 2015).

Malnutrition

A condition commonly caused by an insufficient intake of nutritious food (Zhang *et al.* 2016).

Nutrition

Process of consuming foods for adequate growth and health (Hefferon 2015).

Orphan Food Crops

Crops that are produced in large quantities and consumed by local communities (Mabhaudhi *et al.* 2019).

Perception

Involves the use of sensory impressions to shape a particular view which subsequently guides consumer's behaviour in general (Eneh *et al.* 2016).

Photosynthesis

A process in which plants make use of sunlight to synthesise nutrients (ISAAA 2019).

Procedural Knowledge

Refers to the personal knowledge that consumers have which is represented by consumers' habitual actions (Boshoff 2015).

The Food and Drug Administration (FDA)

Is a federal agency of the Department of Health and Human Services in the USA (Bawa & Anilakuma 2013).

Ring Spot Virus

A type of plant disease caused by a virus (Bawa & Anilakumar 2013).

Staple Foods

Foods that are consumed frequently and forms a large portion of a standard diet (Hefferon 2015).

LIST OF ACRONYMS

GM	Genetically Modified
Bt	*Bacillus thuringiensis*
USA	United States of America
USDA	United States Department of Agriculture
F&B	Food and Beverage
EFA	Exploratory Factor Analysis

CHAPTER 1

INTRODUCTION

The purpose of an Introduction chapter is to present the reason and need for the study. It is a discussion of how the study aims to satisfy the aim and objectives (Iskander *et al.* 2018).

This chapter introduces the research in terms of the background, problem statement, justification for the research and the research aim and objectives. It also briefly describes the research methodology, the ethical clearance obtained for the study and presents an outline of the dissertation.

1.1 INTRODUCTION AND BACKGROUND

Genetically modified (GM) food products are becoming increasingly popular in the food industry, particularly due to the various benefits of these products (Singhal 2018). In 1983, the first GM plant was created by producing an antibiotic-resistant tobacco plant, and in the 1990s, China was the first country to produce and sell a transgenic crop, namely virus-resistant tobacco (Bawa & Anilakumar 2013). The Food and Drug Administration (FDA) in the United States of America (USA) decided to accept and approve tomatoes known as the 'Flavour Saver Tomato' in 1994, which was genetically modified in such a way as to slow the ripening process after being picked (Abbas 2018). After this approval occurred, many other food products had their genetic material altered, such as corn, cotton, potatoes, canola, soybeans, squash, strawberries, tomatoes, papaya, rice and brinjals (Verma 2013, Chondie & Kebede 2015; Tanius & Seng 2015). In Africa, South Africa was the first country to produce and sell a naturally occurring bacterium known as *Bacillus thuringiensis* (Bt) cotton in 1997, Bt maize in 1998, and GM soybeans in 2000 (Kotey *et al*. 2016). Also in South Africa, GM food products such as sugarcane, maize, sugar beet, strawberry, tomato, potato and sweet potatoes are available in supermarkets (Wray 2017).

In 2013, 18 years after the commercialisation of GM crops were approved, 175.2 million hectares of land worldwide was used to grow GM crops, which is 5.2 million hectares more compared to 2012. These figures consequently show that the production of GM crops is rapidly increasing each year (Hefferon 2015). This is particularly evident in the South African context

as South Africa is ranked ninth as a worldwide GM food producer; the country has grown GM maize on approximately 20 million hectares from the years 2000-2015, which has resulted in a yield of over 50 million tons of GM maize. Therefore, biotechnology is considered the fastest-growing crop-related technology worldwide and in South Africa (Bennett 2016). These crops were not part of the food chain for many years, yet South African consumers are currently consuming foods that have been genetically modified without being aware of the existence of such products, as in the case of maize, porridge, corn flakes and soy (Jaffer 2014).

The genetic material of food products is genetically modified for various reasons. These include increasing crop yield, improving taste, ensuring longer shelf life, producing better quality food products, and reducing the usage of herbicides and insecticides (Deffor 2014). The production of GM food products also has the potential to assist in food security by allowing a larger portion of the population to have access to and availability of food in the future. This is seen as a major benefit of GM food products, particularly considering the negative impact that climate change is believed to have on food production and supplies (Qaim & Kouser 2013). Furthermore, the consumption of GM food products can assist consumers in successfully meeting their nutritional requirements on a daily basis as staple food products such as maize and rice have been genetically modified in order to increase their original nutritional content (Bawa & Anilakumar 2013). The mentioned staple food products (maize and rice) are already available in South Africa for human consumption, and many South African brands, namely Nyala, Ace, White Star, Tiger Brands, Pioneer Foods and Premier have adopted biotechnology to increase the nutritional content of these food products (Jaffer 2014).

Consumer concerns relating to GM food products are important to establish as these concerns inadvertently affect consumers' purchasing decisions of GM food products in the long run (Hingston & Noseworthy 2018). A study was conducted by Rzymski and Krolczyk (2016) in Poland on students at universities, at schools, among farmers and scientific societies by means of an online survey with the intention of establishing consumers' attitudes to GM organisms. The results showed that health-related concerns emerged that affected the respondents' attitudes, including allergic reactions, toxicity, immune malfunction, alternations in kidney function as well as fertility issues. A concern towards the possible negative effect on the environment also emerged from the study. Therefore, it is important to determine the procedural knowledge and perception that consumers have of GM food products in order to establish on what basis these concerns, if any, are formed.

Procedural knowledge is a type of knowledge that involves the process in which consumers use their pre-existing knowledge (Saricam & Okur 2019) to perform a specific task (Genc *et al.* 2019). Therefore, the already acquired knowledge and information can lead to the formation of opinions, awareness and attitudes (Hoque *et al.* 2018) of GM food products. Investigating consumers' procedural knowledge of GM food products will be an indication of their previously acquired information of GM food products, which will also shed some light on their prior experiences with GM-related food products due to the interlinking relationship between prior experience and acquired knowledge. The procedural knowledge could also demonstrate – to a certain extent – whether consumers have any sort of awareness of GM food products. Consequently, procedural knowledge is directly linked to purchasing decisions and it is important to determine consumers' procedural knowledge as it can assist in increasing the understanding of consumers' behaviour in the process of deciding whether to purchase GM food products.

Conceptual knowledge, another type of knowledge, also affects consumer purchasing decisions. In this context, it involves the understanding that consumers have (Zuya *et al.* 2017) of GM food products, which consumers use to understand the concept of GM food products. Subjective knowledge is also a type of knowledge which refers to how much a consumer thinks they know (Han 2019) about GM food products. This affects their beliefs of the product which then also influences their decision-making process (Redman & Redman 2016). Therefore, by presenting consumers with questions or statements that will trigger their subjective knowledge of GM food products, it could demonstrate what consumers think or perceive they know about these products. This will also be a great indication of the extent or level of knowledge that consumers have specifically relating to GM food products.

Perception refers to the individual belief or opinion that consumers have towards a specific product (Rebeka & Indradevi 2015) such as GM food products. Therefore, determining consumers' perception of GM food products assist in establishing how consumers feel about such products. This is essential as consumers are able to perceive newly developed products, such as GM food products, negatively or positively (Wunderlich & Gatto 2015). The perception that consumers have towards GM food products is closely linked to the risks and benefits of these products; this may, in turn, affect consumers' purchasing decision of GM food products (Zhang *et al*. 2018). Furthermore, a study was conducted in Kenya by Bett *et al.* (2014) to determine which factors influence consumers' perception of the consumption of GM food products. The results showed that the safety of GM food products, nutritional content and knowledge of GM food products had an influence on consumers' perception of these products. However, it is imperative to understand the foundations on which perceptions are formed as

perception is related to the knowledge the consumer has of aspects, such as GM food products. There are various factors that also affect consumers' procedural knowledge and perception of GM food products, and therefore it is important to explore these factors to ultimately gain a better understanding of consumers' purchasing decisions (Bawa & Anilakumar 2013). This is essential as purchasing decisions is one of the best predictors of consumers' behaviour (Han & Harrison 2016).

1.2 PROBLEM STATEMENT

The production of GM food products has generally brought about a positive revolution in the food industry, particularly in terms of food security and consumers' nutritional wellbeing, which contributes to consumers purchasing more GM food products (Deffor 2014). Deffor (2014) also suggests that the risks and benefits of GM food products are the foremost factors that influence consumers' decision to purchase such products; however, it is still not certain if consumers know and are aware that they are in fact purchasing GM food products. Several authors agree that the various risks and benefits associated with GM food products may also positively or negatively influence consumers' purchasing decisions of these products (Kikulwe *et al*. 2011; Deffor 2014; Rzymski & Krolczyk 2016). Generally, the positive factors outweigh the negative factors associated with GM food products, but consumers may still have a cynical opinion based on their concerns (Dizon *et al.* 2016). Although studies have been conducted to determine consumers' procedural knowledge and perception specifically relating to GM food products in other countries (Mandal & Paul 2012; Wunderlich & Gatto 2015; Hassan *et al*. 2016), research in this regard is limited in South Africa.

In order to ensure food security and to produce food products with enhanced favourable traits, such as being drought resistant, having a longer shelf life and superior taste, it is crucial that consumers accept GM food products and thereby hold a more favourable perception of such products. South Africa is known to be culturally diverse, and therefore South African consumers have various expectations and needs of the food products they purchase (Peter & Karodia 2014). These include high quality, shelf life, taste and nutritional content (Bawa & Anilakumar 2013; Rosculete *et al.* 2018; Shetty *et al.* 2018). Such expectations or needs are largely influenced by consumers' procedural knowledge and perception of GM food products, which is not well determined within the South African context.

Consumers' knowledge of GM food products alters their perception of such products. Those with limited knowledge may perceive food products produced by biotechnology as being high risk and ethically wrong, which could simultaneously have an effect on their purchasing

behaviour (Gastrow 2018). However, consumers with adequate knowledge are known to possess a better understanding of the potential that GM food products hold, particularly concerning nutritional wellbeing and food security, which will positively influence their purchasing behaviour (Hassan *et al*. 2016). Javeed *et al*. (2017) also highlight the fact that consumers make use of their existing knowledge to form a perception of GM food products. This emphasises the fact that procedural knowledge and perception is a driving force of consumers' purchasing behaviour (Parumasur & Roberts-Lombard 2014). However, in the South African context, procedural knowledge and perception have not been determined in terms of their influence on the purchasing decisions of South African consumers.

Consumers purchase various types of food products based on different motivations and influences (Schiffman & Wisenblit 2019). Consequently, these factors can ultimately affect whether or not consumers purchase GM food products (Lucht 2015). As previously mentioned, the various risks, benefits, as well as procedural knowledge and perception of GM food products influence consumers' purchasing decisions thereof, but this is unknown in the South African context, which this study aims to identify. Gouse *et al*. (2016) conducted a survey study in KwaZulu-Natal, South Africa, in order to establish the degree to which the gender of smallholder farmers affects the adoption of GM maize. Kotey *et al*. (2016) also conducted a study in the Eastern Cape, South Africa, to ascertain the awareness that extension personnel have pertaining to GM maize technology and the extent to which they disseminate the use of GM seeds in the agricultural industry. Evidently, studies have been conducted on the effect and usage of GM maize in South Africa from an agricultural perspective, yet limited studies have been conducted on GM foods from the consumers' perspective.

Gastrow *et al*. (2018) conducted a study in South Africa by means of a survey to establish consumers' understanding and knowledge of biotechnology. The study included a variety of participants from different socio-demographic groups, education, income, racial groups and geographical locations. Another study was carried out in Gauteng, South Africa, by using a survey to establish urban South Africans' attitudes and acceptance of GM white maize (Vermeulen *et al.* 2005). Similarly, Lanzillotti (2007) used a survey to conduct a study in South Africa at the University of South Africa to establish consumers' attitudes towards food biotechnology. In order to establish consumers' acceptance of GM food products, Peter and Karodia (2014) conducted a study in the Chris Hani District Municipality in South Africa using six focus groups and surveys. Thus, studies have been conducted specifically focusing on biotechnology or the attitudes and acceptance of GM food products, or only one specific GM food product. However, limited studies have been conducted in South Africa particularly regarding consumers' procedural knowledge and perception of GM food products in general

and the factors that influence their purchasing decision, specifically focusing on consumers from smaller geographical areas.

Furthermore, various studies have been conducted internationally in urban areas based on consumers' opinions, views, perception and knowledge regarding their purchasing and consumption behaviour of GM food products (Mandal & Paul 2012; Deffor 2014; Todua *et al.* 2015; Vecchione *et al*. 2015; Eneh *et al.* 2016; Lopez *et al.* 2016; Popek & Halagarda 2017), but a limited number of studies have been conducted in rural areas. As a result, there is uncertainty as to how South African consumers perceive GM food products as well as the extent and level of their knowledge of GM food products. Therefore, the overall purpose of this study was to gain deeper insight into the procedural knowledge and perception that consumers have regarding GM food products, as well as the degree to which the various factors of such food products influence consumers' purchasing decisions of these products in a more rural setting, rather than a densely populated urban environment.

1.3 JUSTIFICATION FOR RESEARCH

As mentioned in Section 1.2, studies have been conducted in the South African context, but from an agricultural and biotechnology perspective or only focused on attitudes and acceptance of GM food products. Very little research has been done in the South African context to understand what consumers know and perceive GM food products to be. This study could fill the current gap in this regard by considering the procedural knowledge and perception, as well as factors that influence consumers' purchasing decision of GM food products. However, although this study used a very limited sample from a rural setting, it will still contribute to a better understanding of the concepts particular to this study.

This study will approach two behavioural influences, namely the procedural knowledge and perception of consumers towards GM food products. More specifically, the study will aim to determine what underlying drivers exist within each of these components that come forward when the consumer is confronted about their knowledge and perception of GM food products. Such drivers may point to important aspects that need to be addressed, such as lack of knowledge or fear of technology when dealing with GM food products, and information related to GM food products.

There are several factors that may influence the purchase decision of GM food products. The importance of determining these factors is found in its relationship to the consumer's decision to purchase GM food products or not. As this study aims to present several factors stemming

from literature to evaluate how these influence the purchase decision, it will offer the respondents the opportunity to give their opinion about the aspects that are more likely to influence their decision to purchase GM food products. The factors will therefore not be derived from analysis procedures but from an evaluation by the respondents. Underlying these factors may be very pertinent elements that could represent the way in which the respondents consider these factors where GM food products are concerned.

The contribution of this study is also specific to the relationship that it is looking at between procedural knowledge and the factors influencing the decision-making process. The relationship between perception and the factors influencing the decision-making process is also determined, as well as the relationship between procedural knowledge and perception. Through these relationships, it could be possible to determine whether any of these behavioural elements will have an influence on consumers' decision to purchase GM food products.

What consumers know and understand does influence their decision to purchase a product, and therefore their purchasing decision. Marketers and product development specialists may find the contribution of this study useful in developing information and food products containing GM information. From this study it might be possible to identify the information that may be necessary to inform consumers' about GM food products and the GM-related developments.

1.4 RESEARCH AIM AND OBJECTIVES

The aim of the study was to explore consumers' procedural knowledge and perception of genetically modified (GM) food products and the factors that influence their purchasing decision. To achieve this aim, four objectives were formulated as follows:

1. To explore consumers' procedural knowledge of GM food products by determining:
    a. Consumers' general knowledge of GM food products.
    b. The sources of information pertaining to GM food products.
    c. The latent factors of procedural knowledge (general knowledge and sources of information) within GM food products.
2. To explore consumers' perception of GM food products in terms of:
    a. Nutritional aspects of GM food products.
    b. Health aspects of GM food products.
    c. Socio-economic aspects of GM food products.
    d. Product quality-related aspects of GM food products.

e. Ethical aspects of GM food products.
f. Consumption aspects of GM food products.
g. The latent factors of perception (nutritional aspects (2a), socio-economic (2c) and product quality-related (2d) as well as health (2b), ethical (2e) and consumption aspects (2f)) within GM food products.

3. To identify the factors that influence the purchasing decisions of consumers in terms of:
    a. GM-related factors.
    b. GM-related barriers.
    c. The latent factors from the GM-related factors and GM-related barriers that influence the purchasing decision of GM food products.
4. To identify any significant relationship between the following:
    a. Procedural knowledge of GM food products and the factors that influence the purchasing decision of GM food products.
    b. Perception of GM food products and the factors that influence the purchasing decision of GM food products.
    c. Procedural knowledge and perception of GM food products.

1.5 RESEARCH DESIGN AND METHODOLOGY

A quantitative paradigm was used to explore the procedural knowledge and perception of GM food products as well as the factors that influence consumers' purchasing decision based on feedback from 326 respondents. The quantitative paradigm also guided the researcher in obtaining information from the respondents by capturing numerical data in order to examine the objectives of the study. An exploratory and survey research design was used in this study as there are a limited number of studies that have been conducted in South Africa particularly focusing on consumers' procedural knowledge and perception of GM food products, as well as the factors that influence their purchasing decision of such products.

The non-probability sampling strategies used for this study included purposive and snowball sampling strategies. In order to recruit respondents, questionnaires were distributed to various businesses and to staff at schools situated in the study location, which is Mooi River, KwaZulu-Natal. Respondents were asked to share the names of acquaintances who would also be able to complete questionnaires, in order to create a snowball sample.

Survey data were gathered through a structured, self-administered questionnaire by physically distributing the questionnaires through a data collection method known as group-administered

questionnaires. The questionnaire was designed to gather data specifically relating to the procedural knowledge and perception that consumers have towards GM food products. Survey questions were also designed to determine which factors influence consumers' purchasing decision of GM food products, such as the reduced price of GM foods, increased nutritional value, longer shelf life, availability of food in different colours, reduced usage of herbicides, and possible allergic reactions, to name a few.

Statistical analysis was done using descriptive and inferential analysis. The descriptive statistics included frequencies, percentages, central tendency (mean) and standard deviation. The inferential analysis included determining the normal distribution of the quantitative data sets by using the Shapiro-Wilks test. The data were presented by means of tables in which percentages and the n-value were indicated for each statement. Exploratory factor analysis (EFA) was performed to reveal the main elements that form knowledge of GM food products in the acquisition of information of GM food products; perception-related aspects of GM food products; the GM-related factors that influence the purchasing decision of GM food products; and the general GM-related barriers that influence the purchasing decision of GM food products. Simple linear regression was performed to determine if there was any significant relationship between procedural knowledge and the factors that influence the purchasing decision, as well as to determine if there was any significant relationship between perception and the factors that influence the purchasing decision. Moreover, simple linear regression was conducted to determine if there was a significant relationship between procedural knowledge and perception of GM food products.

1.6 ETHICS

The research adhered to ethical requirements as stipulated by UNISA in its *Policy on Research Ethics* during the research process. The research proposal was approved by the Health Research Ethics Committee of the College of Agriculture and Environmental Science at UNISA for approval before the study commenced. The CAES Ethics Approval is attached as Appendix B (Reference Number: 2018/CAES/162). Data were only gathered after ethical clearance was received. Anonymity was ensured by not making use of the names of the respondents thus also respecting the privacy of their information. The data was not shared with anyone else, other than the supervisors. Respondents were informed of the purpose of the study and what was expected of them, that participation was completely voluntary, that they were not obliged in any way to participate in the study, that withdrawal from the study at any given time was allowed without penalty, and that feedback would be given upon

completion of the study. The information was captured in the consent form that the respondents signed (as seen in Appendix C).

1.7 OUTLINE OF THE DISSERTATION

This dissertation is presented in six chapters and can be described as follows:

Chapter 1: Presents the introduction of the study and includes the background, research problem, the aim and objectives of the study. This chapter also offers a brief description of the research method, which includes the data gathering methods that were used and the ethical clearance obtained.

Chapter 2: Presents a literature review on the background of genetic modification, GM food production systems, labelling regulations and policies of GM food products, and the benefits, risks and concerns of GM food products as well as consumer research that has been conducted.

Chapter 3: Discusses consumer purchasing behaviour, which includes procedural knowledge and the consumer learning process, as well as the perception and perceptual process. The chapter then explains the consumer decision-making model using the Schiffman and Wisenblit (2019) model which is also the proposed schematic conceptual framework of this study.

Chapter 4: Describes the research methodology that was used in this study. The chapter gives a description of the quantitative paradigm, the type of study, the geographic location of the study, the respondents (inclusion criteria), the sampling strategies used, as well as the instrument, data collection method, data analysis, reliability and validity in order to determine data quality in this study.

Chapter 5: This chapter presents the descriptive and inferential results obtained from the research. The results are presented and discussed as set out in the aim and objectives of the study.

Chapter 6: Concludes the research and makes recommendations for further research. The findings are presented in the context of the conceptual framework, as well as the contributions and limitations of the study. Recommendations are made to the GM food industry based on the research findings specifically pertaining to the procedural knowledge and perception that

consumers have towards GM food products and the factors that influence their purchasing decision. This chapter also suggests where further research is needed.

1.8 ACADEMIC-RELATED INFORMATION

In this dissertation, the Harvard referencing style was used. This dissertation was also submitted through the Turn-it-in plagiarism software program of which the certificate is included in Appendix E. A publication stemming from this study will also be drafted and submitted to an accredited journal. A local conference presentation will be considered in order to disseminate the information.

1.9 CONCLUSION

In this chapter, the researcher presented the reader with an introduction including the background of the study, the problem statement, justification for the research, research aim and objectives, brief methodology, ethical clearance obtained for this study, the dissertation layout and academic-related information. The following chapter will present the literature review which will discuss the background of genetic modification, GM food production systems, labelling regulations and policies, the benefits, risks and concerns of GM food products and consumer research conducted pertaining to GM food products.

CHAPTER 2

LITERATURE REVIEW

The purpose of a Literature Review chapter is to present information and discuss studies that have been conducted (Mudavanhu 2017).

In this chapter, a literature review of the background of genetic modification, the GM food production systems, labelling regulations and policies, the benefits, risks and concerns of GM food products and consumer research conducted pertaining to GM food products are presented.

2.1 INTRODUCTION

In general, GM food products are continually growing in the food industry and are therefore becoming readily available in supermarkets (Deng *et al.* 2019). However, the debate around the GM food production system and the consumption of GM food products continues (Chagwena *et al.* 2019). Consumers are becoming increasingly interested to know more about the products they consume and are growing more concerned about newly developed food products on the market, such as those containing GM elements due to the manner in which these products are manufactured (Singhal 2018) and what the products contain (Wunderlich & Gatto 2015). Of consumer concern is the potential negative effect that a GM-related food production system may have on the environment and possible unforeseen health risks and allergenicity effects on consumers (Deffor 2014), to name a few. The introduction of genetic modification to the food production system has allowed producers, manufacturers and consumers to benefit from the production and consumption of these food products, although the disadvantages and consumers' concerns associated with GM food products may still hinder the purchasing and consumption of these products. To provide a pertinent background to the subject field of GM food products, it is necessary to define and describe genetic modification.

2.2 BACKGROUND TO GENETIC MODIFICATION

2.2.1 Definition of 'Genetically Modified'

In 1946, scientists discovered that DNA could be transferred from one organism to another (Raman 2017). Since this discovery, various species of plants, crops and bacteria have been genetically modified and is believed to have been adopted by many farmers and producers of GM food products (Brookes & Barfoot 2018). A genetically modified, or the genetic modification of plant food products, refers to plant-based foods that have been produced from plant material of which a genetic composition (a component of the plant material) has been altered to produce a particular characteristic (Ruiz *et al.* 2018). Therefore, this component has undergone a process in which certain identified genes have been introduced and placed into a component of the plant material in order to give the plant specific characteristics (Zhang *et al.* 2018). The modified characteristics may result in longer shelf life, improved taste and enhanced nutritional content (Rosculete *et al.* 2018) among others. As a result, patented plant products can be developed (Paull 2018).

Therefore, genetic modification is the result of the use of technology to modify the genetic make-up of plants or bacteria, commonly known as biotechnology (Eneh *et al*. 2016). Biotechnology is also referred to as a technological application to the genetic material of plants or animals with the intention of altering particular characteristics for a previously identified purpose (Abbas 2018). Evidently, the process of genetic modification gives rise to the production of plant material which occurs in an unnatural manner through the manipulation of genetic components of the specific organism (Zhang *et al*. 2016). The final product can then be referred to as being "genetically modified", "genetically engineered" or "transgenic" (Eriksson 2018).

Within the food production system, genetic modification is being implemented in order to, for example, produce plant-based foods at a quicker rate that are better tasting and contain more nutrients (Lamichhane 2014). Many genetically modified crops that contain novel traits are being used for commercial agricultural production. These include herbicide, pest and insect resistance (Anderson *et al.* 2019), with the main crops in South Africa currently under commercial cultivation being soybean, maize, cotton and canola (Chondie & Kebede 2015).

2.2.2 History of GM Food Production in Various Countries

Food production systems refer to the production system that includes all processes and infrastructure involved in feeding a population, such as growing, harvesting, processing, packaging, transporting, marketing, consumption and disposal of food and food-related items (Ruben *et al.* 2019). It specifically includes GM plant material and is continually growing (Deng *et al.* 2019). This allows and encourages producers worldwide to plant and grow GM crops (Eneh *et al*. 2016). With the transfer of genetic material already established in 1946 (Zhang *et al.* 2016), as reflected in Section 2.2.1, the first set of GM seeds were planted and produced in the United States of America (USA) in the 1980s (Wunderlich & Gatto 2015). However, during this time and in the years to follow, Lucht (2015) highlights that USA consumers showed limited or no concern at all towards GM-related food products as well as biotechnology, which could be due to their superficial knowledge and awareness of GM food products or that it was not something they were interested in engaging with. However, USA consumers still purchased GM plant food products, possibly due to their lack of knowledge and awareness of these products (Lucht 2015). A decade later, GM plants were being produced on approximately 90 million hectares of agricultural land across the world (Peter & Karodia 2014). Between the years 1996 and 2011, the total area used to cultivate GM crops increased from approximately 1.7 million hectares to approximately 159 million hectares. In 2012, GM crops were planted in 28 countries, and it was the first year in which developing countries grew the majority of GM crops in the world (52%). Moreover, in 2012, 17.3 million farmers in developing countries grew GM crops, of which approximately 90% were small hold farmers (Chondie & Kebede 2015). In 2015, a staggering 172 million hectares of land was used to cultivate GM crops, which celebrated the twentieth year since GM crops were produced (Brookes & Barfoot 2017).

In 2016, the global land used for the production of GM crops reached 185.1 million hectares (Cui & Shoemaker 2018), and in the year 2017, 24 countries worldwide grew 189.8 million hectares of GM crops, largely consisting of soybean, cotton, maize and canola. It was also documented that from 1992 to 2017, the regulatory authorities handed out 4133 approvals for 29 GM crops, which clearly exhibits how quickly the GM industry has grown and will continue to grow in the future (Boutigny *et al.* 2019). This attributes to the fact that GM crops are known to be the fastest adopted agricultural technology across the globe (Gouse *et al*. 2016). As a result, over the years, components of soybeans, rice, cotton, maize, canola and sugar beet plant materials have been genetically modified, and products from these modified materials are currently available for consumers to purchase and consume (Brookes & Barfoot 2017).

Currently, the USA is the top producing country of GM crops as approximately 90% of their farmland is used to produce GM corn, GM soybean and GM cotton (Wunderlich & Vecchione 2014), together with four other countries that are principle growers of GM crops namely the USA with 47.6 million hectares, Argentina with 16.2 million hectares, Canada with 5.4 million hectares, and Brazil with 5 million hectares (Chondie & Kebede 2015). Many of the crops grown and produced in the USA have been genetically modified in order to make these crops resistant to insects (Armenakas & Alexiades-Armenakas 2013), which has led to increased revenue of these crops (Wong & Chan 2016). Moreover, 80% of the food products available for consumption in the USA consist of GM components (Wunderlich & Vecchione 2014). The USA is the largest producer of GM soybean, followed by Argentina and Canada, and also the largest producer of GM corn, followed by Canada (Ma 2015). According to Chondie and Kebede (2015), other countries such as Australia, India, China, Spain, Uruguay, Mexico, Romania and the Philippines are also growing GM crops. This type of production has the potential to continue growing annually as countries worldwide – including Sudan and Cuba – are adopting this technology, known as biotechnology (Wunderlich & Vecchione 2014; ISAAA 2017).

2.2.3 History of GM Food Production Systems in South Africa

South Africa has embraced the adoption of GM crops and is currently the world's ninth-largest producer of such crops (Hefferon 2015). Until 2008, South Africa was the only country to produce GM maize, GM cotton and GM soybean in Africa (Goitom 2014). However, since then, Egypt started growing GM maize, and Burkina Faso started growing GM cotton (Chondie & Kebede 2015). In the South African context, GM white maize was commercialised in 2001, which is known to be the first GM crop used for direct human consumption (Gouse *et al*. 2016). In 2013, statistics showed that 86% of the maize produced in South Africa was GM (Schneider 2016) and South Africa also commercialised GM cotton and soybean (Hefferon 2015). Schneider (2016) explained that insect-resistant cotton was the first GM crop to be grown in South Africa in 1997 and now accounts for more than 95% of the cotton produced in the country. Furthermore, Schneider (2016) stated that herbicide-tolerant soybean has been grown in the country since 2001 and now contributes to 85% of soybean cultivated. These statistics show that the GM industry in South Africa is expanding (Goitom 2014); this demonstrates South Africa's potential in producing larger quantities and a larger variety of GM crops in the future, resulting in more GM-related food products to be available to consumers.

In 2016, South Africa planted 2.66 million hectares which included 2.16 million hectares of GM maize, 494 000 hectares of GM soybean and 9000 hectares of GM cotton. This contributed to

a 16% increase from the 2.29 million hectares planted in the year 2015 (Anon 2017). Anon (2017) further explains that the average maize yield in South Africa is approximately 5.95 ton per hectare per year, which is said to be the highest national maize average in Africa. Moreover, in the year 2017, a 22% larger area was used to plant GM maize which is equivalent to 2.16 million hectares (Anon 2017). South Africa also aims to produce more maize using less land through GM crops (Goitom 2014).

South Africa has approved its staple food products, namely maize and rice, to be genetically modified, making this country unique compared to other countries that have not genetically modified all of their respective staple food products (Schneider 2016). As of 2013, 86% of the maize crop produced in South Africa is GM and is commonly found in various milled maize products sold through different brands such as Ace, White Star, Iwisa Super Maize Meal, Tiger Brands, Pioneer Foods and Premier (Jaffer 2014). Figure 2.1 shows the percentage of GM components found in each of these maize products from the different brands, considered a staple food for many South African consumers (Anon 2017).

Figure 2.1: Maize Products Containing a GM Component (Jaffer 2014)

These products make up 73% of the maize meal market (Jaffer 2014). There are also other GM food products available in South African supermarkets for human consumption, such as sugarcane, maize, sugar beet, strawberry, tomato, potato and sweet potato (Wray 2017). It is thus evident that more and more food products available for purchase in supermarkets have undergone genetic modification (Schneider 2016).

2.3 LABELLING REGULATIONS AND POLICIES ON GM FOOD PRODUCTS IN SOUTH AFRICA AND OTHER COUNTRIES

The labelling laws of GM food products differ from country to country. In the USA, the labelling of food products containing a GM component is not mandatory unless the product is considerably different in nutritional or safety characteristics (Dizon *et al.* 2016). Australia, the European Union, Japan, South Korea, South Africa and Indonesia have implemented mandatory labelling of all GM food products that contain a GM component, while Canada and Argentina have voluntary labelling policies pertaining to GM-containing food products sold in supermarkets (Wunderlich & Vecchione 2014). The European Union has implemented a strict labelling policy resulting in any food product containing a value of 0.9% of GM components to be labelled, Australia's labelling policy requires a value of 1%, as in New Zealand, with Japan requiring a 5% value of GM components to be labelled (Byrne *et al.* 2019).

In 2008, the labelling laws pertaining to GM foods evolved in South Africa and the current labelling policy states that if a food product contains more than 5% GM components, it is mandatory for the food product to be labelled (Wunderlich & Vecchione 2014). South African consumers are primarily informed about the presence of GM ingredients in a food product through text, and not pictures or symbols which could in fact ease the communication of GM ingredients or components. This could be problematic as consumers do not frequently read food labels (Goyal & Deshmukh 2018). There are three types of mandatory labels that are commonly used to indicate the presence of a GM ingredient, namely "containing GMOs" if the GM value is 5% or more, "produced using genetic modification" if the food was produced straight from a genetically modified organism (GMO) source, and "may contain GMOs" when it is not practical to test for a GM component or ingredient in the specific food product (Gouws & Groenewald 2015). There are, however, also voluntary labelling pertaining to GM food products. If the GM value is less than 1%, the food products can be labelled as "does not contain GMOs", if the GM value ranges between 1% and 5%, the label could say "GM content is less than 5%", and if no GM content can be found in the food product, the label could say "may contain genetically modified ingredients" (Gouws & Groenewald 2015). It is evident that more and more countries are implementing labelling policies specifically pertaining to GM food products as consumers have a right to know what they are consuming (Sebastian-Ponce *et al.* 2014). There are two symbols that the United States Department of Agriculture (USDA) have approved to be used on the packaging of GM food products in order to allow consumers to recognise products that contain GM ingredients (Shreeves 2018), as seen in Figure 2.2.

Figure 2.2: Two Symbols Approved by the USDA for Foods made with Bioengineered Ingredients (Shreeves 2018)

A study on consumers' beliefs regarding the labelling of GM food products was conducted in the USA by McFadden and Lusk (2016) who used a nationwide online survey. The study concluded that 84% of the respondents felt that any food product containing a GM component should be labelled. Another study conducted by Wunderlich and Gatto (2015), using a survey sent to students at the Rutgers University in the USA, was conducted to determine consumers' desire for labelling on food products that contain a GM component; it was established that 73% of the respondents felt that products that had been genetically modified should be labelled. In order to establish consumers' awareness of GM food products, a study was carried out in Klang Valley, Malaysia, using a survey (Tanius & Seng 2015). The respondents indicated that they felt they had the right to know what ingredients were used in GM food products and therefore what GM food products consist of. Consumers want to know if they are consuming a GM or non-GM containing food product, however, consumers are unsure how to distinguish between the differences of GM and non-GM food products. Consequently, not being aware of the ingredients GM food products consist of, possibly due to insufficient labelling, may influence whether consumers purchase GM food products.

Another survey was conducted on consumers' behaviour and attitude to purchasing GM food products in Europe by Sleenhoff and Osseweijer (2013). It was concluded that 50% of the respondents stated they would not purchase a food product if the label indicated that the product contained a GM component. These results were echoed in a study conducted by Lefebvre *et al.* (2019) in the USA via an Internet survey method; it was established that if a product contained a GM label, consumers showed negative associations towards the product which simultaneously negatively affected their purchasing behaviour of GM food products. Although this might be the case, Pham and Mandel (2019) proposed that GM messages which emphasise the benefits of GM-containing food products, such as the improvement of human health and environmental benefits, could result in consumers being more likely to buy GM food

products as opposed to the counterparts of GM food products. However, Sleenhoff and Osseweijer (2013) also mentioned that it is becoming more evident that consumers are inclined to demand labels on GM food products as this enables them to make informed decisions while purchasing, since labelling does have an effect on consumers' purchasing behaviour and decisions (Popek & Halagarda 2017).

2.4 BENEFITS OF GM FOOD PRODUCTS

GM food products have the ability to assist in addressing major challenges that the world is currently experiencing through climate change, food insecurity and nutritional deficiencies (Zilberman *et al.* 2018). The most succinct benefits and effectivenesss of the adoption of GM plant-based food products are presented in the following sub-sections.

2.4.1 Food Security and Increased Crop Yields

The process of genetic modification is known by many as the pathway to the future of food production (Deng *et al.* 2019), largely due to the fact that these food products hold the potential to ultimately assist in addressing food insecurity while hosting various other benefits (Deffor 2014). It would therefore be interesting to determine if consumers are, in fact, knowledgeable about the impact that GM food products may have on food security. It is expected that by 2050, the world's population would have reached 9.7 billion (Rahman 2017), resulting in the demand for food simultaneously rising; this poses a great threat to food production and supplies (Dizon *et al.* 2016). Unfortunately, the agricultural area that is used to produce crops is not increasing, and food production and supplies are thus struggling to meet the rapidly growing demand of the world population (Husaini & Sohail 2018). It is thus evident that the gap between the worldwide supply and demand for food will be increasing, although it can potentially be filled by the agricultural production of GM plant foods (Qaim & Kouser 2013), and subsequently, GM food products.

Therefore, the production of GM food products will be able to contribute to building a more food-secure environment by boosting food availability. This could potentially be achieved through the increase of food production, simultaneously increasing the availability of food the population has physical access to (Cui & Shoemaker 2018). Genetic modification can also be applied to increase the yield of orphan food crops (crops that are produced in large quantities and consumed by local communities) (Mabhaudhi *et al.* 2019) and supplies of locally produced fruits, vegetables and staple food products (Zaidi *et al.* 2019). For example, fruit such as pawpaw in Hawaii has been genetically modified to be resistant to the ringspot virus,

essentially guaranteeing an increase in the production of locally produced pawpaw (Sekeli *et al.* 2018). In addition, salmon known as *AquAdvantagea* was the first animal to be genetically modified in Canada and Indiana facilities, with the intention of maturing more quickly as this fish species usually takes 3 years to grow to full size; these fish now mature in 18 months (Benessia & Barbiero 2015) and is fed less than wild harvest species (Weir & Sproul 2019). As seen in Figure 2.3, normal salmon weigh approximately 1.3kg and are 33cm long at 18 months, whereas the *AquAdvantagea* salmon is measured at 3.0kg and 61cm at 18 months old (Bissett 2017).

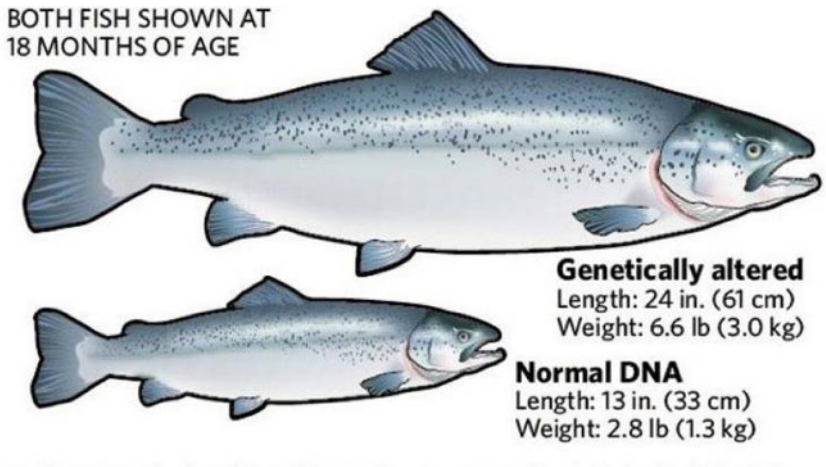

Figure 2.3: Difference in Size between Normal Salmon and Genetically Altered Salmon (Bissett 2017)

The faster growth is possible as this salmon species have been genetically modified through the insertion of a growth hormone from Chinook salmon and a promoter sequence from the fish known as Ocean Pout, with the intention of stimulating the growth hormone gene in the *AquAdvantage* (Voelker 2016). As a result, the yield of this GM salmon has increased, which also serves as a benefit to farming with this particular fish species. The farming of *AquAdvantage* salmon also contributes to promoting the availability of salmon to consumers (Zhang *et al.* 2016). Furthermore, in general, rice plants have also been genetically modified in order to boost their photosynthesis by being greener and larger, increasing grain yield by approximately 27% (ISAAA 2019).

Through the intervention of biotechnology, the global production of soybean increased with an additional estimated 138 million tons, an additional estimated 274 million tons of corn and an additional estimated 21.7 million tons of cotton for the period 1996-2013 (Zhang *et al.* 2016). These figures point to the major agronomic potential of GM plant foods (Garcia-Yi *et al.* 2014)

which can, in turn, boost food production and supplies which serve as a major benefit for food security (Brookes & Barfoot 2017).

2.4.2 Environmental Benefit and Reduced usage of Herbicides and Pesticides

GM crops are also known to grow at a faster rate as compared to other crops and are resistant to harsh conditions such as droughts and floods (Husaini & Sohail 2018). These characteristics are becoming extremely beneficial to the food industry, especially considering the rate at which climate change is evolving. Climate change has the potential to decrease crop yields, reduce water availability, increase the prevalence of infections with pathogens, and increase temperatures (Qaim & Kouser 2013). The production of GM crops can potentially assist in minimising the consequences of climate change which contributes to the benefits of such crops (Abdullah *et al*. 2014).

A major benefit of the cultivation of GM crops is that a specific gene can be inserted into the plant material in order to make the cultivar resistant to insects (Smyth 2017). For example, corn has been genetically modified to be resistant to insects, which benefits the farmers of such crops to a great extent. It is not necessary to spray these crops with pesticides (chemicals used in the agricultural industry to protect plants from pests and various diseases) (Nicolopoulou-Stamati *et al.* 2016), which are known to be harmful to the soil and crops itself (Lamichhane 2014). Furthermore, a component of soybean has been genetically modified with the intention of being resistant to pests, allowing farmers to refrain from spraying pesticides and insecticides on these crops (Schutte *et al.* 2017). This reduction of pesticides and insecticides on GM plant foods benefits both the producers and consumers of GM food products to eliminate the health concerns that consumers have of pesticides on plant foods (Garcia-Yi *et al.* 2014).

In South Asia, an increase in the crop yield of GM brinjals (a staple food product of this country) from farmers in Bangladesh has been a financial benefit to this country (Prodhan *et al.* 2018). Farmers in Bangladesh were struggling with the cultivation of brinjals due to caterpillars harming the crops and therefore farmers had to spray their crops with insecticides, resulting in the loss of between 30-60% of their entire yield. However, Bangladesh now celebrates the cultivation of GM brinjals that are resistant to weeds, and reducing insecticide usage by 61%, which has shown to boost their crop yield (Shelton *et al.* 2018).

Since consumers are concerned with the negative health effects that pesticides may induce (Kikulwe *et al*. 2011), it will be interesting to determine whether consumers have any

knowledge of the reduced usage of pesticides during the production stages of GM plant foods. It is also important to determine whether the respondents will know that GM plant foods are in fact resistant to harsh conditions, and whether these factors will initiate a positive perception and motivate consumers to purchase GM-related food products.

One of the main reasons farmers have adopted the cultivation of GM crops is because of the reduction in pesticides used on the crops (Garcia-Yi *et al.* 2014). From 1996 to 2016, the use of pesticides has reduced by 448 million kg, and in the year 2010, the total amount of carbon dioxide emission saving – particularly associated with GM crops – was the equivalent of removing 8.6 million cars from the roads. This was related to a reduced amount of fuel and an increased amount of soil carbon sequestration (Brookes & Barfoot 2017). According to Herman *et al.* (2019), the reduced carbon dioxide emissions released into the atmosphere as a result of the adoption of biotechnology crops can be directly beneficial to the environment. The reduced usage of herbicides, which are used to kill weeds (Gaba *et al.* 2016), and insecticides, used to kill insects (Sarwar 2015), also encourage tillage, weed management, as well as monoculture that allows land to retain its moisture and boost the fertility of soil (Schutte *et al.* 2017).

The need for chemical pesticides has reduced by approximately 37% which is largely due to the use of *Bacillus thuringiensis*-based insect control that improves the biodiversity of insects and proves beneficial to the normal functioning of the environment (Dinneny 2018). The adoption of GM crops has also proven to suppress target pest populations which, in return, serves as a benefit of growing such crops as the crops are protected from unwanted pests while simultaneously supporting biological control (Romeis *et al.* 2019). GM crops can be produced using less land which holds benefits of its own as water and air contamination is reduced, the impact on biodiversity is reduced, resources are saved, and fuel consumption is minimised. This beneficial factor also lends itself to using less water, thereby increasing water resources (Garcia-Yi *et al.* 2014).

It is evident that GM technology has already proven itself to be beneficial to the environment (Dinneny 2018). Considering consumers' increasing concern for the environment (Zhang *et al.* 2016), it will be beneficial to determine if consumers have any knowledge and perception of the beneficial impact that the food production system of GM plants has on the environment, and whether this will have any impact on their purchasing decision of GM food products.

2.4.3 Health and Nutritional Benefits

The GM production system plays a significant role in providing consumers with nutritionally enhanced food products which, as a result, can assist in reducing nutritional deficiencies such as vitamin A and zinc while increasing daily nutritional intake (Dizon *et al.* 2016). For instance, a component of Golden Rice©, which is a staple food product in South Africa, has been genetically modified with vitamin A and iron (Qaim & Kouser 2013). This was achieved by genetically modifying the genome of the rice by inserting more copies of genes which are responsible for the synthesis of vitamin A and iron (Kramkowska *et al.* 2013). The genome of Golden Rice© has also been genetically modified to contain a high quantity of beta-carotene, said to protect against night blindness (Muntaha *et al.* 2016). Moreover, the genome of Golden Rice© has been genetically modified by inserting specific genes from bacteria commonly known as *Erwinia uredovora,* as well as genes from jonquil flowers into the rice grains. This has resulted in increased activity of the enzyme known as phytoene synthase which increases the synthesis of beta-carotene, a precursor of vitamin A (Kramkowska *et al.* 2013). Due to the increased levels of beta-carotene, Golden Rice© has a more yellow-gold colour as opposed to the white colour of traditional rice (Dubock 2017), as seen in Figure 2.4.

Figure 2.4: Deep Yellow Genetically Modified Rice and Traditional White Rice Grains (Charles 2013)

Other staple food products in South Africa, such as components of maize and wheat, have also undergone genetic modification in order to enhance their macronutrient content (Hefferon 2015). Hefferon (2015) explains that the components of wheat that have been genetically modified also form part of the ingredients used in bread. As a result, these increased nutritional values in food products resulting from GM plant material can potentially address chronic malnutrition (Garg *et al.* 2018) in specific areas of the world, as well as in South Africa. Genetic modification to plant materials has also been applied to nutraceuticals, which refer to a food product that has been fortified in order to promote physiological health benefits (Dutta *et al.*

2018). These nutraceuticals consist of vitamin A, vitamin C, vitamin E, plant pigments, indispensable unsaturated fatty acids, cellulose, prebiotics and probiotics (Kramkowska *et al.* 2013).

Malnutrition persists with approximately 900 million malnourished people worldwide, which evidently shows that a significant number of people do not have access to and are not consuming nutritionally adequate food (Qaim & Kouser 2013; Hefferon 2015). In 2016, 795 million people worldwide were malnourished, exacerbating the problem of malnutrition, illnesses and vitamin deficiencies (Zhang *et al.* 2016). Therefore, plant foods have been genetically modified with the intention of providing consumers with food products that have enough nutrients at an affordable price to improve their nutritional intake (Garg *et al.* 2018) and possibly address malnutrition (Hefferon 2015). For example, the genome of bananas has been genetically modified in order to boost vitamin A content in order to assist in decreasing the prevalence of vitamin A deficiency in young children in East African nations where bananas form an integral part of their staple food and are therefore consumed on a daily basis (Rebgetz 2017). Vitamin A deficiency is the leading cause of blindness in children (Martini *et al.* 2018) which may result in an impaired immune system and have a negative effect on brain development (Chen *et al.* 2018). In this regard, biotechnology has proven to manifest major benefits by addressing some of the deficiencies that pertain to human health and nutrition (Hefferon 2015) and may provide a solution to the persisting malnutrition problem.

The genome of bananas has also been genetically modified and are used to produce human vaccines against particular infectious diseases, namely hepatitis B (Bawa & Anilakumar 2013). Genetic modification further allows the presence of viral or bacterial antigens in the edible parts of plant cells. GM food products have the potential to serve as oral vaccines which will have the ability to stimulate the immune system through mucosal immunity that facilitates the production of antibiotics (Zhang *et al.* 2016).

Determining whether consumers know which food plants have been genetically modified and the purpose of these foods, will indicate the GM-related knowledge that consumers have. It will also indicate whether consumers are actually aware of the health and nutritional benefits of the production and consumption of GM food products, and whether this will have a positive perception and impact on their purchasing decision of GM food products. It will be valuable to the study to establish if health and nutritional aspects of GM food products will motivate consumers to purchase such GM food products.

2.4.4 Economic Benefit

GM crop technology plays a major role in the manner in which GM plant foods are produced as income is increased, fewer pesticides and herbicides are used, less land is required, and production costs are lowered (Schutte *et al.* 2017) as discussed in Section 2.4.2. Consequently, a country's economy can benefit from the implementation of biotechnology and the production of GM crops as the financial expenditure is decreased during the production stages of GM crops (Zhang *et al*. 2016). Farmers of GM crops also benefit as cultivation costs are limited since the production of GM crops is not as labour intensive (Brookes & Barfoot 2018). Resources, such as fuel, are saved as less herbicides and pesticides are required throughout the cultivation of GM crops which also serves as an economic benefit (Garcia-Yi *et al.* 2014).

Financial gain was particularly evident during the period of 1996-2016 when the production of GM soybean contributed to 54.6 billion (USD) extra global farm income, and in 2016 GM soybean increased farm incomes by 4.37 billion (USD). With regards to GM maize, the total farm income between 1996-2016 was 13.1 billion (USD) and 2.1 billion (USD) in just the year 2016 (Brookes & Barfoot 2018). Furthermore, the global farm income derived from GM cotton between 1996-2016 was 1.92 billion (USD) and 130.1 million (USD) in 2016. Over the years between 1996-2014, an estimated additional value of 158 million tons of soybean was produced globally as well as 322 million tons of corn, which would not have occurred without the presence of biotechnology (Smyth 2017). It is thus evident that the production of GM plant foods have already proven to be beneficial to farmers in terms of income and is believed to become even more rewarding in future years (Garcia-Yi *et al.* 2014).

South Africa has also economically benefitted from GM crops. Between the years 1998 and 2015, the country gained 2.1 billion (USD), and 237 million (USD) in the year 2015 alone (Brookes & Barfoot 2017). This shows that the South African GM food industry is growing and that the country is achieving financial and economic benefits from doing so (Dinneny 2018). It would be useful to establish whether consumers are aware of the financial benefits of adopting the production and cultivation of GM plant foods, whether they are aware that the GM food production systems have the potential to boost the country's economy and whether this will result in a positive perception of GM food products.

2.4.5 Food Processing and other Major Benefits

Genetic modification of plant foods also contributes to improving and facilitating food processing (Wunderlich & Gatto 2015). This advantageous trait was achieved when the tomato, known as the 'Flavour Saver', was genetically manipulated to suppress an enzyme commonly known as polygalacturonase with the pre-identified intention of slowing down the ripening rate in order to successfully increase the tomato's shelf life (Zhang *et al.* 2016).

In Figure 2.5, the difference between an organic and GMO tomato can be seen.

https://www.organicconsumers.org/news/gmo-awareness-campaign-continues

Figure 2.5: An Organic Tomato on the Left compared to a GMO Tomato on the Right (Mercola 2015)

Consequently, the genetic material of many food products has been genetically modified in order to increase shelf life, simultaneously ensuring that consumers do not have to fear that the food product, especially fresh produce, will spoil in a short period of time (Bawa & Anilakumar 2013). To this effect, USA consumers now enjoy the benefit of purchasing and consuming apples known as the 'Arctic Apple' that has been genetically modified to specifically contain genes that prevent these apples from bruising and turning brown when exposed to air (Maxmen 2017), as seen in Figure 2.6.

Figure 2.6: Traditional Golden Delicious Apple on the Left and the Genetically Modified Arctic Apple on the Right (Horin 2018)

Other potential benefits of the GM food production system include improved product quality, enhanced flavour, a variety of colours of foods (Shetty *et al.* 2018) such as pink pineapples (Pomranz 2017), as well as a reduction in the price of these products (Dizon *et al*. 2016). As mentioned, the production costs involved to cultivate GM crops are lower for farmers due to the reduction in the usage of pesticides, herbicides and resources (Schutte *et al.* 2017). This could possibly result in the selling of GM food products at a lower cost. In order to establish consumers' acceptance of food and beverage (F&B) products produced by small enterprises, a survey study was conducted in Malaysia (Diana-Rose *et al.* 2016). The results of the study showed that when the respondents purchased F&B products, they first considered the quality of the product, thereby indicating that product quality is an influencing factor in the decision to purchase products. Product quality may therefore be a significant factor when consumers purchase food products, which may be the same when purchasing GM food products.

It is, therefore, evident that genetic modification manifests numerous advantages for both the producer and consumer (Zhang *et al*. 2016). Establishing whether consumers are aware and knowledgeable of the other major benefits GM food products have to offer, including longer shelf life, improved product quality, enhanced taste and reduced price will be valuable; these benefits are directly linked to consumers. These could also be potential GM-related factors that could influence consumers' purchasing decision of GM food products.

2.5 RISKS AND CONSUMER CONCERNS OF GM FOOD PRODUCTS

Many of the debates revolving around GM food products are largely founded upon the concerns that consumers have towards such foods as well as the risks associated with GM foods, including possible allergenicity, the safety of GM food products, possible harmful effect

on the environment and the cost of GM seeds (Kikulwe *et al*. 2011; Azadi *et al.* 2015; Ozkok 2015; Todua *et al.* 2015; Wunderlich & Gatto 2015; Lopez *et al.* 2016; Popek & Halagarda 2017). Consequently, anxiety towards GM food products is common among consumers, particularly regarding aspects such as the effect on human health, the environment and ethical issues (Zhang *et al.* 2016).

2.5.1 Health Risks

According to Hilbeck *et al.* (2015), many people are consuming GM food products, but have not shown or reported any negative health effects. However, Hilbeck *et al.* (2015) add that due to the absence of or insufficient labelling of GM food products, consumers may not be aware that they are in fact consuming GM food products and therefore it cannot be claimed with confidence that GM food products are unhealthy or unsafe to consume. In addition, Nicolia *et al.* (2014) highlight that studies conducted thus far could not identify any major hazards pertaining to the consumption of GM food products, although the debate around GM safety and health risks continues. Nevertheless, due to food products being developed with new technology, consumers have expressed the fear that such products may harbour potential health risks and cause bodily damage (Deffor 2014). This is because the consumption of GM food products is believed to possibly cause particular diseases which can, in turn, be resistant to antibiotics (Bawa & Anilakumar 2013). Resistance to antibiotics may occur as bacteria is commonly used when genetically modifying a particular food product that is resistant to antibiotics. The danger occurs when these antibiotic-resistant genes are transferred to the bacterial microflora tracts of the human body, which affects the physiological and pathogenic microflora (Kramkowska *et al.* 2013). Kramkowska *et al.* (2013) explain that, as a result, the pathogens will have the potential to prompt different types of diseases less sensitive to particular antibiotics, which poses a threat as these diseases will not react sufficiently to treatment using antibiotics. The consumption of GM food products can also lead to unpredictable consequences, including carcinogenic effects and toxicity (Ozkok 2015). There is also a likelihood that if foreign genes present in GM food products integrate into the DNA of humans, the genes could possibly switch with other genes within the human body and potentially result in an overproduction of toxins or allergens (Godheja 2013).

These aforementioned consequences occur largely due to the disrupted genes in particular food products (Zhang *et al*. 2016). Furthermore, new proteins are formulated during the genetic modification process that can lead to unpredictable allergic effects (Delaney *et al.* 2018) defined as a pathological immune reaction. This commonly occurs in response to an antigen present in a food component (Ozkok 2015). When these alimentary proteins are

consumed, skin reactions may occur, and alterations in the circulatory system and respiratory system may be experienced. The proteins that are formulated during genetic modification are also believed to harbour allergising potential as its sequence is exactly the same as another protein, which then has the potential to induce an allergic reaction (Kramkowska *et al.* 2013).

Allergic reactions can also occur when genes and new genes are combined from non-food sources, making existing allergic reactions even worse (Ozkok 2015). For example, GM rice with a reduced glutelin level has been associated with an increase of prolamin, which are types of protein that can cause allergenicity in coeliac disease (Dadgarnejad *et al.* 2017). By using a questionnaire, a study was conducted in Poland by Rzymski and Krolczyk (2016) with the aim of establishing consumers' attitudes towards GM food products. They concluded that the majority of consumers revealed that factors such as allergic reactions, cancer-causing effects, possible harmful health effects such as immune malfunction, alternations in kidney function and infertility problems were factors that would negatively influence their purchasing decision of GM food products.

This shows that based on the manner in which GM food products are produced, particularly referring to the insertion, alterations and disruption in the genetic make-up of foods, unforeseen and negative consequences may arise which poses a problem when these foods are consumed. It is, therefore, evident that many consumers are concerned about the consumption of such food products, especially considering that consumers are becoming increasingly aware of their health (Singhal 2018). It is important to establish whether consumers are indeed knowledgeable and aware of the possible health risks associated with the consumption of GM food products, how they perceive these health risks, and whether these health risks could ultimately influence their purchasing decision of GM food products.

2.5.2 Environmental Risks

There is a concern that growing and producing GM crops have the potential to disrupt the food chain resulting in the generation of undesirable pests, while simultaneously causing a negative influence on fungi and bacteria in the soil (Makate *et al.* 2015). Garcia-Yi *et al.* (2014) also explain that due to the mixing of genes during the genetic modification process, there is a possibility that when these crops are produced, the ecosystem can be disrupted. A concern raised by consumers relating to the environment is that the production of GM crops has the potential to promote the development of pesticide-resistant pests (Zhang *et al.* 2016). Another potential risk of growing viral resistant GM crops is that the production of such crops can result in the formation of new viruses and consequently new diseases. This is largely due to the fact

that naturally occurring viruses attach to viral fragments that are placed into GM crops, thereby forming new viruses (Bawa & Anilakumar 2013). Many farmers use glyphosate on GM plants, however, glyphosate can filter into the soil and induce the growth of a fungus commonly referred to as *Fusarium* that can cause botanical infection. This shows that the production of GM crops does have the potential to endow unfavourable effects on the environment (Dadgarnejad *et al.* 2017). Wunderlich and Gatto (2015) also suggest that consumers perceive that the production of GM food products could be dangerous to all living things, which increases consumers' concern towards GM-related food products.

Evidently, the production of GM food products also holds the potential to cause negative effects on the environment, particularly on soil and the ecosystem. Therefore, precautions should be taken by farmers when GM crops are produced in order to minimise these potential effects on the surrounding environment. However, caution should also be exercised by scientists developing such food products. In light of consumers' increasing concern with the environment, determining consumers' knowledge about the impact of GM food plants on the environment and their perception of the negative effects the product of GM plant foods may have on the environment, and whether this would influence consumers to refrain from purchasing GM-related food products, would be of interest to this study.

2.5.3 Ethical Issues

Ethics can be defined as the standards that are right or wrong which appeal to a person's beliefs, values and morals (Dizon *et al.* 2016). These could cause opposition towards human and technological interference with the food supply as well as the foods that are available for consumers to purchase and consume (Hingston & Noseworthy 2018).

Many consumers perceive the production of GM food products as being unethical (Bawa & Anilakumar 2013) and conflicting with their personal religious beliefs (Lucht 2015). Consumers express this particular concern attributed to the fact that the production of GM food products is based solely on an unnatural procedure and method (Dizon *et al*. 2016). Zhang *et al.* (2016) state that consumers may have ethical concerns towards GM food products as producers are using technology to create food products despite being fully aware of the negative anticipated results that may occur from doing so. Kotze (2016) also explains that using biotechnology to alter the plant material disrupts the natural process of growing and producing crops and food, which may be seen by many consumers as being unethical. Therefore, tampering with the environment and natural growth of crops can be considered unethical. A study in the Chris Hani District Municipality in South Africa used six focus groups to determine consumers'

awareness of GM food products. The results showed that the respondents did not accept the use of biotechnology in the agricultural industry (Peter & Karodia 2014). Evidently, GM food production systems are viewed by consumers as being man-made, which has moral implications and may affect consumers' opinion and views of GM food products in general (Hingston & Noseworthy 2018).

Considering the harmful effects that the production and consumption of GM food products may have on the environment and human health, the production thereof is viewed as being unethical (Bawa & Anilakumar 2013). Gastrow *et al.* (2018) conducted a survey study in South Africa in order to establish how consumers perceive biotechnology; results indicated that 44% of the participants felt that the production of GM food products was ethically wrong. The question raised by society is whether humans have the right to use technology to generate new foods. It is thus becoming increasingly evident that there is controversy regarding the ethical aspects of GM food products (Lucht 2015).

Consumers clearly have concerns about GM food products which negatively affect their purchasing behaviour of such products, but Hingston and Noseworthy (2018) state that if consumers can understand why GM food products were originally created and the good intentions related to its existence, moral opposition towards GM food products can decrease. This might simultaneously increase the perceived benefits of GM food products and subsequently lead to a positive effect on consumers' purchasing decisions of these foods. Sorensen (2019) also made an interesting comment about consumers' concerns about GM food products by stating that consumers who are in opposition to GM food products generally have the least knowledge of GM food products. It is therefore essential to educate and increase consumers' knowledge in order for consumers to make informed decisions with regards to GM food products. This could possibly indicate that consumers still have some level of ignorance of GM food products in the USA where the production of these food products started. The statement made by Sorensen (2019) was founded on a recent study conducted by researchers from the Leeds School of Business at CU Boulder, Washington University in St. Louis, the University of Toronto and University of Pennsylvania by means of a survey in order to establish consumers' knowledge and opinion about GM foods itself, as well as using true-false questions to specifically determine consumers' knowledge of general science and genetics. Any ethical implications in the production and consumption of food products may be considered as a concern to many consumers, therefore establishing whether consumers perceive the production of GM plant foods as being unethical and whether this would influence their purchasing decision of GM food products as a whole, would be valuable to this study.

2.5.4 Cost of GM Seeds

In future, the production of food products can potentially be dominated by a few large organisations, which consequently pose a threat to other food-producing businesses (Ozkok 2015). Therefore, in order to acquire GM seeds, farmers are required to purchase them from a legitimate dealer or organisation (Zilberman *et al.* 2018). Azadi *et al.* (2015) point out an economically devastating factor, stating that the production of GM food products can increase the price of seeds to such an extent that small farmers and developing countries will ultimately be unable to afford to purchase GM seeds. Additionally, these seeds are only feasible to grow in one season throughout the year which forces farmers to purchase new seeds annually (Mishra & Singh 2013). As a result, GM crops will mostly be grown by commercial farmers as small-scale farmers will not have the financial capability to purchase and grow GM crops (Wray 2017). Interestingly, Zilberman *et al.* (2018) state that even though GM seeds are more expensive than conventional seeds, farmers are more likely to purchase GM seeds due to the increased total profitability of GM crops. Many farmers therefore believe they are better off purchasing GM seeds as opposed to conventional seeds (Ozkok 2015). According to Wong and Chan (2016), as the production of GM food products increases, the prevalence of traditional, naturally occurring food products may decrease; and the use of limited varieties can also potentially decrease the development of newer varieties as the genetic make-up can become uniform.

Nevertheless, the advantages associated with GM food products may outweigh the disadvantages and concerns due to the fact that the consumer can benefit from purchasing and consuming such foodstuffs (Deffor 2014). Therefore, it is important to determine consumers' procedural knowledge and perceptions of GM food products.

2.6 CONSUMER RESEARCH CONDUCTED ON GM FOOD PRODUCTS

Several studies published in scientific journals have been conducted across the world in order to accurately establish consumers' opinions regarding GM food products. For instance, a study by Kikulwe *et al*. (2011) on consumers' perception, attitudes and trust specifically pertaining to GM bananas, determined by means of a consumer survey that the majority of respondents' felt that improved taste, increased nutritional value, different colours, reduced price and the reduced usage of pesticides and herbicides were factors that positively influenced their purchasing decision. Another study was conducted using a face-to-face survey by Popek and Halagarda (2017) in order to establish consumers' awareness, opinion and attitude towards GM food products. This study showed that the majority of consumers felt that the primary

benefits of GM food products included increased shelf life, and increased resistance to pests and climatic conditions. Most consumers also revealed that their biggest concern regarding GM food products was that the consumption of it could cause food allergenicity. The study, furthermore, showed that the majority of consumers strongly felt that the packaging of GM food products should present information particularly pertaining to any potential contraindications to the consumption as well as any possible allergic reactions that may occur.

A study conducted by Peter and Karodia (2014), as discussed in Section 1.2, concluded that consumers have concerns about the disadvantages of GM food products which may halter the GM food products they consume. These studies evidently show that consumers have concerns about the consumption of GM food products and that their attitudes towards GM food products are influenced by factors relating to product quality, reduced usage of pesticides and herbicides, resistance to pests and climatic conditions, as well as possible allergenicity.

Lopez *et al*. (2016) conducted a survey in order to establish Mexican urban consumers' perception and attitudes towards GM food products. This study concluded that the majority of consumers felt that the production of GM food products could assist in combatting food shortages, that labelling should be present on such products, and that consumers would be more likely to purchase GM foodstuffs if they were cheaper and contained less fat as compared to conventional organic products. Using a survey, another study was conducted with the intention of establishing consumers' perception of GM food products. It revealed that consumers felt that biotechnology had the ability to improve GM food products and that such crops should be produced in order to reduce pesticide use and enhance the nutritional quality of food (Wunderlich & Gatto 2015). In contrast, a survey was conducted with the aim of identifying consumers' attitudes and behaviour towards GM food products, which showed that consumers thought the consumption of GM food products could cause organ damage, antibiotic resistance, biological pollution and intoxication (Ozkok 2015). These studies illustrate that factors specifically pertaining to human health, nutritional content and the environment has an impact on consumers' perception and attitudes of such products.

A survey study was conducted to determine consumers' attitudes towards GM products, which revealed that the majority of consumers felt the increased quality of GM food products was a likely factor that would influence their purchasing decision, but they were sceptical about health damage and portrayed fear towards GM food products (Todua *et al*. 2015). Further investigation was done into consumers' attitudes towards GM food products, using a survey, in which it was revealed that the majority of consumers were sceptical of the safety of GM food products as well as the possible harmful effects that the production of GM crops could have

on soil surroundings as well as on the ecology of the environment. The results of this study, however, also presented that consumers were very optimistic about the possible advantages of GM food products, which is promising to the GM industry (Ma 2015).

A study was conducted using a survey to establish the attitudes of Agribusiness Managers towards GM technology, which depicted that the majority of the respondents opposed the adoption and cultivation of GM crops due to their concern specifically pertaining to the safety of such crops. The respondents also showed concern towards economic factors associated with producing GM crops such as the organisation's profitability. In addition, the respondents indicated that they were not optimistic of the demands that consumers have of GM food products (Deng *et al.* 2019). Moreover, an interesting point was highlighted by a survey study conducted pertaining to the relationship between young adults' attitudes and their referent people, in which it was concluded that a strong relationship existed; consequently, the attitude of parents, siblings or friends can negatively or positively affect consumers' attitudes of GM food products (Brosig & Bavorova 2019).

These studies reveal that there are common aspects consumers agree on, but there is a concern among consumers in terms of the effect of GM food products, particularly on the environment and human health. These studies also show that consumers across the world exhibit fear towards GM food products, but consumers are inclined to purchase GM food products due to the value-added properties of such products, including characteristics such as increased shelf life, improved taste, increased nutrients and reduced usage of herbicides and pesticides. Consequently, these findings reveal contradictory, but also very positive views of GM food products in a global sense.

2.7 CONCLUSION

The existence of GM food products is becoming more apparent in the food industry. Therefore, it is vital to fully understand consumers' procedural knowledge and perception of GM food products, while simultaneously establishing which factors may contribute to and influence consumers' purchasing decision. These factors may be specifically related to the various benefits and risks of GM food products that include increasing food security, providing access to nutritionally adequate food, improved taste, shelf life and quality. Other factors also include allergic reactions, being harmful to the environment and being produced in an unethical and unnatural manner. Evidently, these factors are closely related to the procedural knowledge and perception consumers have, which may also have a direct effect on their attitudes, opinion and acceptance of GM food products. The two behavioural concepts related to this study,

namely the procedural knowledge and perception of consumers related to GM food products, will be discussed in the next chapter together with the consumer purchasing decision and conceptual framework for this study.

CHAPTER 3

PURCHASING BEHAVIOUR

It is important to investigate the purchasing behaviour of consumers in order to determine which aspects consumers are affected by, which ultimately affects their final purchasing decision (Auf *et al*. 2018).

In this chapter, consumer knowledge is discussed and the consumer learning process is explained. This is followed by defining perception and the perceptual process. This chapter also discusses various studies that have been conducted on consumers' knowledge and perception of GM food products. Information regarding the purchasing decision is presented and the role of consumers' involvement in this process is also clarified. Thereafter, the consumer decision-making model of Schiffman and Wisenblit (2019) is presented and the conceptual framework based on this model is discussed.

3.1 INTRODUCTION

In the previous chapter, the literature on GM food products was presented. This chapter discusses the two main behavioural influences that the study is focusing on that influence consumers' decision to purchase, namely consumer knowledge and perception (Schiffman & Wisenblit 2019). This chapter also reviews the three types of knowledge that consumers may acquire as they are exposed to products and product stimuli, which includes procedural knowledge, conceptual knowledge (Star & Stylianides 2013) and subjective knowledge (Han 2019). However, there is a process that consumers go through in order to attain knowledge, known as the consumer learning process. Consumers also move through a process known as the perceptual process in order to form a perception (Paramasur & Roberts-Lombard 2014), and this will be described.

Various studies have been conducted with the intention of determining consumers' knowledge and perception of GM food products, which will be addressed in the sections that follow on each of these behavioural influences. The purchasing decision, which comprises of low and high consumer involvement, forms an integral part of consumers' purchasing behaviour (Schiffman & Wisenblit 2019) and is therefore also discussed, together with the conceptual

framework adopted for this study from the consumer decision-making model of Schiffman and Wisenblit (2019). Knowledge forms an integral part of the consumer decision-making process, which is discussed first, followed by perception.

3.2 CONSUMER KNOWLEDGE

Researchers have been on a quest for some time to fully understand what consumers know about GM food products (Mandal & Paul 2012). In general, knowledge is defined as the information and values that a person acquires through experience (Ogbamichael & Warden 2018), which is used when a specific activity or behaviour is performed (Duy & Ai 2019). Bolisani and Bratianu (2018) also define knowledge as what a person knows, or what they think – in their own opinion – they know. Knowledge is built in a person's own mind (Olusegun 2015), and is therefore based on a person's way of thinking. Subsequently, decisions that are made are led by all the information obtained and gained throughout a person's life, accumulated over many years (Mwangi *et al.* 2018).

Due to knowledge being such a big part of what a person thinks, it is interwoven with the attitudes and opinions a person has formed which culminates and affects an individual when deciding whether or not to purchase a product (Wunderlich & Gatto 2015). The purchase decision is thus the result of prior or existing knowledge that was acquired through previous experience, meaning that information about the product features has already been obtained and will therefore play a role in the formation of attitudes, opinions and future purchasing decisions about the respective product, depending on whether or not the consumer was, in fact, satisfied with the product (Hoque *et al.* 2018). Duy and Ai (2019) explain that knowledge is the first aspect that consumers use in consumer behaviour and there is thus a strong correlation that exists between pre-existing knowledge and purchasing behaviour. Duy and Ai (2019) also add that knowledge has been found to relate to the acceptance of a product and the willingness to purchase a product. Furthermore, Bonah *et al.* (2017) specifically found that where GM food products were concerned, a correlation was found between knowledge and acceptance of GM food products, as well as between knowledge and willingness to purchase GM food products. This can be explained due to the pre-existing information and experience already attained as knowledge may influence whether or not a person will accept a product or be inclined to purchase the product.

Procedural knowledge and conceptual knowledge are two sub-fields of knowledge (Star & Stylianides 2013) that are very closely related, as both are needed to solve a problem that arises (Surif *et al.* 2012). However, procedural knowledge involves using knowledge and

experience that was previously obtained to complete different types of tasks (Genc *et al.* 2019), which refers to an activity that is performed (Schiffman & Wisenblit 2019) such as how to select wine to drink with a meal or how to select soup that is low in salt (Worsley 2002). In the case of GM food products, it relates to how to select a GM food product for consumption based on knowledge of genetic modification. This knowledge also manifests in consumers' habitual actions (Boshoff 2015). Procedural knowledge assists consumers in doing things and is therefore used to execute even the most basic task such as going to an ATM (Worsley 2002) or shopping for food products in a store. Due to procedural knowledge driving consumers to perform a specific task, knowledge of a specific product, together with awareness of a specific product, influences the perception of a product (Saricam & Okur 2019). This is due to previously acquired information and experience affecting attitudes and opinions (Hoque *et al.* 2018), as previously mentioned, which will allow for the formation of awareness and specific perception of a product (Saricam & Okur 2019). Therefore, investigating consumers' procedural knowledge of GM food products offers an indication of how the consumer goes about making the decision regarding these products based on their pre-existing knowledge and experience with GM food products.

Conceptual knowledge refers to the knowledge or understanding of a particular concept (Zuya *et al.* 2017), such as the concept of GM foods or GM food products. Procedural knowledge refers to how to apply the conceptual knowledge gathered of a concept to solve a problem (Surif *et al.* 2012); for example, in the GM-related context, what the concept 'genetically modified' means. Conceptual knowledge represents unconscious thinking (doing something without realising it), and procedural knowledge refers to conscious thinking (being fully aware of doing something) (Kadijevich 2018). Conceptual knowledge requires consumers to apply previously learnt experiences and includes the connection and comparison between newly attained knowledge and already existing knowledge in order to execute a task or solve a problem. It therefore facilitates the learning process of becoming acquainted with a specific product (Saricayir *et al.* 2016), which may be applied during product choices between GM food products and non-GM food products. Therefore, consumers will be able to use their pre-existing knowledge of GM food products together with newly attained knowledge in order to decide whether or not to purchase GM-related food products. Consequently, conceptual knowledge related to GM food products will assist the consumer in making their decision of which food product to purchase and why they may opt for a GM food product.

Subjective knowledge is another sub-field of knowledge and refers to how much consumers think they know about a product (Han 2019). According to Gambaro *et al.* (2013), subjective knowledge shows the extent of a person's own knowledge of a specific product. Gambaro *et*

al. (2013) conducted a study in Montevideo, the capital of Uruguay, by using a survey in order to investigate consumers' objective and subjective knowledge of olive oil and determine whether it influenced their consumption frequency. The results of the study concluded that the consumers' subjective knowledge of olive oil indeed had a direct influence on the frequency of their consumption of olive oil, indicating that subjective knowledge affected their purchasing behaviour. Han (2019) warns that consumers' perceived subjective knowledge (how much they think they know) may not be a true reflection of their actual knowledge pertaining to a specific product, such as GM food products. Subjective knowledge also includes the attitudes and beliefs that consumers have about a product; consumers will use the information obtained about a product through the development of knowledge in order to form an attitude or belief towards the product. In order for consumers to have any knowledge about GM food products, the process of consumer learning must have already occurred in order to obtain information about the product (Redman & Redman 2016). Therefore, in this study, the subjective knowledge consumers have of GM foods and GM food products are important as this knowledge may also influence their purchasing decision of GM food products.

The different sub-sections of knowledge that has been discussed cannot exist without consumer learning. In general, learning refers to acquiring and gaining knowledge through experience (Oke *et al.* 2016). Therefore, what a consumer has learnt about a particular product may increase their understanding of a product (Parumasur & Roberts-Lombard 2014). Thus, the more consumers learn about GM food products, the better their understanding of these products will be. However, learning influences and changes behaviour as the consumer obtains new information (Durmaz 2014). Learning is considered to be a psychological factor that affects purchasing behaviour as newly attained information about a product may alter how the consumer views the product. This could either halter consumers from purchasing a product or encourage consumers to purchase a product (Batkoska & Koseska 2012). As consumers move through the learning process, information about a specific product is subsequently acquired, which may be of a specific food product. As a result, the information is stored as a memory and ultimately knowledge of the product is gained, thereby increasing their knowledge of the respective product, which results in learning that influences consumers' knowledge of products (Schiffman & Wisenblit 2019).

Consumer learning plays a crucial role in the development of procedural knowledge as the learning process relies strongly on obtaining purchasing and consumption knowledge and experience to use in future decision making and behaviour (Schiffman & Wisenblit 2019). Parumasur and Roberts-Lombard (2014) explain that there are three sequential stages or elements involved in the consumer learning process starting with the availability of a stimulus,

followed by the consumer's response to the stimulus, and the reinforcement experienced by the consumer after use or consumption of the stimulus (such as a GM food product) as depicted in Figure 3.1.

Figure 3.1: Elements of Learning (Paramasur & Roberts-Lombard 2014)

Stimulus refers to the stimulation of interest, after which consumers are inspired to seek the product before actual learning about the product can occur (Paramasur & Roberts-Lombard 2014). Paramasur and Roberts-Lombard (2014) explain that if the inspiration and motivation is strong, the consumer will learn about the product in a short period of time, but in order for learning to be initiated, a stimulus (which may be a GM food product) must occur (De Houwer *et al.* 2013). Advertising through stimulating packaging also plays a significant role in providing information to consumers (Chukwu *et al.* 2019). Kumar and Kapoor (2017) state that labelling is one of the primary methods used by marketers to provide consumers with information about the product that assists consumers during this stage of the learning process. During this stage, consumers may also acquire information about the product features and characteristics, and seek information from various sources such as the Internet, newspapers and magazines (Schiffman & Wisenblit 2019).

The second stage of the consumer learning process, namely response (Paramasur & Roberts-Lombard 2014), refers to the reaction to a particular stimulus (Duggal 2019), for example, an advertisement (Cant *et al.* 2006). However, the responses to a stimulus can occur many times before actual learning of the product takes place since consumers do not always respond to the first stimulus to which they are exposed (Paramasur & Roberts-Lombard 2014). As a result, marketers may not always succeed in motivating consumers to purchase a new product (Cant *et al.* 2006). Schiffman and Wisenblit (2019) also highlight that a consumer's response to stimuli depends on prior learning and how the previous response was reinforced, as consumers may respond to stimuli in the same manner as the response to previous stimuli. Therefore, consumers' response to stimuli will directly influence their reinforcement (Cant *et al.* 2006).

Reinforcement, which is the third stage of the consumer learning process, refers to the reward that the consumer enjoys, such as the benefits of the product after the product has been purchased (Oke *et al.* 2016). During this stage, a memory of the successful purchase of the product is initiated, which leads to consumers continuing their purchasing behaviour of the product (Parumasur & Roberts-Lombard 2014). The memory acquired through learning that occurred results in the consumer's knowledge of a product. Therefore, knowledge of a product will only be present once the consumer has engaged in learning or gathered information about a product. The facilitation of the consumer learning process may thus be critical to ensure that consumers obtain a sufficient amount of adequate information about a product in order to allow them to form and increase their knowledge of a particular product and allow an informed decision to take place.

3.2.1 Consumer Knowledge of GM Food Products

As mentioned in Section 1.2, previous studies have set out to determine the knowledge consumers have of GM food products. As such, the study conducted in the Chris Hani District Municipality in South Africa by Peter and Karodia (2014) using six focus groups and surveys to determine consumers' awareness of GM food products, found that only 38% of the participants had some understanding of the term 'Genetic Modification'. This study also revealed that the respondents were not completely sure if there were any GM food products available on the market. Another study was carried out by Wunderlich and Gatto (2015) using a survey to determine consumers' knowledge of GM food products in the USA. Approximately 48% of their respondents' knew that GM food products were available to purchase in supermarkets, 30% indicated that they knew a fair amount about GM food products, and 48% indicated that they knew very little regarding GM food products. Overall, the respondents did not feel very knowledgeable about GM food products. This study also revealed that 78% of consumers knew that the consumption of GM food products could cause allergic reactions.

A survey study conducted in the USA by McFadden and Lusk (2016) obtained results which showed that the majority of respondents did not know that soybean contained a GM component. Most respondents also did not know that rice contained a GM component, as established by a study conducted in the USA to determine consumers' knowledge of GM food products (Wunderlich & Gatto 2015). However, in order to determine consumers' awareness of GM food products, a survey study was conducted in Klang Valley, Malaysia, in which it was determined that slightly more than half of the respondents knew that corn/maize contained a GM component (Tanius & Seng 2015). In order to establish consumers' awareness of GM food products, a survey research study was carried out in Ghana in which only 34% of the

respondents had heard of or read about GM food products (Deffor 2014). These results clearly demonstrate that consumers' knowledge of GM food products is limited. The concern is thus raised in terms of how much South African consumers know about GM food products and if the same level of GM knowledge would be present among South African consumers.

Bonah *et al.* (2017) suggest that the lack of knowledge is largely due to the fact that consumers may not have a particular interest in looking for information pertaining to GM food products, which could result in not looking for GM food products in store. This lack of knowledge is also attributed to the labelling of GM food products not being mandatory, resulting in consumers not being adequately informed and educated about these products. Many consumers are also not fully aware that GM food products are available for them to purchase in the supermarkets due to insufficient labelling (Popek & Halagarda 2017). These results were furthermore substantiated by Cui and Shoemaker (2018), who stated that consumers are unfamiliar with GM food products and the potential benefits they have to offer. The authors added that the solution to this problem is to implement more public lectures and expand on educational curricula specifically centring their focus on GM food products and biotechnology. However, various studies have concluded that consumers' knowledge is limited regarding GM food products, which poses a concern as this limited knowledge makes them unaware and unfamiliar with GM food products.

Hassan *et al*. (2016) state that if a consumer is more familiar with the characteristics of GM food products, their knowledge of such products could be more accurate. However, consumers' level of knowledge may not necessarily lead to a more positive attitude or opinion about such products (Deffor 2014). Vecchione *et al*. (2015) used a survey to conduct a study in northern New Jersey in order to determine if there is a relationship between knowledge and purchasing decisions, specifically pertaining to GM food products. The results showed that the more consumers knew about these products, the more they purchased non-GM food products as their knowledge about the potential risks of GM food products were deterring them from purchasing GM food products. The procedural knowledge that consumers have regarding GM food products has an impact on their acceptance of such products, which can inadvertently be associated with their purchasing decisions (Deffor 2014).

It is, however, essential to facilitate consumers' procedural knowledge by ensuring that accurate information regarding the production of GM food products, as well as the various risks and benefits related to GM food products, are made available to consumers. This can successfully be achieved by using information sources such as consumer organisations, environmental groups and scientists as these sources are believed to be the most credible

sources of information pertaining to GM food products (Mandal & Paul 2012). To illustrate where consumers get their information on GM food products, Wunderlich and Gatto (2015) conducted a study on Latvian consumers using a survey in order to determine their primary sources of GM information. Their study suggests that the majority of Latvian consumers received their information regarding GM food products from the Internet, television, newspapers, magazines and people with whom they were acquainted. The information gathered plays a major role in consumers' purchasing decisions and therefore it will be hugely beneficial to establish the actual procedural knowledge that consumers have accumulated from such sources regarding GM food products (Mandal & Paul 2012).

In order to investigate the procedural knowledge that consumers have of GM-related food products, their general knowledge is measured and the sources from which they acquire the information give an indication of the extent of consumers' procedural knowledge.

3.3 CONSUMER PERCEPTION

Rebeka and Indradevi (2015) define perception as the belief or opinion that an individual holds after selecting, interpreting and organising stimuli in order to understand their exposure to the specific stimuli. Qiong (2017) provides an elementary approach by defining perception as the manner in which a person thinks about something and their impression of what something is like; therefore perception refers to the process of gaining awareness and understanding of something. Perception thus refers to the broad imagination that a person has formed in their own minds about something (Lekhanya & Dlamini 2017). Froese and Leavens (2014) add to the basic definitions of perception by pointing out that perception involves the processing of information obtained from external stimuli such as advertisements, which are then used for reasoning in the future. Therefore, in terms of this study, perception is considered in relation to how a person perceives a product. Due to perception involving the use of sensory impressions to shape a particular view, it subsequently guides consumers' behaviour in general, as the perception a person holds towards a product is also an indication of their opinion towards the product. If the perception and opinion are positive, there is a good possibility that it will result in the purchasing of the product, while a negative perception or opinion may prevent purchasing of the particular product (Eneh *et al.* 2016).

Perception can also be shaped by visual stimuli such as pictures or colours (Montemayor & Haladjian 2017), referred to as visual perception. It can be defined as the process of gathering and absorbing information from what consumers actually see (McCabe *et al.* 2016). Consumers learn about food products in various ways, therefore it is essential to provide

consumers with visual elements in terms of labels and packaging that will attract their attention, thereby giving consumers the opportunity to attain more knowledge and create a favourable perception of the product (Miltgen *et al.* 2016). However, for a perception to emerge, a four-stage process is initiated through which the perception is formulated (Parumasur & Roberts-Lombard 2014), which will subsequently be discussed.

According to Parumasur and Roberts-Lombard (2014), the four stages involved in the perceptual process includes the exposure to stimuli, attention to the stimuli, interpretation of the information projected by the stimuli and memory or recall of what the stimuli represented, and the knowledge gained from the exposure, as shown in Figure 3.2.

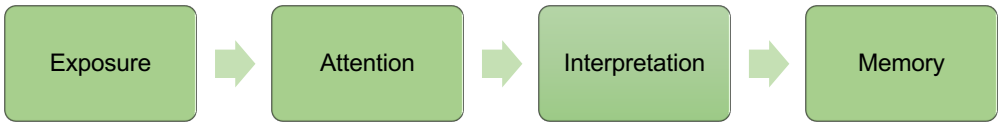

Figure 3.2: The Perceptual Process (Parumasur & Roberts-Lombard 2014)

The perceptual process is largely built around how information is processed by consumers. Therefore, the first stage in the perceptual process is exposure, which refers to the level to which a consumer takes notice of stimuli surrounding them though their senses (Parumasur & Roberts-Lombard 2014). Stimuli refer to something that causes a particular reaction which may include hearing words, smelling or tasting something, or seeing something about a particular product (Qiong 2017). In this sense, stimuli may refer to a GM food product to which consumers are exposed. There are various methods that marketers can use to expose consumers to stimuli and information about a product. Product packaging and design is one method used by many marketers to advertise and present information about a product. It is a very useful way to attract consumers' attention by displaying attractive packaging which can influence consumers' intention to purchase the product (Younus *et al.* 2015). Advertisements of products and commercials, including the models used in the advertisement, size of the advertisement and the type of writing used in the advertisements are also methods used by marketers to expose consumers to stimuli (Schiffman & Wisenblit 2019). Moreover, brand image is used to provide information to consumers in order to build an intended perception in the minds of consumers by using the brand image to show how the product can successfully satisfy consumers' needs. It creates value and an identity of the product, therefore influencing perception of the product (Erdil 2015). As mentioned, marketers use various methods to expose consumers to stimuli in order to create the desired perception towards a product. However, the exposure to a message or advertisement does not necessarily mean that

consumers will focus all their attention on it (Hanna *et al.* 2017). This may lead to consumers not absorbing the information provided to form a perception of the product, such as a GM food product or information about GM organisms.

Attention, which is the second stage of the perceptual process, refers to the degree to which the processing activity is focused entirely on a specific stimulus (Parumasur & Roberts-Lombard 2014). Hanna *et al.* (2017) also describe that attention can either be planned by consumers, it could be completely involuntary, or it could be voluntary. However, due to consumers being bombarded with information on a daily basis, they tend to select the type of information they pay attention to and may only choose to notice information that is relevant to them and that they are familiar with (Qiong 2017). Therefore, interest, which is an indication of a person's long-term (for example wanting to be a lawyer) and short-term goals (for example satisfying hunger), is believed to largely influence the attention that a consumer devotes to stimuli (Parumasur & Roberts-Lombard 2014). Subsequently, attention to stimuli depends on a consumer's personality as personality will affect what a person likes or does not like; this will subsequently influence their interest towards something, such as a product (Schiffman & Wisenblit 2019).

The third stage of the perceptual process, namely interpretation, refers to attaching meaning to a selected stimulus (Cant *et al.* 2006). However, consumers may not interpret specific stimuli in accordance with what marketers originally aimed for (Parumasur & Roberts-Lombard 2014). This makes it even more difficult for marketers as different people assign different interpretations to exactly the same stimuli (Qiong 2017) as people organise information in various ways. Therefore, people may form various perceptions of the same product (Schiffman & Wisenblit 2019). It is essential for marketers to ensure that they evoke the intended interpretation as consumers will use their interpretation to assess a product (Cant *et al.* 2006). Interpretation is thus a vital step in the formation of perception as consumers use their interpretation to form an overall perception of a product (Agyekum *et al.* 2015).

Memory or recall, which is the fourth stage of the perceptual process, refers to what the consumer actually remembers about the stimuli that he/she was originally exposed to. It involves the process of organising selected information into a meaningful pattern by placing information into separate categories which can be used in the future (Qiong 2017). Unfortunately, consumers do not always remember the information they were exposed to (Parumasur & Roberts-Lombard 2014). Subsequently, memory of information forms part of knowledge which shows that as consumers move through the perceptual process, perception, as well as knowledge about the product, is formed (Cant *et al.* 2006). Information that has

been stored in memory can act as factors that form future perceptions (Philbeck & Witt 2015). In order for perception to occur, consumers must be aware of specific stimuli, have personal experience and have the comprehension to use information to drive a specific response, thereby leading to memory (Mcdonald 2012). Overall, consumers create a perception of a product after obtaining and categorising the information of the respective product, therefore creating an expectation from a particular product (Kazmi 2012). This reiterates the importance of guiding consumers through the perceptual process in order for an everlasting positive perception to be shaped.

3.3.1 Consumer Perception of GM Food Products

Perception may shape consumers' beliefs and attitudes (Qiong 2017) towards GM food products; therefore determining consumers' perception of GM food products forms an integral part of establishing their purchasing decision and behaviour (Mandal & Paul 2012). Thus, perception has a direct influence on whether consumers accept GM food products or not (Deng *et al.* 2019). Hassan *et al.* (2016) add that the perception that consumers have about GM food products is largely influenced by the benefits and risks portrayed through these food products as mentioned previously. Consequently, these benefits and risks can potentially result in a positive or negative perception, respectively. The authors also state that a positive perception may simultaneously result in a positive attitude and belief towards GM food products, which could significantly increase consumers' purchasing decision. Conversely, a negative perception can ultimately decrease consumers' purchasing decision of such food products.

Todua *et al*. (2015) conducted a study in Georgia, by using a survey, to determine consumers' attitude towards GM food products. Their results revealed that the majority of the respondents perceived GM food products as being harmful to the environment and that it can jeopardise human health. A survey study was also conducted by Rzymski and Krolczyk (2016) in Poland to determine consumers' attitudes to GM food products, and it was concluded that other factors, namely religion and culture, also influenced consumers' perception and ultimately their attitude of GM food products. Another study conducted in Ghana by means of a survey revealed that consumers had the perception that the production of GM foods contradicted religious beliefs (Deffor 2014). Wunderlich and Gatto (2015) also stated that many consumers had the perception that the production and consumption of GM food products were dangerous and risky to all living things. This shows that several consumers perceive GM food products as being harmful to human health and the environment, and this perception is often influenced by consumers' religion.

Bett *et al.* (2014) add that perception can also be largely influenced by whether consumers feel that the production of GM food products takes place in an ethically correct way. Therefore, it is important to determine the perception that consumers have towards the potential risks of GM food products, which include the ethical, health and environmental aspects of GM food products.

Additionally, labelling GM food products is believed to be a major factor that influences consumers' perception of such foods, as labelling gives consumers the opportunity to decide whether or not to purchase the product (Mandal & Paul 2012). Due to an absence of or insufficiency of labelling on GM food products, many consumers perceive these products as being unsafe; therefore, providing sufficient labelling on GM food products can positively influence consumers' perception (Hassan *et al*. 2016). Understanding consumers' perception of GM food products can ultimately assist in understanding consumers' purchasing decision of such products (Amin *et al*. 2014). Investigating consumers' perception towards the safety aspects of GM food products is also critical in order to establish whether consumers perceive GM food products as being safe for human consumption or not, as it could ultimately be a major determining factor in their decision to purchase GM food products. The next section presents the consumer decision-making process.

3.4 THE PURCHASING DECISION

According to Schiffman and Wisenblit (2019), consumers make purchasing decisions that are driven by alternatives available in the market. The purchasing decision is the result of a process through which the consumer is subconsciously guided, resulting in a final decision between alternatives. Various explanatory models have been elicited to explain the decision to purchase. In general, the consumer decision-making process can be defined as the process of obtaining and sifting through information and evaluating the acquired information in order to establish which product can best satisfy a need, followed by the actual purchase of the product (Prasad & Jha 2014). Therefore, consumers go through a set sequence of specific stages when they make a purchase decision before a decision to purchase can be made (Ashman *et al.* 2015).

There are, however, various factors that can influence consumers while moving through the decision-making process, such as culture, income, type of brand, personality and social status (Schiffman & Wisenblit 2019). Parumasur and Roberts-Lombard (2014) provide a more categorised approach to the factors that Schiffman and Wisenblit (2019) have listed by grouping the influences as individual influences (motive, personality, perception, learning,

attitudes and lifestyle), external influences (culture, social status, references groups and family), personal characteristics (age, lifestyle, gender and education), environment influences (technological changes, economics and politics) and marketing (price, brand, place, product and others). The significant role each of these factors play in the decision-making process will briefly be explained.

According to Oke *et al.* (2016), culture is a set of values, opinions and perceptions that a person has that can be influenced over time by family and friends which can have an effect on the purchase decision of a product. In order to determine if culture has any influence on consumers' decision to purchase, Durmaz *et al.* (2011) conducted a study in Gaziantep, Samsun, Sinop, Konya, Manisa, and Adiyaman provinces, in Turkey using interviews. The results of the study showed that culture was most certainly a factor that affected consumers when purchasing products, as 86% of the participants indicated that culture, beliefs and tradition are important criteria for them when deciding to purchase a product. Income is another big determinant during the decision to purchase as the disposable income of a consumer directly affects the type of product the consumer can afford (Ramya & Ali 2016). This was illustrated by a survey study conducted in India by Khan and Chawla (2014), which investigated the impact of consumer income on the purchasing decision. The results showed that the income of a consumer and the price of a product are two major factors that influenced purchasing decisions.

Brand, which refers to the name, symbol and design that makes a product unique (Ahmed *et al.* 2017), also plays a key role in the purchase decision as consumers tend to repurchase a brand with which they are familiar, thereby affecting their decision on what type of product to purchase (Chakraborty & Suresh 2018). A study, using a survey data collection method, was conducted in three cities in Pakistan namely Lahore, Gujranwala and Faisalabad to determine if the brand name of a product had any influence on consumers' choice and decision to purchase (Shehzad *et al.* 2014). The results showed that brand name or image had a strong relationship with consumers' purchasing decision.

Another element Schiffman and Wisenblit (2019) propose as an influence on the purchase decision is personality. Similarly, Orji *et al.* (2017) point out that personality includes how a person thinks, feels and ultimately behaves, which results in a pattern in which a person responds to a product. Therefore, a person will purchase a product such as jewellery or clothes that represent their personality. This was confirmed by a study conducted by Agbo *et al.* (2014) in South Eastern Nigeria, by using a survey, to determine if there was a relationship between

personality and consumer buying behaviour. Results indicated that there was, in fact, a strong relationship that existed between personality and consumers' purchasing behaviour.

In terms of social status, the position that a person holds in a specific club or group also influences consumers' purchasing decision, as a person will purchase a product that reflects their status in society (Ramya & Ali 2016). Therefore, any one or more of these and other factors may affect the consumers' purchasing decision. Abdolmaleki *et al.* (2016) conducted a study, by using surveys, in Tehran to determine if socio-cultural factors played a role in consumers' behaviour towards sports products. The results showed that social class affected the respondents' purchasing decision of sports products. It is therefore important to investigate the consumer decision-making process in order to understand if any of these factors or others, or a combination of factors, influence the purchasing decision of consumers (Orji *et al.* 2017), as in the case of purchasing GM food products.

3.4.1 Consumer Involvement during the Purchase Decision

According to Schiffman and Wisenblit (2019), there are two main types of purchasing decisions that a consumer uses when deciding to purchase a product, namely routine or low involvement purchasing decision, and extensive or high involvement purchasing decision. Cant *et al.* (2006) proposes that there is a third type of decision making that influences purchasing decision namely limited decision making; however, it is very similar to low involvement purchasing decision (Parumasur & Roberts-Lombard 2014) and will therefore not be discussed in this study.

Bruwer and Buller (2012) define involvement as the state of mind towards a product and an indication of a person's interest in a product; therefore, involvement is different in each person. Consumer involvement also guides consumers' opinions, feelings and behaviour when making decisions about a specific purchase (Parumasur & Roberts-Lombard 2014). Parumasur and Roberts-Lombard (2014) add that low involvement decisions suggest that consumers behave in a certain way without thinking about their actions. Consumers who engage in routine purchasing decisions make low involvement decisions, meaning that decisions to purchase a product are made automatically and very little information is acquired, therefore the need to acquire any additional information is absent (Calvo-Porral *et al.* 2018). However, if these consumers do need any information about the product to make a purchasing decision, they revert to an internal information search, which refers to the information and knowledge they already have (Inaba & Ito 2015). Calvo-Porral *et al.* (2018) therefore point out that consumers who are engaged in low involvement purchasing decisions do not regard the

purchasing decision as being important. As a result, these consumers lack motivation and the urgency in searching for and processing information about a product (Bian & Moutinho 2011). Inaba and Ito (2015) claim that low involvement products can include products such as detergents and coffee. As a dearth of research exists regarding consumers' purchasing decision of GM food products, it is not confirmed how involved consumers are when it comes to GM food products.

On the other hand, consumers who engage in extensive or high involvement decisions require the presence of interest in attaining more product-related information, while evaluating product features (Bian & Moutinho 2011). This information could be attained by collecting brochures of the product, visiting stores to enquire about the product and asking family or friends about their opinion or experience with the product (Inaba & Ito 2015). Therefore, high involvement decisions involve personal relevance (Schiffman & Wisenblit 2019) and suggest that consumers apply their minds to thinking about the process of how to purchase a product (Parumasur & Roberts-Lombard 2014). Furthermore, these consumers show a higher purchase intention and have positive opinions and perceptions towards the product features; as a result, consumers devote more time and energy to the purchasing decision of a product (Calvo-Porral *et al.* 2018). Bruwer and Buller (2012) add that consumers who take part in high involvement decisions are active seekers of information and ensure that they use the information to make the correct purchasing decision, in their own opinion. As a result, these consumers have the ability to evaluate products, thereby gaining a perception of the desired product (Bian & Moutinho 2011). Highly involved consumers also usually have good knowledge of the intended product to be purchased due to the extensive search for information. High involvement products include computers, laptops (Deshmukh & Das 2012), cars (Schiffman & Wisenblit 2019) and fashion products (Inaba & Ito 2015). Choubtarash *et al.* (2013) conducted a study at the Azad University of Sanandaj in Iran by distributing surveys to determine the relationship between consumer involvement and the purchase decision of cell phones. The results of the study demonstrated that there was indeed a relationship between consumer involvement and the purchasing decision of cell phones, thereby indicating that consumer involvement in the decision-making process influences consumers' decision to purchase. Overall, it can be concluded that a relationship exists between the level of involvement and purchasing decisions as the higher the degree of involvement, the higher the level of decision making that occurs (Parumasur & Roberts-Lombard 2014). Yet the degree to which consumers are involved in the decision-making process of GM food products is unknown.

3.4.2 Types of Consumer Decision Making

Consumers engage in different types of decision making such as habitual decision making, limited decision making and complex decision making (Parumasur & Roberts-Lombard 2014). Parumasur and Roberts-Lombard (2014) explain that habitual decision making refers to consumers who engage in low involvement decisions during the decision-making process, which causes consumers to repeatedly purchase the same product (Jain 2019). Limited decision making lies between habitual and extended decision making, and refers to consumers who do not have a high level of involvement or are not overly concerned with alternative products available on the market (Cant *et al.* 2006). In order to investigate young adult consumers' decision-making styles, Mishra (2010) used a survey to perform a study in India. The results showed that the respondents gave limited or no thought to the products they purchased and they did not engage in the evaluation of different types of brands. This showed that these respondents were habitual and limited decision-makers; product information and other competitive products in the category did not catch their attention nor act as a stimulus that would receive their attention.

According to Padmanabhan (2019), complex decision making refers to consumers who find themselves to be highly involved in the purchasing decision process, and as a result, they will compare alternatives of the product. A survey was conducted by Khan and Hameed (2019) in Pakistan to establish the determinants of sustainable consumption in high and low involvement product categories. The results showed that when consumers are highly involved in the purchasing decision of products, they make a better assessment of the product, which in turn affects their feelings towards a product, ultimately leading consumers to make a purchasing decision. This shows that complex decision making may result in consumers studying the product intensely, which may be the case with GM food products for some consumers, influencing their purchasing decisions. Therefore, the type of decision made by consumers may influence them as they continue moving through the decision-making process.

3.4.3 Schiffman and Wisenblit's (2019) Consumer Decision-Making Model

The Schiffman and Wisenblit (2019) consumer decision-making model is useful to study a purchase decision process as it shows all aspects of the various influences and proposes that these influences represent psychological and marketing-related influences that ultimately affect the consumer while moving through the purchasing decision. Therefore, this model discusses their general views on the identified influences that may explain why consumers behave in a particular way (Mihart 2012). The consumer decision-making model of Schiffman

and Wisenblit (2019) represents a systems perspective, which refers to various parts or aspects that have been grouped together and are related to each other (Jensen 2019). Therefore, the Schiffman and Wisenblit (2019) system perspective can be used to look at and determine all behaviours in a particular context. Thus, three components, namely input, process and output, are evident in the consumer decision-making model, as seen Figure 3.3.

Each of these components is discussed briefly in terms of how these aspects influence the input, process and output components.

3.4.3.1 Input Component

The input component influences consumers' realisation of a particular need (San & Yazdanifard 2014) and includes three main aspects, namely the marketing mix, socio-cultural influences and communication sources, as seen in Schiffman and Wisenblit's (2019) model. These three components are also referred to as external influences which together form the input system to the consumer decision-making process. According to Isoraite (2016), the marketing mix, which includes the marketing tools businesses use to position their product to meet consumer needs while achieving their own goals, consists of the product, promotion, price and place or distribution, commonly known as the 4 P's. These are controlled elements that marketers use to ensure that consumers satisfy their needs through the purchase of a product (Alnaser *et al.* 2017). Pour *et al.* (2013) explain that a product should encompass features that consumers could benefit from, while promotion refers to all the information that is provided from various sources about the product (Dominici 2009).

Dominici (2009) also explains that price refers to the money, time, as well as effort given by the consumer in order to purchase and obtain a product. Distribution refers to where the product will be sold and how the product would be distributed (Jackson & Ahuja 2016) in order to ensure that the product is available to the consumer (Pour *et al.* 2013). The marketing mix has, however, expanded from the 4 P's to many more components, including people, process, physical evidence and productivity, resulting in 8 P's (Alnaser *et al.* 2017). These have not been included in the Schiffman and Wisenblit (2019) consumer decision-making model, and will not be taken into consideration for this study.

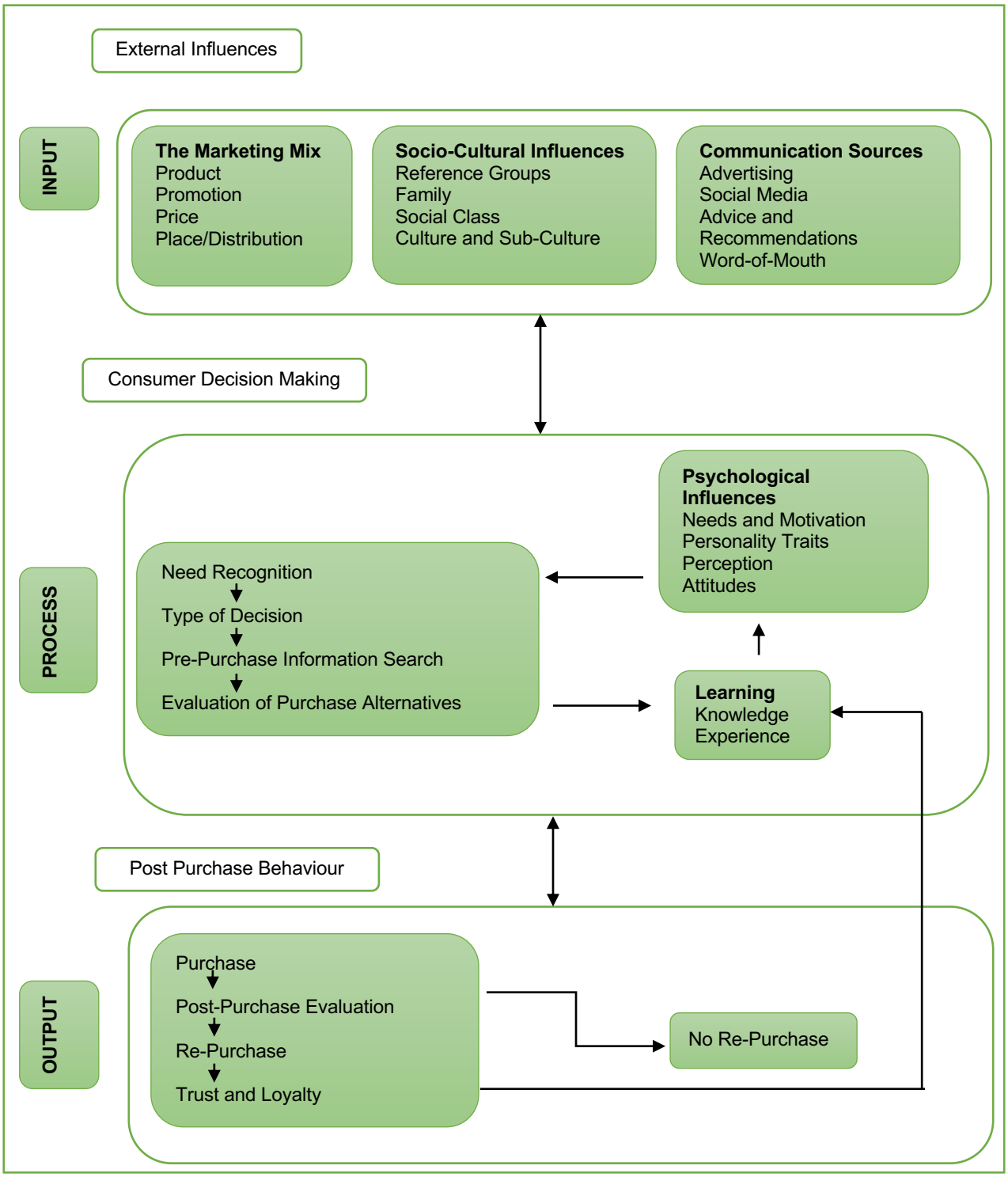

Figure 3.3: Schiffman and Wisenblit (2019) Consumer Decision-Making Model

The socio-cultural influences proposed in the Schiffman and Wisenblit (2019) consumer decision-making model include reference groups, family, social class, culture and sub-culture. Reference groups refer to a group of two or more people with whom a person can relate (Ramya & Ali 2016), whereas family refers to the group of people that a person relates to which has an influence on a person's personality and attitude and ultimately their purchasing

decision (Schiffman & Wisenblit 2019). A survey study was carried out by Fattah and Al-Azzam (2014) in Jordan, in order to determine what social factors influence consumers when purchasing home furnishing products. The results showed that there was a positive relationship between reference groups, family, price, colour and product quality, and the decision to purchase home furnishing products. Furthermore, social class refers to a group of people that share similar behaviours and hold similar status in society, and they may purchase products to reflect their status or position (Durmaz & Tasdemir 2014), as discussed in Section 3.4. According to Durmaz (2014), culture refers to the set of beliefs and values, preferences and perception that a person has which drives behaviour, whereas sub-culture refers to a group of individuals from the larger cultural group who share a set of beliefs that vary from the main culture (Ramya & Ali 2016), also discussed in Section 3.4. Therefore, the marketing mix and socio-cultural influences form part of the input stage as all of these factors are underlying influences that affect consumers even before they start with the decision to purchase a new product. They can be considered as latent influences in the consumer decision-making process.

A third component in the input phase of Schiffman and Wisenblit's (2019) consumer decision-making model points to various communication sources, from which consumers obtain information about products. Communication may include, but is not limited to, advertising, social media, advice and recommendations, and word-of-mouth. Advertising can be defined as a form of communication of a product to consumers by presenting ideas about a product in order to persuade consumers to purchase the product (Terkan 2014). In order to determine the impact that advertising has on consumers' buying behaviour, a study using a survey was conducted in Karachi City in Pakistan (Fatima & Lodhi 2015). The findings demonstrated that advertising influenced consumers' awareness and perception of products and, as a result, advertising showed to have a positive relationship to consumer buying behaviour. Marketers are actively engaging in using social media to form part of their advertising schemes as social media refers to advertising a product online such as websites and social networks which numerous consumers have access to on a daily basis (Voorveld *et al.* 2018). Madni (2014) used a survey to conduct a study in Pakistan to determine the effectiveness of social media on consumers' behaviour, in which the results concluded that social networks influence consumers' purchasing decisions.

According to Parumasur and Roberts-Lombard (2014), advice and recommendations refer to the opinions and views that consumers acquire from acquaintances such as friends and family. Word-of-mouth refers to positive or negative comments that are made by individuals after a product has been purchased and experienced, which is then made available to other people

(Naz 2014). As seen by the study conducted by Fattah and Al-Azzam (2014), as discussed earlier, family and reference groups influence consumers' purchasing decision. Another study using a survey was conducted by Ahmad *et al.* (2014) in Pakistan with the purpose of determining the impact of word-of-mouth, family and friends on consumers' purchasing decision. The results illustrated that word-of-mouth and the opinions of friends and family were indeed factors that influenced consumers when making a purchasing decision. These methods are therefore communication sources that distribute information about a product to consumers.

In terms of GM food products, a review of the literature also revealed that communication might include scientists or environmental groups. Information presented in the form of scientific papers make consumers feel that the information presented by scientists are believed to be credible (Wunderlich & Gatto 2015). Other sources of information, specifically in relation to GM food products, also include the Internet, television, friends and family (Cui & Shoemaker 2018), magazines and newspapers (Wunderlich & Gatto 2015). Therefore, the consumer decision-making process can be influenced by various types of communication sources.

3.4.3.2 Process Component

The second component, namely the process, of the Schiffman and Wisenblit's (2019) consumer decision-making model refers to the stage in which the model concentrates on the manner in which consumers make a purchasing decision (San & Yazdanifard 2014). During the process stage, which includes different phases, psychological influence is a major contributing factor to the purchasing decisions of consumers. The psychological influences are also referred to as internal influences. These psychological influences include needs and motivation, personality traits, perception and attitudes, which will be discussed first, followed by the stages of the consumer decision-making process.

Need and motivation refers to why a person behaves in a certain way (Auf *et al.* 2018) and is driven by five levels of needs such as physiological needs, safety needs, belonging needs, esteem needs, and self-actualisation needs (Schiffman & Wisenblit 2019). As Aruma and Hanachor (2017) explain, physiological needs refer to having the need for food, water, shelter, clothes, sleep and reproduction. Therefore, consumers will purchase products such as water, food, clothes, a bed and a house to fulfil the needs to survive (Schiffman & Wisenblit 2019). Aruma and Hanachor (2017) also explain that safety needs refer to having security and being safe from any danger, which may include financial security, medical aid (Taormina & Gao 2013) and legal protection (Raus *et al.* 2012). Belonging needs include the need to be loved

by family and friends (Schiffman & Wisenblit 2019), social clubs, belonging to a community and having friendships (Raus *et al.* 2012). Jerome (2013) explains that self-esteem needs refer to the need to be admired, to have respect and status, and to have self-worth, which stems largely from a person's mental image of themselves. Self-esteem needs can include prestige, recognition and responsibility (Raus *et al.* 2012). Self-actualisation needs refer to the need to accomplish something based on their own personal talents (Dima *et al.* 2010). For example, a musician would pursue a career in music, and a painter would seek to pursue a career in painting (Kenrick *et al.* 2010). Therefore, consumers will purchase a product based on their current needs and motivation.

Personality also forms part of a consumer's decision-making process as it refers to a person's being, which is formed by how a person thinks, feels and ultimately behaves. It results in a pattern in which a person responds to a product, and they will therefore purchase a product that reflects their own personality, such as clothes (Orji *et al.* 2017).

Another psychological factor that affects consumers' purchasing decision is perception, which is the process of interpreting information in order to make sense of something that allows the formation of a specific belief (Iuliana *et al.* 2012), as discussed in detail in Section 3.3. As a result, this belief affects consumers' opinion or view about a particular product, thereby influencing their purchasing decision (Parumasur & Roberts-Lombard 2014). Karedza *et al.* (2017) suggest that attitudes involve the beliefs or feelings that a person has about a particular product which also influences consumers' intention to purchase products. Consequently, these factors need to be kept in mind as the consumer moves through the consumer decision-making process.

According to the Schiffman and Wisenblit (2019) consumer decision-making model, the process stage involves four stages that the consumer moves through during the consumer decision-making process. However, there is a fifth and final stage, namely post-purchase evaluation, that other authors add to the consumer decision-making process (Parumasur & Roberts-Lombard 2014; Stankevich 2017; Xu & Chen 2017). Parumasur and Roberts-Lombard (2014) state that the post-purchase evaluation is considered part of the consumer decision-making process as it encompasses consumers' behaviour after the product has been purchased and shows whether the product did indeed satisfy their needs and solve the problem as identified in the first stage. This reasoning is also supported by Cant *et al.* (2006), Stankevich (2017) and Xu and Chen (2017).

Irrespective of the different views on the number of stages in the consumer decision-making process, the first stage in all processes pertains to a problem or need recognition. The *problem or need recognition* refers to the realisation of dissatisfaction towards a product after a product has failed to meet a consumer's needs and expectations (Hanaysha 2017). However, there is also a state consumers find themselves in when they have a need to purchase a new product, which can be initiated through new demands on the market that occur due to various internal and external stimuli (Xu & Chen 2017). Nevertheless, consumers who are habitual buyers may not exemplify a need and will therefore not be affected by their exposure to stimuli as these consumers purchase products they are familiar and satisfied with, and as a result, engage in frequent purchasing of the same product (Munthiu 2009). The unsatisfied needs can be further classified as tangible (for example a car or cell phone) or psychological needs (for example food, shelter and clothing) (Oke *et al.* 2016).

The *type of decision* in the Schiffman and Wisenblit (2019) consumer decision-making model refers to the second stage of the consumer decision-making process, in which the consumer decides if information should be acquired, particularly regarding any alternative products (Oke *et al.* 2016). This stage is influenced by the types of decisions, namely habitual decision making, limited decision making and complex decision making, discussed in Section 3.4.2.

Pre-purchase information search or information search, as it is referred to in other models (Parumasur & Roberts-Lombard 2014), is the third stage in the consumer decision-making process. It involves searching for internal and external information to assist in making a decision. The internal information search refers to consumers' culture, religion, prior purchasing experiences and already acquired knowledge (Xu & Chen 2017), whereas external search refers to searching for information on the Internet, television, newspapers, magazines, scientific articles and acquaintances (Wunderlich & Gatto 2015), which are also sources used by consumers to acquire information about GM food products. The time spent on this stage of the consumer's decision-making process typically depends on whether the consumer has had any prior experience purchasing the respective product and whether any interest is shown towards the product (Stankevich 2017).

Ashman *et al.* (2015) suggest that in the fourth stage of the consumer decision-making process, which involves *evaluation of purchase alternatives*, consumers will have a set of alternative products to choose from. During this stage, consumers will make an assessment between various types of products as well as brands prior to making a final decision about what product to purchase (Oke *et al.* 2016). Consumers will also decide which product characteristics are most important to them and which they most desire, based on their

personal preferences (Xu & Chen 2017). In the GM food product context, the attributes of GM food products could include improved taste, enhanced nutritional value, longer shelf life and reduced price.

As mentioned, other authors include a final stage, namely the post-purchase evaluation stage, in the consumer decision-making process (Parumasur & Roberts-Lombard 2014; Stankevich 2017; Xu & Chen 2017), whereas Schiffman and Wisenblit (2019) add this stage to the output stage of their system's perspective, where it will be discussed in relation to the study in the section to follow.

3.4.3.3 Output Component

The output component relates to the post-purchase behaviour of a consumer (San & Yazdanifard 2014). Schiffman and Wisenblit (2019) explain that after the consumer has moved through the input and process components of their system's perspective, the consumer comes to the stage in their decision-making process where they decide whether or not to purchase the product, which forms the output component of the consumer decision-making model. If the consumer does indeed decide to purchase the product, the action will lead them to post-purchase evaluation of the product, which involves the comparison of certain product characteristics (Parumasur & Roberts-Lombard 2014) such as taste, nutritional value, shelf life and price, and whether their perceived expectations of the product were successfully met (Schiffman & Wisenblit 2019). Therefore, at this point, consumers switch from evaluating their set of product alternatives from the process component of the systems perspective, to the buying process of the output component of the systems perspective (Stankevich 2017) of the product that best satisfies their pre-identified need (Noureddine & ZeinEddine 2018). This point in the output component of the systems perspective also involves consumers either disposing of or re-using a product based on their satisfaction (Oke *et al.* 2016). Therefore, if the product satisfied the consumer's needs, the consumer will purchase the product a second time. However, if the product did not satisfy the consumer's pre-identified needs, the consumer may refrain from purchasing the product in the future, and no repurchase will occur. After the product has been purchased, consumers could also acquire the opinion and views of acquaintances to make a final decision about the product (Parumasur & Roberts-Lombard 2014), which could largely influence their next purchase (Xu & Chen 2017).

Based on the consumer's satisfaction after deciding to purchase the product, experience and knowledge of the product are gained, which allows consumers to learn more about the purchased product (Stankevich 2017). Consequently, trust and loyalty is gained and

established (Schiffman & Wisenblit 2019). Trust and loyalty relies and is dependent on the entire consumer decision-making process as aspects such as the actual purchase of the product, the post-purchase evaluation, decision to repurchase or not to repurchase at all affects the formation of trust and loyalty. Trust refers to the degree of reliability that a person holds towards something, such as a product, thereby creating a relationship with the product (Nguyen *et al.* 2013). Whereas, loyalty can be defined as the evidence of repeated behaviour of a consumer towards a product which is a great indicator of consumer satisfaction (Leninkumar 2017).

Ilieska (2013) states that customer satisfaction, which can be defined as the fulfilment that a consumer enjoys of a particular response, forms a fundamental part in trust and loyalty of a product. As a result, customer satisfaction shows the extent to which a consumer was satisfied or unsatisfied by the product features in relation to their needs or wants (Van Tonder & De Beer 2018). Therefore, establishing trust, loyalty and ultimately customer satisfaction is fundamental to the success of a product in the market place (Chinomona & Dubihlela 2014). Furthermore, the trust and loyalty developed by consumers will affect consumers when deciding to purchase a product in future, which will revert them back to the process component of the consumer decision-making model. The Schiffman and Wisenblit (2019) consumer decision-making model thus includes various aspects which affect each other, moving consumers through their decision-making process. The conceptual framework for this study is discussed next.

3.5 CONCEPTUAL FRAMEWORK

In order to determine consumers' procedural knowledge and perception of GM food products and the factors that influence their purchasing decision, the conceptual framework proposed for this study is based on the Schiffman and Wisenblit (2019) consumer decision-making model, as seen in Figure 3.4.

The conceptual framework illustrates three components form the external influences, namely the marketing mix, socio-cultural and communication influences. These remain essential influences when considering the effects that determine consumers' decisions regarding GM food products. As in the case of the Shiffman and Wisenblit (2019) consumer decision-making model, these influences also feed into the process phase of the model that contains the internal influences. Specific to this study are the two psychological influences on which the study is focusing, which is perception and consumer learning. The importance of the remaining psychological influences (motivation, personality traits, and attitudes) are not abandoned. But

for the purpose of this study, they are not the main focus, and therefore their presence is merely recognised as potential and/or additional influences to the GM food product decision. However, with regard to the current study, perception as a psychological influence, includes nutrition, health, socio-economic, product quality, ethics and consumption concepts that the literature has indicated from the main elements in the consumer's understanding of GM foods and its related products. Within consumer learning – as psychological influence – attention is given to the component of procedural knowledge (which is a sub-field of knowledge as discussed in Section 3.2), an influence on the GM food product decision as manifested through general knowledge and information acquisition. Both of the psychological influences (perception and consumer learning) feed into the consumer decision-making process which is also, according to the Shiffman and Wisenblit (2019) consumer decision-making model, part of the process component in the model. The process remains significant in the need for recognition, pre-purchase and evaluation of alternative phases, which culminate in the experience the consumer gains about GM food products.

It is of interest to note that both perception of GM food products and the consumer's procedural knowledge of GM food products may start the consumer decision-making process. Consumers' knowledge about GM food products may create the need or act as the motivation in the consumer decision-making process in considering purchasing a GM food product. The conceptual framework proposes that an outer block encapsulates both the external influences and the internal influences, which suggests that these influences all funnelled into the consumer's purchase decision when faced with the GM food product.

However, the conceptual framework also proposes that, specifically in the field of GM foods and food products, specific GM-related factors, such as price, nutrition, acceptability, quality, health, environmental, ethics and food security may also influence the decision to purchase GM food products. In addition, the specific GM-related barriers such as GM knowledge, habitual behaviour and consumer uncertainty may also influence the decision to purchase. The conceptual framework lastly proposes that the external, internal and GM-related influences (which can be seen as additional external influences) all feed into the purchase decision resulting in the purchase or not of the GM food product.

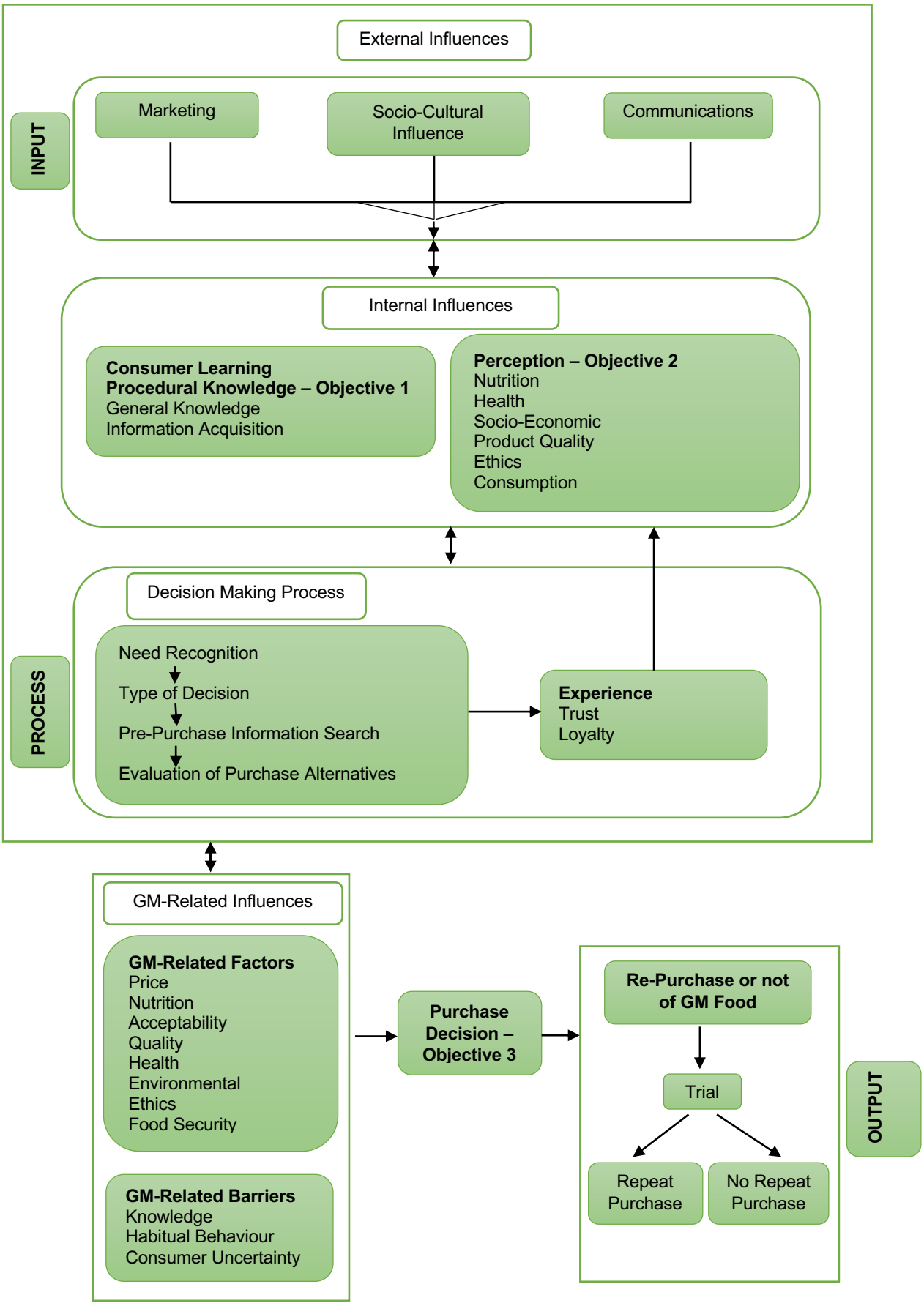

Figure 3.4: Proposed Schematic Conceptual Framework for this Study

Although the framework is postulating that these influences may drive the decision to purchase, the purpose of the study is to determine which factors come forward as the most prolific factors that result in consumers' decision to purchase or not to purchase a GM food product. In the output component of the Schiffman and Wisenblit (2019) consumer decision-making model, the purchase is also significant in the use or trial of the product, which is part of the post-purchase evaluation that takes place, potentially resulting in repurchase of the GM food product. The experience related to the output component is concluded with trust and loyalty established regarding the GM food product that feeds back into the experience the consumer had through the purchase and consumption of the product.

3.6 CONCLUSION

In this chapter, evidence has been presented of two behavioural influences in the consumer decision-making process, namely procedural knowledge and perception that may have a significant role to play in consumers' GM food product decisions. The conceptual framework for this study was based on the Schiffman and Wisenblit (2019) consumer decision-making model, which allows for a deeper understanding of consumers' procedural knowledge and perception of GM food products, as well as the factors that influence consumers as they move through the decision-making process. The research methodology will be presented in the following chapter.

CHAPTER 4

RESEARCH METHODOLOGY

The purpose of a Research Methodology chapter is to show how the strategies and procedures were carried out to obtain information in order to successfully address the research objectives (Iskander *et al.* 2018).

In this chapter, the methodology adopted in this study is described in terms of the research paradigm and design. The sampling strategy and sampling techniques used, data gathering methods, including the questionnaire design and data analysis methods that were applied, are discussed. The reliability and validity of the study in order to determine data quality and ethical considerations of the study are also reviewed.

4.1 INTRODUCTION

The previous chapter presented a literature review on consumers' procedural knowledge and perception of GM food products and the known or potential factors that influence their purchasing decision of GM food products. In this chapter, the methodology that was adopted to achieve the objectives of the study will be presented. The topic called for an investigation that would allow a better understanding of consumers' procedural knowledge and perception of GM food products as well as the factors that influence their purchasing decision of GM food products. The research was conducted in a way that would bring forward the underlying drivers of the knowledge, perception and the factors that influence consumers' purchasing decision of GM food products, and determine if procedural knowledge or perception impact the factors that influence the purchasing decision of GM food products.

A quantitative paradigm was used, and an exploratory survey research design was employed to execute the study. In this chapter, the geographic location of the study is presented, and the respondent criteria and non-probability sampling strategies used, namely purposive sampling and snowball sampling, are described. The respondent recruitment locations, inclusion criteria and sample size are also discussed. The questionnaire as data gathering method is presented as well as the design of the questionnaire. The operationalisation of the study, as well as the data analysis methods, are also discussed. In particular, the descriptive

data analysis methods applied to the data are presented, followed by the exploratory factor analysis (EFA) and the simple linear regression that was performed. The chapter concludes with the reliability and validity aspects regarding the instrument and study in general, as well as the ethical considerations applicable to the current study. The discussion will now follow on the motivation for the selection of the research paradigm.

4.2 RESEARCH PARADIGM

In this study, a quantitative paradigm was used. It added value by allowing the objectives of the study to be tested by exploring the relationship that existed within the key concepts of the study (Khaldi 2017). In research, a paradigm is used as an approach towards a particular research problem, acting as a guidance structure during the inquiry process (Kivunja & Kuyini 2017) and referring to the implementation of a deductive approach (Almalki 2016). This paradigm offers various benefits to the researcher as it involves a systematic process in which numerical data are obtained from a certain subgroup of the population while remaining objective (Maree & Pietersen 2016a) in the context of this study. It also allows the researcher to focus on human behaviour (procedural knowledge and perception), which could then be quantified (Rahman 2017). Moreover, a quantitative paradigm lends itself to ensuring that the objectives of the study are examined while exploring the relationship between variables or key concepts in the study (Khaldi 2017). The quantitative paradigm therefore allowed the researcher to measure three important concepts of the current study, namely procedural knowledge and perception of GM food products, as well as the factors that influence the purchasing decision of GM food products, thereby also enabling the researcher to describe the data obtained from the research (Rahi 2017).

In a quantitative paradigm, the data that are collected in an objective and systematic way, allow the researcher to analyse the data by making use of statistical procedures such as descriptive statistics and EFA through Statistical Package for Social Sciences (SPSS) (Queiros *et al.* 2017). Seeing that in a quantitative paradigm the researcher's involvement with the respondents is restricted, researcher bias can also be avoided (Daniel 2016). Therefore, the quantitative paradigm allowed for the capturing of numerical data for this study and, after analysis, the results were used to generalise the topic to the sample population (Saher 2015). This paradigm suited the current study as it allowed the researcher to obtain quantitative information that could be analysed to give a better understanding of consumers' procedural knowledge, perception and the factors that influence their purchasing decision of GM food products.

4.3 RESEARCH DESIGN

An exploratory research design was used in this study. It afforded the researcher the opportunity to gain a better understanding of consumers' procedural knowledge and perception of GM food products and the factors that influence their purchasing decision of GM food products, in an endeavour to investigate the nature of the problem (Berman 2017). The exploratory research design was particularly useful to this study as a limited number of research studies have been conducted on the specific topic (Bhat 2019). The purpose of the exploratory research design, in general, was to provide structure to the study as it incorporated decisions that were devised throughout the planning of the study (Abutabenjeh & Jaradat 2018) and questionnaire design (Palinkas *et al.* 2015). The exploratory research design also assisted the researcher in addressing the research objectives by choosing the appropriate data collection method as well as the most suitable respondents in order to collect and obtain information that was relevant to the problem being researched (Maree & Pietersen 2016b). This was done to determine whether consumers have knowledge of GM food products, what perception they have of the different aspects associated with GM food products (such as nutrition, socio-economic, product quality, health, ethics and consumption), and which factors would influence their purchasing decision when purchasing GM food products.

Apart from the exploratory research design adopted for this study, a survey research design was also used in order to measure the respondents' procedural knowledge and perception of GM food products and the factors that influence their purchasing decision. A survey research design is defined as the process of obtaining information from a group of individuals through their responses to questions (Ponto 2015). This research design is also useful in assessing and establishing respondents' opinions and thoughts pertaining to the research (Maree & Pietersen 2016b); in this case, related to GM food products. A survey research design was therefore deemed appropriate for the current research to address the study's primary objectives.

4.4 GEOGRAPHIC LOCATION OF STUDY

This study was conducted in a small town called Mooi River which forms a part of the Midlands Meander, situated in KwaZulu-Natal, South Africa, and a direct route to the Drakensberg Mountains (African Nights 2019). Mooi River is surrounded by various local farmers, including maize, potatoes, cattle and pig farming (South-African-Hotels. Com 2019). Consequently, access to a wide demographic diversity of consumers in a rural setting was possible, also largely due to the six main schools in town.

The significance of conducting the study in a rural setting is based on the fact that the majority of studies regarding GM food products were conducted in urban areas internationally, as illustrated in Table 4.1. The study would therefore provide a different exploratory view of the relationship between consumers and GM food products to what consumers in urban environments offer. It is important to determine rural consumers' views of GM food products as their opinions will form an integral part in the adoption and success of GM food products (De Groote *et al.* 2016) such as in South Africa. There are various reasons why the opinions and views of rural consumers differ compared to that of urban consumers; for example, consumers residing in rural areas lead different lifestyles and may therefore have different perceptions and knowledge on the topic compared to consumers residing in urban areas (Mahdi & Zin 2018). Furthermore, these consumers are exposed to a surrounding farming community which may result in sensitivity towards the cultivation of crops and the potential of GM farming. This, in turn, may influence their knowledge and perception of GM food products as well as the factors that influence their purchasing decision of GM food products.

Table 4.1 represents various GM food studies that have been conducted internationally related to consumers' perception, acceptance, awareness, opinion, and attitudes of GM food products. Also included are the purpose of these studies, location where the studies took place, and the sample used to deliver the research. This table evidently shows that the majority of published studies have been conducted in international urban areas. It is thus worth exploring if the location of a GM study, such as a rural area, would yield similar or different results compared to what has been published internationally and locally on studies conducted in urban areas.

Although various studies have been conducted on consumers and GM food products internationally, as seen in Table 4.1, a very limited number of such studies have been conducted in the South African context. Vermeulen *et al.* (2005) performed a study in Gauteng, South Africa, by means of a survey to establish urban South Africans' attitudes and acceptance of GM white maize. Lanzillotti (2007) used a survey to conduct a study in South Africa at the University of South Africa to establish South African consumers' attitudes towards food biotechnology. Additionally, Peter and Karodia (2014) conducted a study in the Chris Hani District Municipality in South Africa with the intention of determining consumers' awareness of GM food products, and Gastrow *et al.* (2018) recently conducted a study in South Africa by using a survey to determine consumers' understanding and knowledge of biotechnology.

Table 4.1: GM Food Studies

Authors	Topic of GM Food Study	Purpose of Study	Location of Study	Sample Used
Deffor, E.W.	Consumer Acceptance of Genetically Modified Foods in the Greater Accra Region of Ghana (Deffor 2014)	To establish consumer acceptance of GM foods	Region: Greater Region of Ghana	• Male and female • 240 respondents • Ages 20-50 and above
Popek, S. and M. Halagarda	Genetically modified foods: Consumer awareness, opinions and attitudes in selected EU countries (Popek & Halagarda 2017)	To establish consumer awareness, opinions and attitudes of GM foods	City: Warsaw - Poland	• Male and female • 976 respondents
Lopez, O.A., E.F. Perez, E.E.S. Fuentes, I. Luna-Espinoza and F.A. Cuevas	Perceptions and attitudes of Mexican urban population towards genetically modified organisms (Lopez *et al*. 2016)	To measure perception and attitudes about the production and consumption of GMOs	City: Mexico urban areas	• Male and female • 14720 respondents
Todua, N., T. Gogitidze and J. Phutkaradze	Georgian Consumer Attitudes Towards Genetically Modified Products (Todua *et al*. 2015)	To determine consumers attitudes towards GM products	City: Ajara in Georgia	• Male and female • 603 respondents
Eneh, O.C., C.A. Eneh and S.N. Chiemela	Food consumer perception of genetically modified foods in Enugu metropolis, Nigeria (Eneh *et al*. 2016)	To establish consumers perception of GM foods	Metropolis: Enugu in Nigeria	• Male and female • 60 respondents
Mandal, S. and R. Paul	Consumer Perception of Genetically Modified Food: Empirical Evidence From India (Mandal & Paul 2012)	To identify the factors that shape consumers perception towards the consumption of GM food	City: Hyderabad, Delhi and Kolkata in India	• Male and female • 422 respondents
Vecchione, M., C. Feldman and S. Wunderlich	Consumer knowledge and attitudes about genetically modified food products and labelling policy (Vecchione *et al*. 2015)	To examine the relationship between consumers knowledge, attitudes and behaviour towards foods containing GMOs	State: Northern New Jersey	• Male and female • 331 respondents

Another study was conducted by Gouse *et al*. (2016) in South Africa, KwaZulu-Natal by using a survey in order to establish the degree to which the gender of smallholder farmers affects the adoption of GM maize. Kotey *et al*. (2016) conducted a study in South Africa, Eastern Cape, to ascertain the awareness that extension personnel have pertaining to GM maize technology and the extent to which they disseminate the use of GM seeds in the agricultural industry. Evidently, limited studies have been conducted in South Africa specifically focusing on the knowledge and perception that rural consumers have of GM food products, as well as the factors that influence their purchasing decision, which this study aims to measure.

4.5 SAMPLING STRATEGY

The sampling strategy is a plan that a researcher follows in order to ensure that the sample, which is intended to be included in the study, will accurately represent the population (Elfil & Negida 2017). The discussion to follow will explain the use of the non-probability sampling strategy adopted for this study. The use of the purposive and snowball sampling methods used to recruit the participants for the study are also discussed.

4.5.1 Non-Probability Sampling Strategy

A non-probability sampling strategy is an effective strategy that is commonly used in quantitative research, allowing the researcher to implement their own judgement in terms of selecting potential respondents (Sarstedt *et al.* 2018). Therefore, a non-probability sampling strategy was used in this study. This sampling strategy assisted the researcher in selecting respondents who could help answer the research objectives and research questions (Martinez-Mesa *et al.* 2016). There are, however, limitations associated with a non-probability sampling strategy such as the lack of generalising the results to the population (Maree & Pietersen 2016c). Furthermore, specific non-probability sampling methods were used (purposive and snowball sampling) due to the fact that the researcher decided which groups of the population would form part of the sample (Maree & Pietersen 2016c) through the inclusion criteria used to select respondents. A discussion of the non-probability sampling methods that were applied in this study follows next.

4.5.1.1 Purposive Sampling Method

Purposive sampling, which is a type of non-probability sampling method, allowed the researcher to choose which cases he/she would like to make use of (Ames *et al.* 2019). The researcher thus had the opportunity to create a sampling frame of participants that would most likely be able to provide optimal information regarding the research topic (Van Rijnsoever 2017). This subsequently assisted the researcher in meeting the research objectives (Moser & Korstjens 2018). Purposive sampling therefore relied on the judgement of the researcher when selecting the respondents to take part in the study (Ragab & Arisha 2018). There are, however, limitations of purposive sampling such as researcher bias and the inability to generalise the results to the larger population (Maree & Pietersen 2016c).

The respondents were selected and included based on their relevance to the study, which comprised of respondents who had the desired characteristics. Evidently, the researcher

selected respondents who she believed warranted inclusion in the study (Taherdoost 2016a). However, the respondents who did not adhere to the inclusion criteria, as discussed in section 4.5.3, were eliminated as potential respondents of the study (Maree & Pietersen 2016c). The study had specific inclusion criteria for respondents, and purposive sampling was therefore implemented. Purposive sampling was used by the researcher to reach and recruit the first round of respondents who met the inclusion criteria of the study. Thereafter, the respondents were also asked to identify other potential respondents who would be interested in completing the survey. This initiated the snowball sampling method, supplementing the purposive sampling method in order to achieve a statistically significant number of respondents.

4.5.1.2 Snowball Sampling Method

Snowball sampling, also referred to as chain-referral sampling (Naderifar *et al.* 2017), is a type of non-probability sampling method which researchers use in order to identify possible respondents when respondents are difficult to locate (Geddes *et al.* 2017). When snowball sampling was implemented, it had a starting point in which the researcher made contact with one or more person of the population, with desired characteristics, who were asked to complete a questionnaire (Etikan & Bala 2017). Thereafter, the initial group of respondents gave information about other people who had the same or similar characteristics who could be contacted next by the researcher to also complete a questionnaire (Maree & Pietersen 2016c). The snowball effect took place as one referral was obtained from another, resulting in the identification of more and more respondents (Kirchherr & Charles 2018). Thus, respondents identified through purposive sampling were requested to encourage other respondents to take part in the study, thereby increasing the sample size (Taherdoost 2016a). A major advantage of snowball sampling is that this sampling strategy greatly assisted the researcher in locating and accessing the desired population (Sharma 2017). Snowball sampling was used by the researcher until an adequate number of respondents were reached (Naderifar *et al.* 2017) who completed the questionnaire, which allowed the researcher to do relevant statistical analysis on the data that were obtained. There are, however, limitations to using a snowball sampling method such as the researcher not having full control over the sampling method and the concern that sampling bias may be present (Taherdoost 2016a).

4.5.2 Respondent Recruitment Locations

The respondents for this study were adult consumers recruited from schools such as Treverton College, Treverton Preparatory School and Mooi River Primary School. Respondents were also recruited from businesses in Mooi River, which included individuals

working at Zuyberink Offices (block of offices rented by various businesses), TWK Agriculture (farm equipment supplier), the Mooi River Veterinary Wholesalers (veterinary pharmacy), Mooi River Veterinary Clinic, Glenrock Game and Trout (self-catering cottages), Mooi River Pharmacy and Medicine Depot, Nsele Emergency Services (ambulance services, medical rescue, first aid training and security services), as well as respondents from the Nederduitse Gereformeerde (NG) Church. These recruitment settings were approached to reach respondents of various demographic groups, which could allow the researcher to obtain a variety of responses. Purposive sampling and snowball sampling took place at all the mentioned locations. The headmasters of the schools and owners of the businesses were approached in person by the researcher beforehand to obtain permission to approach their employees.

4.5.3 Inclusion Criteria Used in the Study

Respondents who participated in this study were included if they were *male or female, above 18 years of age* and *residing in Mooi River*. Both male and female respondents were included in this study to ensure that the opinions were not gender-specific in terms of GM food products, as the views and opinions of males may differ to those of females. Although this might be the case, this study, in particular, did not set out to determine the differences between male and female respondents' views on GM food products. The researcher's aim was only to include as many respondents as possible from both genders to ensure that a variety of opinions could be captured. The inclusion criteria further stipulated the recruitment of respondents who, in their own opinion, *had heard of or were aware of GM foods products*. The respondents also had to be *general consumers who purchased from food product stores in Mooi River* and, in their own opinion, must have had *some experience with purchasing and/or consuming GM and non-GM food products*. Establishing whether the respondents had some experience with purchasing and/or consuming GM and non-GM food products was important to the research, as the respondents may already have had some knowledge of GM food products prior to the study that may contribute to a better understanding of the context within which the responses were generated. However, respondents were not excluded based on what they thought they knew about GM food products. The respondents' own perceived understanding of GM food products, whether correct or not, made them eligible to participate in the study.

The inclusion criteria also involved respondents who were *exposed to GM food products in store in terms of noticing the availability of GM food products on the shelves while shopping for food products* and therefore were *possibly also aware of the presence of GM food products in store*. If the consumers were unsure whether they had or had not consumed GM food

products but had some awareness of GM food products and would have liked to share their opinion or experience about GM food products, they were also included in the study. It was important to include all possible respondents in the study, as a variety of opinions about GM food products was important to be included, irrespective of the level of the exposure and knowledge of GM food products.

In an attempt to support the inclusion criteria, four positioning questions were used to enable the researcher to create a profile of the respondents (Taherdoost 2016b). This allowed her to form a better understanding of the perspective from which the respondents were coming while meeting the inclusion criteria of this study. Positioning questions were used not to eliminate participation in the completion of the questionnaire but to allow the researcher to establish a perceived level of understanding respondents thought they had in terms of GM food products.

Each positioning question was related to a respective section in the questionnaire. The intention of the relationship between the positioning questions and each section (Sections B to D) of the questionnaire was to enable the researcher to create a better understanding of the answers that the respondents gave in the questionnaire in relation to where they positioned themselves on the relevant question. The first positioning question referred to the respondent's *level of exposure* in terms of their experience of or exposure to GM food products. This question pertained to Section B of the questionnaire, which elicited responses related to the procedural knowledge of GM food products. Determining the level at which the respondents thought they were exposed to GM food products, may indicate their level of knowledge of GM food products. If respondents feel they have great exposure to GM food products, it could indicate that they already have knowledge of GM food products and are in fact aware that they are exposed to GM food products, could possibly identify the products, and are well aware of their existence among the food items they purchase. Whereas, respondents who think they are not exposed to GM food products may lack knowledge of GM food products and subsequently be unaware of the products' existence.

The second positioning question which determined *the level at which the respondents thought they looked at or noticed GM food products* in store, pertained to Section C of the questionnaire which involves the respondents' perception of GM food products. This included a measure of how often respondents looked for or noticed GM food products in store. It gives an indication as to whether the respondents have a perceived awareness of GM food products, which products they are, and in which food product categories they are available. The respondents' perceived awareness of GM food products may also influence whether the respondents were indeed looking to purchase GM food products in store.

The third positioning question related to the *level of awareness of GM food products*, and pertained to Section B of the questionnaire. It involved the procedural knowledge of GM food products as the respondents' awareness of GM food products relates to their knowledge of such products. If respondents are knowledgeable about GM food products, it is more likely that they will be aware of these products. Contrary to this, if the respondents do not have knowledge of GM food products, they may not be aware of GM food products.

The fourth positioning question, which established *how often GM food products were used*, pertained to Section D of the questionnaire and involved the factors that influence the purchasing decision of GM food products. The fourth positioning question gives the researcher an indication as to the respondents' purchasing behaviour of GM food products; their use of GM food products will directly indicate how often the respondents are specifically purchasing GM food products.

4.5.4 Size of the Sample

The size of the sample for this study was critical as it allowed the researcher to make inferences about the population, which could prevent unreliable conclusions from being made. It was therefore imperative that the sample size included sufficient power in the number of responses to achieve significance (Majid 2018) from the results. Consequently, a larger sample size is more representative of the population and could simultaneously yield more accurate results (Chander 2017). A sample size of 250 respondents were desired based on the population size (Census 2011), with a confidence level of 90% and a 5% margin of error. However, to account for population growth of Mooi River and to increase the statistical significance of the calculations, the aim was to increase this number to 300 respondents. A total of 400 questionnaires were distributed to mediate the factors that might cause potential questionnaires not to be returned, or returned incomplete and or completed incorrectly. The questionnaires that were returned were screened for the completion of the consent form and completion of all the questions and statements. The final number of usable questionnaires were 326.

4.6 DATA COLLECTION

Data collection forms an integral part of research as it involves the process of obtaining and gathering information in order to answer research objectives and questions (Maree & Pietersen 2016b).

4.6.1 Method of Data Collection

The method of data collection adopted for this study was through means of a survey. Taherdoost (2016b) states that the main purpose of a survey is to gather information from a particular group of individuals regarding a certain topic in a reliable and viable manner. Surveys are commonly used as a data gathering method in order to investigate the opinions of respondents while minimising researcher bias (Phillips 2017). The survey data collection method also allowed the researcher to gather information from many respondents that simultaneously increased the statistical power of the study and facilitated the use of a validated (through means of construct, face and content validity) and reliable tool of measurement (Turk *et al.* 2018). Therefore, the survey method was an appropriate data collection method to use in this study.

A survey data collection method commonly employs a questionnaire as data gathering instrument through which data can be collected (Maree & Pietersen 2016b); therefore, in this study, a questionnaire was used as data gathering instrument. A questionnaire was suitable since questionnaires are often used to obtain information from a large number of respondents (Bosnjak *et al*. 2016). A questionnaire was also a relatively inexpensive data gathering instrument to use (Ebert *et al.* 2018) and assisted in ensuring respondent confidentiality as only the respondent, researcher and supervisors had access to the completed questionnaire. It also meant that more respondents were willing to take part in the study.

The questionnaire was designed in a user-friendly format which made it easy for respondents to complete (Rice *et al.* 2017). Using questionnaires as a data collection instrument was quite easy to administer and allowed for a quick response rate. The information received from questionnaires were analysed in terms of numbers, which were then converted into tables, figures and graphs to present the results of the study (Bosnjak *et al*. 2016). Furthermore, questionnaires used in quantitative research commonly use scales (Ponto 2015); Likert scales with predefined response choices (Schiffman & Wisenblit 2019) were applied in this study.

Questionnaires can be administered to respondents in various ways. In this study, the questionnaires were administered through a data collection method known as group-administered questionnaires (Ponto 2015). The researcher thus personally distributed the questionnaires to a group of respondents and waited until the questionnaires were completed. Group-administered questionnaires allowed the respondents to complete the questionnaire quickly, while having the opportunity to ask the researcher to clarify any uncertainties (Maree

2016). Upon completion, the questionnaires were retrieved by the researcher, and the respondents were thanked for their participation and excused.

Prior to distributing the questionnaires, the researcher made contact with the managers of the companies and headmasters of the schools, to set a date and time to distribute the questionnaire in groups at each of the aforementioned identified locations. However, if some of the respondents in the group were unable to complete the questionnaire immediately or needed more time, the researcher set a confirmed date specifying when the researcher would physically return to collect the questionnaires from the respondents' workplace. However, there were gatekeepers present, who had access to the respondents and collection points to collect the questionnaires. Some respondents did not have the questionnaires completed upon collection or forgot the collection date agreed upon with the researcher. A reminder for the completion of the questionnaire was then issued, and collection of the questionnaires were arranged as suitable to the respondents.

4.7 QUESTIONNAIRE DESIGN

As part of the survey method used in the study, a questionnaire was used as the main instrument through which data were gathered on consumers' procedural knowledge and perception of GM food products and the factors that influence their purchasing decision. The questionnaire was developed from a combination of existing literature and from research conducted and tabled or discussed in findings from relevant studies published in scientific papers. The questionnaire that was designed for this study consisted of four sections. Section A included questions that required the respondents to provide basic demographic information to enable the researcher to describe the respondent profile of the study. Sections B, C and D included statements that measured consumers' procedural knowledge and perception of GM food products. The factors that influence their purchasing decision were also included to address the objectives of the study. The details of the questions pertaining to Section A and the statements pertaining to Sections B, C and D are discussed next. However, in order to ensure ease of understanding of the questions and statements posed to the respondents, simple wording and an easy layout format for the questionnaire (Ebert *et al.* 2018) was used. The font of the questions and statements were kept simple, and the questions and statements were kept short and to the point to ensure that the completion of the questionnaire was quick and to receive the appropriate response from the respondents (Goegan *et al.* 2018). This was important in order to ensure that the respondents remained encouraged to complete the entire questionnaire and for the researcher to receive a good response rate (Taherdoost 2016b).

A five-point Likert scale can be referred to as an ordinal scale (Wu & Leung 2017) in which the respondents choose an option that best describes their opinion, attitude or perception towards a specific statement, and commonly ranges from 'Strongly Disagree' to 'Strongly Agree' (Mondiana *et al.* 2018). The 'neither agree nor disagree option' in a Likert scale is the middle option commonly selected by respondents who feel that they position themselves as being neutral to the statement or question asked, or because they do not feel that they have a particular opinion (Joshi *et al.* 2015). However, there are various views around whether the middle option in a Likert scale, namely 'neither agree nor disagree', could influence the validity of a questionnaire (Tsang 2012). Tsang (2012) explains that studies have shown that the middle value of a Likert scale does not influence construct validity, whereas other studies have shown that failing to include the middle option in a Likert scale could negatively affect the validity. Langbecker *et al.* (2017) explain that respondents may also choose the middle option to avoid admitting their true opinion, but it may not be beneficial to remove the middle option from a Likert scale as it may not give respondents who are truly neutral the opportunity to give an accurate response. Nevertheless, researchers commonly use this scale to measure respondents' opinion, and it was particularly useful to the researcher as the construction and analysis of such scales are quick and easy (Ho 2017). Therefore, five-point Likert scales were used in this study and in the questionnaire to measure procedural knowledge, perception and the factors that influence the purchasing decision of GM food products. Respondents could indicate their level of agreement or disagreement with the statements by ticking the response category that best suited their response to the statement. The full questionnaire is available in Appendix A. A description of each of the sections in the questionnaire follows.

Section A pertained to the demographic information of the respondents. The questions were constructed as categorical closed-ended questions addressing the gender, age, income, ethnic affiliation, level of education, marital status and status of employment, type of organisation the respondent works for and the core business of the establishment for whom they work. The demographic questions were included to assist the researcher in compiling the profile of the sample of respondents used in the study. This section also included positioning questions to ensure that the respondents met the inclusion criteria set out for the study. The positioning questions required the respondents to indicate the level to which they thought they were exposed to GM food products, the level to which they thought they looked at GM food products in store, what they thought their level of awareness of GM food products was, and how often they thought they used GM food products.

Section B consisted of two sub-sections that explored the respondents' procedural knowledge of GM food products. Both sub-sections made use of a five-point Likert scale that allowed the

respondents to indicate whether they agreed or disagreed with the statement provided. The statements in the first sub-section of Section B were included to determine whether the respondents knew anything about GM food products and which products they thought available in supermarkets were in fact genetically modified. The second sub-section of Section B consisted of statements to determine whether respondents were looking for information pertaining to GM food products from different sources as well as which sources they felt were the most credible to provide information on GM food products.

Section C also consisted of two sub-sections and examined the respondents' perception of GM food products. A five-point Likert scale was used in both sub-sections in which the respondents were required to indicate whether they agreed or disagreed with the statement provided. The specific statements in the first sub-section of Section C were included to determine the perception of respondents towards the benefits pertaining to the nutritional, socio-economic and product quality aspects of GM food products. The second sub-section in Section C consisted of statements particularly pertaining to the negative health, ethical and consumption aspects of GM food products, which was used to determine the respondents' perception to the statements in terms of their greatest concern (fear) about GM food products or no concern (fear) at all.

Section D consisted of two sub-sections which explored the factors that influence the respondents' purchasing decision of GM food products. Both sub-sections in Section D made use of a five-point Likert scale which gave the respondents the opportunity to agree or disagree with the statement provided. The statements in the first sub-section of Section D attempted to determine which GM-related factors would influence the respondents' purchasing decision of GM food products. The second sub-section in Section D included statements that were used to determine which general GM-related barriers of GM food products would influence consumers' purchasing decision of GM food products.

The questionnaire that was distributed to the respondents included a cover letter to inform them about the aim of the study, how they should complete the questionnaire, and the name and contact details of the researcher as well as the supervisors. The cover letter also assured respondents of their anonymity when participating in the study, and stated that participation in the study was voluntary and that the respondents could withdraw from the study at any given time without penalty.

4.8 QUALITY OF THE DATA

Data quality refers to the assessment of whether the data obtained serves its purpose by answering the research questions and objectives. In order to determine data quality, the reliability and validity of the instruments were determined (Heale & Twycross 2015) for the questionnaire used in the study.

4.8.1 Reliability

According to Thomas (2017), reliability refers to whether an instrument (questionnaire) will yield similar or the same results when conducted on other respondents on a different occasion. It is essential to determine reliability as it refers to the consistency across the entire instrument, such as a questionnaire (Taherdoost 2016b). All the statements pertaining to the respondents' procedural knowledge, perception, and factors that influence their purchasing decision of GM foods were tested using Cronbach Alpha's internal consistency reliability tests during the data analysis stage in order to measure the reliability thereof (Inal *et al.* 2017). Cronbach Alpha is believed to be the most suitable measure of reliability, especially when the questionnaire consists of Likert scales (Taherdoost 2016b). High Cronbach Alpha scores indicate that the questions/statements of the questionnaire are reliable (Taber 2018). Cronbach Alpha scores that are close to 1 signifies high reliability, whereas scores that are closer to 0 signifies little or no reliability at all (Quansah 2017). In this study, a minimum reliability score of 0.7 was set for all statements in order to be included in the results. After the questionnaires were retrieved, the data were coded and entered into an Excel spreadsheet.

4.8.2 Validity

According to Lam *et al.* (2018), validity refers to how well the survey measures what it was intended to evaluate or measure. For the purpose of this study, construct validity, face validity and content validity were implemented in order to determine the validity of the questionnaire.

4.8.2.1 Construct Validity

Construct validity refers to how well the instrument covers all aspects that it is intended to measure (Taherdoost 2016b). The constructs or concepts of the questionnaire were formulated based on relevant literature and previous studies. In order to ensure that construct validity of the questionnaire was achieved, the questionnaire was scrutinised by the research supervisors. EFA was also conducted in order to ensure validity of the instrument as the EFA

will show whether the variables fit into the identified factors which adds to the validity of the questionnaire.

4.8.2.2 Face Validity

Face validity refers to the degree to which the questionnaire appears to measure what it is intended to measure (Ghazali 2016). Therefore, face validity was achieved by making sure the statements in the questionnaire linked back to the objectives of the study (Xie 2018). The questionnaire was presented to the supervisors for careful inspection in order to ascertain whether the statements measured the objectives of the study before approval took place.

4.8.2.3 Content Validity

Content validity refers to how well the questionnaire covers all facets of a particular construct (Hawkins *et al.* 2018), namely the procedural knowledge and perception of GM food products and the factors that influence the purchasing decision of GM food products. Content validity is achieved by asking an expert to review the questionnaire in order to determine that the questions/statements represent the identified objectives of the study (Pietersen & Maree 2016b). For the purpose of this study, content validity was achieved by presenting the questionnaire to the supervisors. Before the questionnaire was developed, the researcher did an extensive literature review in order to ensure that the questionnaire covered all aspects of GM food products. This included the procedural knowledge the respondents possess of GM food products, sources which were used for information regarding GM food products, their perception of GM food products, as well as the factors and general barriers that influence the purchasing decision of GM food products.

4.8.2.4 Pre-Test of Questionnaire

The questionnaire was subjected to a pre-test in Mooi River, KwaZulu-Natal on eight individuals who met the inclusion criteria of the main study, in order to establish whether the statements in the questionnaire worked and measured what they were initially intended to measure (Fraser *et al.* 2018). The pre-test of the questionnaire also gave the researcher the opportunity to check whether the individuals understood the terminology of the questions and statements thoroughly and whether the questionnaire could be completed in the given time frame (Bolarinwa 2015). Pre-testing of the questionnaire ultimately assisted in decreasing sampling errors while simultaneously increasing the response rate (Hilton 2017). After the pre-test was completed, it was concluded that no aspects of the questionnaire were regarded as

difficult, inappropriate or confusing, and the questionnaire was completed in the given time frame, thus no changes were made to the questionnaire.

4.9 OPERATIONALISATION OF THE STUDY

Operationalisation refers to the process in which the researcher defines the variables of the questionnaire into measurable factors (Tariq 2015). The questionnaire was developed with the intention of addressing the objectives of the study and acquiring results while keeping the respondents anonymous throughout the study. The operationalisation of the study, as related to the research objectives, is provided in Table 4.2, Table 4.3, Table 4.4 and Table 4.5, as well as the demographic section and positioning questions.

Table 4.2: The Structure of the Questionnaire

Section	Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Question/ Statement Number
A		Categorical Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation	**Demographic Information**		
				Gender	V2	1
				Age	V3	2
				Estimated household income	V4	3
				Ethnic affiliation	V5	4
				Highest level of education	V6	5
				Marital status	V7	6
				Status of employment	V8	7
				Type of Organisation you work for	V9	8
				Core business of your establishment	V10	9
				Positioning Questions		
				Level of exposure of GM food products	V11	10
				Look at GM food products in store	V12	11
				Level of awareness of GM food products	V13	12
				How often GM food products are used	V14	13
B	To explore consumers'	Likert Scale	Descriptive Analysis	**Procedural Knowledge**		

Section	Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Question/ Statement Number
	procedural knowledge of genetically modified (GM) food products in terms of general knowledge about GM food products		• Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach alpha • Exploratory Factor Analysis • Simple linear regression	General knowledge of GM food products	V15-V24	14-23
				Information pertaining to GM food products	V25-V32	24-31
C	To explore consumers' perception of genetically modified (GM) food products in terms of GM food products	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach alpha • Exploratory Factor Analysis • Simple linear regression	**Perception**		
				Nutritional aspects of GM food products	V33	32
					V34	33
					V35	34
					V36	35
					V37	36
					V38	37
				Health aspects of GM food products	V46	45
					V50	49
					V56	55
					V57	56
					V58	57
					V59	58
					V60	59
					V61	60
				Socio-economic effect of GM food products	V39	38
					V40	39
					V41	40
					V42	41
					V43	42
				Product quality aspects of GM food products	V44	43
					V45	44
				Ethical aspects of GM food products	V47	46
					V48	47
					V52	51
					V53	52
					V54	53
					V62	61
				Consumption aspects of GM food products	V49	48
					V51	50
					V55	54
D	To identify the factors that influence the purchasing decision of genetically modified (GM) food products	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis	**Factors Influencing Purchasing Decision**		
				GM-related factors influencing purchasing decision of	V63-V75	62-74

Section	Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Question/ Statement Number
			• Shapiro-Wilks Test • Cronbach alpha • Exploratory Factor Analysis • Simple linear regression	GM food products		
				General GM-related barriers related to GM food products	V76-V84	75-83

Table 4.3 illustrates how the questionnaire measured the procedural knowledge that consumers have of GM food products.

Table 4.3: Operationalisation of the Procedural Knowledge of GM Food Products

Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Statement Number
To explore consumers' procedural knowledge of GM food products	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	General knowledge about GM food products	V15	14
				V16	15
				V17	16
				V18	17
				V19	18
				V20	19
				V21	20
				V22	21
				V23	22
				V24	23
	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	Information pertaining to GM food products	V25	24
				V26	25
				V27	26
				V28	27
				V29	28
				V30	29
				V31	30
				V32	31

Table 4.4 illustrates how the questionnaire measured the perception that consumers have of GM food products.

Table 4.4: Operationalisation of the Perception of GM Food Products

Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Statement Number
To explore consumers' perception of genetically modified (GM) food products	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	Nutritional aspects of GM food products	V33	32
				V34	33
				V35	34
				V36	35
				V37	36
				V38	37
			Health aspects of GM food products	V46	45
				V50	49
				V56	55
				V57	56
				V58	57
				V59	58
				V60	59
				V61	60
	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	Socio-economic aspects of GM food products	V39	38
				V40	39
				V41	40
				V42	41
				V43	42
	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks Test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	Product quality aspects of GM food products	V44	43
				V45	44
	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation	Ethical aspects of GM food products	V47	46
				V48	47
				V52	51

Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Statement Number
		Inferential Analysis • Shapiro-Wilks test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression		V53	52
				V54	53
				V62	61
	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	Consumption aspects of GM food products	V49	48
				V51	50
				V55	54

Table 4.5 illustrates how the questionnaire measured and established which factors of GM food products will influence their purchasing decision of GM food products.

Table 4.5: Operationalisation of the Factors that Influence the Purchasing Decision of GM Food Products

Study Objective	Measuring Tool Used	Statistical Analysis Procedure	Aspect Measured	Variable Number	Statement Number
To identify the factors that influence the purchasing decision of genetically modified (GM) food products	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	GM-related factors of GM food products	V63-V75	62-74
	Likert Scale	Descriptive Analysis • Frequency • Percentages • Mean • Standard Deviation Inferential Analysis • Shapiro-Wilks test • Cronbach Alpha • Exploratory Factor Analysis • Simple Linear Regression	General GM-related barriers of GM food products	V76-V84	75-83

4.10 DATA ANALYSIS

4.10.1 Descriptive Analysis

According to Moser and Korstjens (2018), the aim of data analysis is to place the obtained information into categories, develop theories, create order in the data and condense the information. Consequently, once the data were obtained and collected from the respondents, the responses from the questionnaires were coded. This refers to the process in which the researcher categorises the data in order to facilitate analysis (Nyumba *et al.* 2018). After the coding process, the information was typed into a predesigned spreadsheet on Excel, which

contained all the variables in the questionnaire. In order to analyse the data, a statistical package known as IMB SPSS Statistics 25 was used.

Different analysis procedures were applied to the data. Descriptive analysis of the data was used to analyse a specific data set which has already been summarised and is used to describe the data of the study in an organised manner (Kaur *et al.* 2018). This allowed for the use of frequencies, percentages, central tendency (mean) and standard deviation in which the data were then converted to tables and graphs. These were used to indicate the numerical values of each variable, as indicated in the questionnaire (Mishra *et al.* 2019). Moreover, using tables and graphs allowed the researcher to interpret the data in such a way as to show comparison between variables and ultimately present the findings in a visual manner. This assisted in presenting the data in a meaningful way (Kaliyadan & Kulkarni 2019) with regards to respondents' procedural knowledge and perception of GM food products, and the factors that influence their purchasing decision of GM food products.

4.10.2 Inferential Analysis

Inferential statistical analysis was also used to analyse the data. This refers to using the findings from sample data in order to make a generalisation and prediction about the population from Mooi River (Kaur *et al.* 2018). Therefore, the data obtained from the study sample was used to state the Mooi River respondents' procedural knowledge and perception of GM food products and the factors that influence their purchasing decision. This, consequently, allowed the researcher to make predictions as to Mooi River respondents' procedural knowledge of GM food products, their perception, as well as predictions pertaining to the factors that may influence their purchasing decision of GM food products.

In order to determine if the data obtained from Sections B, C and D of the questionnaire was normally distributed, the Shapiro-Wilks test was conducted. The statements in the questionnaire were grouped into various components, each addressing a specific factor. These statements were developed from existing literature, research conducted and tabled or discussed in findings from relevant studies published in scientific papers. Therefore, according to studies done by Wang et al. (2011) as well as Baldner and McGinley (2014), the statistical procedure was followed to first conduct the Cronbach Alpha to determine whether the components in the specific sections did indeed address a single overarching factor. This was then followed by the Exploratory Factor Anlaysis (EFA) in order to determine the sub-factors that emerged from the underlying components within these sections, namely Sections B, C and D.

Furthermore, statements will be referred to as variables for analysis purposes. Simple linear regression was also performed to determine if there was any relationship between procedural knowledge and the factors that influence the purchasing decision, as well as to determine if there was a relationship between perception and the factors that influence the purchasing decision. Simple linear regression was also performed to determine if procedural knowledge of GM food products had any influence on the perception of GM food products. Through applying these statistical methods, inferences were drawn about the population at large that assisted in yielding insights into the general rural respondents' procedural knowledge and perception of GM food products, as well as the factors that influence their purchasing decision of GM food products.

4.11 ETHICAL CONSIDERATIONS

It is essential for the researcher to take note of any ethical implications or aspects that may be encountered throughout the process of conducting research. The approved proposal for this study was presented to the College of Agriculture and Environmental Sciences Human Research Ethics Committee (CAES HREC) for approval before data collection took place (Research Ethical Clearance Number: 2018/CAES/162), which can be seen in Appendix B. A cover letter (Appendix C) was presented together with the questionnaire in order to inform the respondents about the purpose and objective of the study. Participation in the research project was voluntary, and no incentives or compensation was awarded to the respondents. The respondents were requested to complete a consent form (Appendix C) explaining the study. Thereafter, they had the opportunity to consider if they want to participate in the study or not. The researcher also informed the respondents, when distributing the questionnaires, what steps had been put into place in order to ensure that the information presented would remain confidential, anonymous and private at all times. In order to obtain informed consent, Ghada and Tajir (2018) suggest that the following factors should be kept in mind when asking respondents to participate in a study:

- The aim of the study was clearly communicated to the respondents.
- The respondents were informed that participation was completely voluntary.
- The respondents were informed that they were not obliged in any way to complete the questionnaire.

- The respondents were informed that if they felt uncomfortable at any stage, they had the right to excuse themselves prior to or during the study without penalty.

- The respondents were informed of what was expected of them if they wanted to participate in the study.

- The respondents were required to sign a consent form to participate in the study.

- The respondents were informed that feedback would be given once the study had been completed.

The researcher also aimed to implement other ethical codes such as honesty while conducting research. The researcher was completely honest when conducting the research, when communicating with respondents, and when analysing and compiling the data. The researcher was also respectful towards respondents and the surrounding environment when conducting research. Moreover, the researcher portrayed consistency while conducting research and ensured that all promises made to respondents were fulfilled. The researcher adhered to relevant governmental laws and policies pertaining to the study that was conducted. The researcher, furthermore, strived to restrict any researcher bias while obtaining and analysing data (McKenna & Gray 2018). At the end of the questionnaire, respondents were asked if they required feedback. If so, the respondents could give their email address to which the researcher will send the feedback upon completion of the research project.

4.12 CONCLUSION

The research was conducted within a quantitative paradigm, and its purpose was that of an exploratory and survey research design. The research was conducted within a town called Mooi River, situated in KwaZulu-Natal, South Africa. In order to reach respondents who met the inclusion criteria, non-probability sampling methods, including purposive and snowball sampling, were used. The questionnaire used was specifically designed for this study to collect information that would be able to provide information regarding the objectives of the research. The data analysis included descriptive and inferential analysis and was adapted for each of the identified research objectives. The results of the research are presented in the next chapter.

CHAPTER 5

RESULTS AND DISCUSSION

The purpose of a Results and Discussion Chapter is to present the outcomes of the study in terms of the analysis of the data (Iskander *et al.* 2018).

In this dissertation, Chapter 5 will include a presentation of the results achieved through means of the questionnaire completed by the respondents as well as a discussion of the most pertinent results. Chapter 5 will thus address the results of the descriptive statistics based on the demographics of the respondents (Section A), respondents' procedural knowledge of GM food products (Section B) and perception of GM food products (Section C), as well as the factors that influence the respondents' purchasing decision of GM food products (Section D). These results will be presented by means of tables and figures. This will be followed by inferential statistics which include a discussion of the normal distribution that allowed the researcher to assess how the data were distributed. Exploratory Factor Analysis (EFA) was also performed on the respondents' responses to procedural knowledge and perception of GM food products to determine the underlying dimensions that drive the procedural knowledge and perception of GM food products, and the factors that influence the respondents' purchasing decision of GM food products. Lastly, linear regression was performed to determine if procedural knowledge of GM food products influenced the factors that affect the purchasing decision, if perception of GM food products had a bearing on the factors that influence the purchasing decision, and if procedural knowledge of GM food products influenced the perception of GM food products.

5.1 INTRODUCTION

The aim of the study was to explore consumers' procedural knowledge and perception of GM food products and the factors that influence consumers' purchasing decision of GM food products. The chapter introduces the profile of the respondents who took part in the study, through the demographic information obtained as presented in Table 5.1. The profile of the respondents was further established by positioning the respondents in terms of their exposure to GM food products, how often they looked for or noticed GM food products in stores, their awareness of GM food products, and how often the respondents thought they might be using

GM food products. Thereafter, the internal consistency reliability scores for Sections B, C and D and the sub-sections of the questionnaire will be presented. The results will then be presented and discussed in terms of the responses given to Section B (Procedural Knowledge of GM Food Products), Section C (Perception of GM Food Products) and Section D (Factors that Influence Purchasing Decision of GM Food Products) of the questionnaire, as analysed through the use of descriptive and inferential statistics. The demographic data of the respondents are presented in the following section.

5.2 RESPONDENT DEMOGRAPHIC PROFILE

Section A, questions 1 to 9, pertained to the respondents' demographic information. Hughes *et al.* (2016) emphasise the importance of gathering demographic data in the research context as it portrays each respondent's identity; this allows the researcher to describe the sample of respondents that took part in the study. The respondent demographic information also allows the results to be interpreted in relation to the profile of the respondents (Maree & Pietersen 2016b). The demographic information in the questionnaire included questions relating to the respondents' gender, age, household income, ethnic affiliation, highest level of education, marital status and employment status. The type of employment and the core business of the establishment that employed the respondents were also included to obtain a better idea of the context in which the respondents completed the questionnaire.

Respondents who participated in this study were included if they were *male or female, above 18 years of age* and *residing in Mooi River*. The inclusion criteria further stipulated the recruitment of respondents who, in their own opinion, *had heard of or were aware of GM food products*. The respondents also had to be *general consumers who purchased from food product stores in Mooi River* and, in their own opinion, must have had *some experience with purchasing and/or consuming GM and non-GM food products*. The inclusion criteria also involved respondents who were *exposed to GM food products in store in terms of noticing the availability of GM food products on the shelves while shopping for food products* and therefore were *possibly also aware of the presence of GM food products in store*.

Table 5.1 represents the results from the demographic information of the respondents, with the frequency of the number of respondents for each demographic field indicated in the middle column (as represented through n) and the percentage it represents of the total number of respondents who participated in this study in the far right column. The data are therefore based on a total of 326 respondents who completed all sections in the questionnaire.

Table 5.1: Respondent Demographic Profile

Demographic Criteria	Number of Respondents (n)	Percentage (%)
Gender		
Male	136	42
Female	190	58
Age		
18-24 years	61	19
25-30 years	40	12
31-40 years	53	16
41-50 years	64	20
51 years or older	108	33
Income		
Monthly Household income	326	Average: R27 602
Ethnic Affiliation		
Black	34	11
White	275	84
Coloured	4	1
Indian	13	4
Other	0	0
Highest Level of Education		
Lower than matric/Grade 12	24	8
Matric/Grade 12	138	42
Grade 12 + a degree/diploma	164	50
Marital Status		
Single	93	29
Married/living with a partner	212	65
Divorced/separated	12	3
Widow(er)	9	3
Type of Employment		
Permanent full time	197	60
Permanent part time	18	6
Contract work	6	2
Self-employed	61	19
Unemployed	44	13
Core Business of the Establishment		
Agriculture	94	29
Education	68	21
Construction	5	2
Food	17	5
Finance	10	3
Medical	21	6
Other	111	34

In Table 5.1, the results indicated that the gender groups of the respondents comprised of 42% (n=136) male and 58% (n=190) female respondents. Zhang *et al.* (2019) are of the opinion that such an occurrence might be attributed to the fact that more females than males would be willing to participate in a study on GM food products in general, as females are more concerned with the types of food products they consume as well as the perceived risks of GM food products. They are also more sceptical about GM foods, thereby having a better knowledge of GM food products. The coincidence of the number of male and female respondents almost being alike, was not the result of a specific recruitment strategy but

perchance as the study only intended to distribute the questionnaire among as many potential respondents who complied with the inclusion criteria as possible.

The age groups of the respondents varied, with a third of respondents between 51 years of age or older (33%; n=108), followed by some respondents between 41-50 years of age (20%; n=64), with the least number of respondents between 25-30 years of age (12%; n=40). It is plausible that a third of respondents were above 50 years of age since the respondents were drawn from an already established community although various age groups of consumers were residing in Mooi River. Voluntary participation was also required from any available respondents who met the inclusion criteria, thus, the study did not set out to achieve an equal distribution among the different age groups in Mooi River as the purpose of the study was not to compare the results of different age groups.

The average monthly household income of the respondents was R27 602. The majority of respondents in this study were white (84%; n=275). Although the questionnaires were widely distributed to include as many ethnic groups as possible, it was not a requirement for this study to have an equal representation of all ethnic groups in the study as comparisons between ethnic groups was not intended in the study. Although some questionnaires were completed by other ethnic groups, participation remained voluntary and dependent on the availability of any respondents who met the inclusion criteria and were willing to complete the questionnaire.

Almost all of the respondents who took part in the study had Grade 12 and further educational qualifications (92%; n=302), with only a small number of respondents with qualifications lower than Grade 12 (8%; n=24). The majority of the respondents were married/living together (65%; n=212), with a smaller number of respondents either being single (29%; n=93), divorced or separated (3%; n=12), or a widow or widower (3%; n=9). From the large number of married or cohabiting participants in this study, it is assumed that respondents were more inclined to purchase food products with a family in mind than for themselves. Although the questionnaire asked for various levels of employment, the aim of the question was to determine whether the respondents had some form of formal or regular income. Out of the 326 respondents who participated in the study, 87% (n=282) of the respondents were employed while the remaining 13% (n=44) were unemployed. In this instance, the large number of employed respondents might have the financial means to purchase the food products of their choice which may include GM and non-GM food products available in store. Unemployed respondents may experience financial constraints that might exclude them from a choice between GM and non-GM food products. Van Wyk and Dlamini (2018) highlight the fact that consumers purchase

food products based on the affordability of the food products and their disposable income, which is directly influenced by consumers' employment status. Other influencing factors that may determine the respondents' decision to purchase particular GM food products include nutritional content, health benefits or health concerns, environmental issues and taste (Bawa & Anilakumar 2013; Deffor 2014; Hefferon 2015), to name a few. However, due to the average monthly household income, it may be assumed that the unemployed respondents could be a stay-at-home spouse with their partner generating a large enough household income for the family to still be able to afford a GM/non-GM consumer-related choice.

The core business where the respondents worked were in most instances related to other businesses (34%; n=111) which did not include the six main businesses, also referred to as industries, namely Agriculture, Construction, Food, Finance and Medical as stated in the questionnaire (Brand South Africa 2015; RH BOPHELO 2019). Education was also added as a main business as it provides many job opportunities for citizens in South Africa. A smaller number of respondents were found in agricultural businesses (29%; n=94), with the least number of respondents working in the construction business (2%; n=5).

To summarise the demographic profile of the respondents, it is evident from the results that respondents were either male or female, of a working-age group, with an average monthly household income of R27 602, predominantly of white ethnic affiliation, they either had Grade 12 or further qualifications, were married or living with a partner and employed, which should be kept in mind throughout the interpretation of the data as it provides a view of the type of respondents to which the data belongs.

5.2.1 Positioning Questions

In an attempt to support the inclusion criteria, four positioning questions were used to enable the researcher to create a profile of the respondents (Taherdoost 2016a). This assisted the researcher in forming a better understanding of the perspective from which the respondents were coming while meeting the inclusion criteria of this study. In this study, positioning questions were used not to eliminate participation but to allow the researcher to establish the perceived level of understanding respondents thought they had in terms of GM food products.

Each positioning question was related to a respective section in the questionnaire. The intention of the relationship between the positioning questions and each section (Section B to D) of the questionnaire was to enable the researcher to create a better understanding of the

answers that the respondents gave in relation to where they positioned themselves on the relevant question.

The first positioning question referred to the *level of exposure* the respondent thought they had in terms of experiencing or being exposed to GM food products. This positioning question pertained to Section B of the questionnaire which elicited responses related to the procedural knowledge of GM food products. Determining the level at which the respondents thought they were exposed to GM food products indicated their level of knowledge of GM food products. If respondents felt they had the opportunity to engage with, study or acquire information about GM food products, it may be an indication of the acquired knowledge already existing related to GM food products. This acquired knowledge results in them being able to identify and distinguish between the qualities of ordinary and GM food products, and being aware of the existence of GM food products among the other food items they purchase. However, respondents who think their exposure to GM food products has been somewhat limited may have inadequate knowledge of GM food products and subsequently their level of awareness, identification and/or distinction between ordinary and GM food products may be reduced.

The second positioning question determined *the level at which the respondents thought they looked at or noticed GM food products* in store. This question pertained to Section C of the questionnaire, which involves the respondents' visual perception of GM food products. This includes a measure of how often respondents looked for or noticed GM food products in store. It gives an indication as to whether the respondents have a visual perceived awareness of GM food products, which products represent GM food products, and in which food product categories GM food products can be found in store. The respondents' visual perception of GM food products may also influence their awareness of these products in store and whether the respondents were indeed looking to purchase specific products containing GM components. Therefore, the visual perception that respondents have of GM food products may allow them to recognise and be aware of the GM food products that are available to purchase.

The third positioning question related to the *level of awareness of GM food products* and also pertained to Section B of the questionnaire. It involved the procedural knowledge of GM food products as the respondents' awareness of GM food products relates to their knowledge of GM food products (Tanius & Seng 2015). If respondents are knowledgeable about GM food products, it is more likely that they will be aware of GM food products. Contrary to this, if the respondents do not have knowledge of GM food products, they may not be aware of GM food products and will therefore be unable to recognise food products containing GM components.

The fourth positioning question established *how often GM food products were used*, and pertained to Section D of the questionnaire. It involved the factors that influence the purchasing decision of GM food products. The fourth positioning question gives the researcher an indication as to the respondents' purchasing behaviour of GM food products as their use of these products will directly indicate how often they are specifically purchasing GM food products, are aware of the products containing a GM component, and are thus knowledgeable about the existence of GM food products.

The data pertaining to the positioning questions are presented in Table 5.2, which represent the respondents' opinion of how each of the questions best related to them.

Table 5.2: Positioning Questions

Positioning Question	Number of Respondents (n)	Percentage (%)
Level of Exposure to GM Food Products		
A little	69	21
Some	171	53
A lot	86	26
Level to which you think you look at or notice GM Food Products in Store		
Never	109	34
Sometimes	177	54
Always	40	12
Level of Awareness of GM Food Products		
A little	125	38
Some	156	48
A lot	45	14
How Often you use GM Food Products		
Never	35	11
Sometimes	258	79
Always	33	10

Approximately half of the respondents (53%; n=171) indicated that, according to them, they had some exposure to GM food products, and only a small percentage of the respondents thought they had very little (21%; n=69) or a lot (26%; n=86) of exposure to GM food products. A study conducted on USA consumers to determine their knowledge of GM foods concluded that only 48% of the consumers knew that GM foods were available to purchase in supermarkets, subsequently indicating that many consumers were, in fact, unaware of their exposure to GM food products in store (Wunderlich & Gatto 2015). Insufficiency and absence of labelling on GM food products were also found to contribute to consumers not knowing that they are exposed to GM food products (Bonah *et al.* 2017). In addition, more than half of the respondents (54%; n=177) in the present study thought they sometimes looked at or noticed GM food products in store, with smaller percentages of respondents who thought they never (34%; n=109) or always (12%; n=40) looked at or noticed GM food products in store.

Interestingly, a study conducted on consumers in Switzerland to determine their acceptance of plant biotechnology and GM crops achieved results which showed that 50% of consumers did not actively avoid purchasing GM food products (Lucht 2015), suggesting that consumers did not actively look for or tried to detect, purchased and used GM food products.

The majority of respondents indicated that they had some (48%; n=156) to little (38%; n=125) awareness of GM food products, with a very small number of respondents (14%; n=45) thinking they were very aware of GM food products. Although respondents thought they were not fully aware of GM food products it may suggest that the respondents were not particularly familiar with GM food products, the brands that carried these products, nor the way it would be communicated on food products that were GM-related. Similar results were obtained from a study conducted on consumers' awareness of GM food products in South Africa, in which it was found that less than half (48%) of the South African population were aware that some foods had been genetically modified. There was thus still a large proportion of consumers in South Africa who were not aware of GM food products (Gastrow 2018). Similarly, a study conducted in Klang Valley, Malaysia concluded that 70% of the respondents indicated they had a low awareness level of GM food products (Tanius & Seng 2015). Mahdi and Zin (2018) point out that such findings raise an important issue of the high number of consumers not being fully aware of the presence of GM food products. This phenomenon may be attributed not only to insufficient labelling of GM food products, as Bonah *et al.* (2017) pointed out, but also to the lack of mass media communication of GM food products to consumers and the inadequacy of information provided to consumers specifically focusing on GM food products.

The majority of the respondents (79%; n=258) thought they were sometimes using GM food products while only 10% (n=33) of respondents thought that they were always using GM food products. Although the respondents thought that they were sometimes using GM food products, it may not be an accurate reflection of their certainty that they were, in fact, using GM food products. However, Sleenhoff and Osseweijer (2013) conducted a study in Europe where it was concluded that 50% of the respondents stated they did not purchase a food product if the label indicated that the product contained a GM ingredient, but 55.6% of the respondents were not careful to avoid purchasing GM food products. This points to the fact that many consumers in Europe are not using and purchasing GM foods if they are aware that a food product is genetically modified; also, European consumers are not entirely avoiding purchasing GM foods either. Moreover, as seen in this study, these South African respondents' are not deliberately avoiding GM food products as they are not fully aware of these products. Results obtained from another study conducted in the USA showed that only 31% of the consumers believed they had consumed GM food products (Wunderlich & Gatto

2015). The positioning questions pointed to the fact that many respondents were unaware whether they have been exposed to GM food products, only sometimes looked for or noticed GM food products in store, were unaware of GM food products, and were not actively seeking to purchase, consume and use GM food products.

In the next section, the results obtained from Sections B, C and D in the questionnaire will be discussed. However, in order to determine if the results were a true reflection of what the statements in the questionnaire were measuring, the reliability of the data from the statements in Sections B, C and D was first established. The internal consistency reliability test that was performed on the data obtained from Sections B, C and D of the questionnaire are discussed in the section to follow.

5.3 INTERNAL CONSISTENCY RELIABILITY SCORES OF THE QUESTIONNAIRE

The statements in the questionnaire were grouped into various components, each addressing a specific factor. These statements were developed from existing literature, research conducted and tabled or discussed in findings from relevant studies published in scientific papers. Therefore, according to studies done by Wang et al. (2011) as well as Baldner and McGinley (2014), the statistical procedure was followed to first conduct the Cronbach Alpha to determine whether the components in the specific sections did indeed address a single overarching factor. This was then followed by the Exploratory Factor Anlaysis (EFA) in order to determine the sub-factors that emerged from the underlying components within these sections, namely Sections B, C and D.

The internal consistency reliability test assisted in determining the reliability of the data that are described and presented in the sections to follow. Therefore, the internal consistency of the responses from the questionnaire were measured on the statements of Section B which included the procedural knowledge of GM food products, statements of Section C, which included the perception of GM food products, and statements of Section D, which included the factors that may influence the respondents' purchasing decision of GM food products. Quansah (2017) states that Cronbach Alpha (α) is commonly used to test internal consistency reliability when the questionnaire consists of Likert scales, and thus Cronbach α's were deemed an adequate measurement (Hajjar 2018) in the case of this study.

A Cronbach α value obtained as 0.7 or greater was regarded as acceptable, a value of 0.8 or greater was regarded as good, and a value of 0.9 or greater was regarded as excellent (Taber 2018). Table 5.3 presents the Cronbach α of the sub-sections of the statements related to

Section B (sub-section on General Knowledge of GM Food Products and sub-section on the Information Pertaining to GM Food Products), C (sub-section on the Nutritional and Socio-Economic Aspects and Product Quality Aspects of GM Food Products; and sub-section on the Health, Ethical and Consumption Aspects of GM Food Products) and D (sub-section on the GM-Related Factors that Influence Purchasing Decision of GM Food Products and sub-section on the General GM-Related Barriers of GM Food Products that Influence Purchasing Decision) of the questionnaire. The mean value that represents the distribution of central tendency is also included, which shows the central point or most common value of the dataset (Sykes *et al.* 2016). The standard deviation shows how many respondents deviated from the mean value identified (Kaliyadan and Kulkarni 2019), as discussed in the following sections.

Table 5.3: Cronbach α Scores and Descriptive Statistics of Each Questionnaire Section

Cronbach α, Mean and Standard Deviation for each Section				
Objectives	**Question**	**Cronbach α**	**Mean**	**Std. Dev.**
Objective 1 - Procedural Knowledge (Section B of the questionnaire)				
General Knowledge of GM Food Products	14-23	0.72	3.45	1.11
Information Pertaining to GM Food Products	24-31	0.81	2.64	1.13
Objective 2 - Perception (Section C of the questionnaire)				
Nutritional, Socio-economic and Product Quality Aspects of GM Food Products	32-44	0.82	3.18	0.95
Health, Ethical and Consumption Aspects of GM Food Products	45-61	0.97	3.44	1.18
Objective 3 - Factors that Influence Purchasing Decisions (Section D of the questionnaire)				
GM-Related Factors that Influence Purchasing Decision of GM Food Products	62-74	0.72	3.35	1.05
General GM-Related Barriers of GM Food Products that Influence Purchasing Decision	75-83	0.79	3.30	1.02

The two sub-sections of statements included in the procedural knowledge section (Section B) of the questionnaire (as indicated in Table 5.3), were each subjected to the internal consistency reliability test depicted as Cronbach α value. The initial Cronbach α value for the sub-section on the general knowledge of GM food products, in Section B, revealed a score of 0.67. The Cronbach α value obtained for this sub-section resulted in questioning the reliability of the measurement, which therefore required scrutiny of the raw data. Upon reviewing the data collected from the respondents, it became apparent that one respondent's data might have been responsible for the undesirable rating as the respondent merely selected the same option with regards to all of the statements in the questionnaire. This can be caused by respondent fatigue that can simultaneously decrease the quality of data given by the respondents (Dolnicar *et al.* 2016). Responses from questionnaire 20 that negatively affected the reliability of the Cronbach α scores were therefore excluded, and the questionnaire was

disregarded. After re-calculating the score, an acceptable Cronbach α value of 0.72 was achieved for the general knowledge of GM food products which formed part of Section B as indicated in Table 5.3.

In the general knowledge of GM food products sub-section of Section B, a mean value of 3.45 and a standard deviation of 1.11 was measured, which showed that the majority of the respondents portrayed general uncertainty and or slight agreement towards the statements given about GM food products, indicating that the respondents were not particularly knowledgeable about GM food products. In the information pertaining to GM food products sub-section of Section B, a good Cronbach α score of 0.81 was achieved, with a mean value of 2.64 and a standard deviation of 1.13. This was the only sub-section of the questionnaire that had a mean value lower than neutral, indicating a negative value. This meant that most respondents disagreed with the statements, simultaneously showing that many of the respondents indicated they did not seek information about GM food products from various sources and were not particularly sure whether environmental groups or scientists were the most credible sources of information of GM food products.

In the first sub-section of Section C, namely nutritional, socio-economic and product quality aspects of GM food products, a Cronbach α score of 0.82 was achieved, together with a mean value of 3.18 and a standard deviation of 0.95, indicating that the respondents did not have a distinct perception of GM food products. In the second sub-section of Section C, namely the health, ethical and consumption aspects of GM food products, an excellent Cronbach α score of 0.97 was measured, with a mean value of 3.44 and a standard deviation of 1.18. These scores, once again, point to the uncertainty that the respondents had in terms of their perception of GM food products.

In Section D of the questionnaire, the first sub-section, namely the GM-related factors that influence the decision to purchase GM food products, obtained a Cronbach α value of 0.72, a mean value of 3.35 and a standard deviation value of 1.05. In the second sub-section of Section D, namely the general GM-related barriers of GM food products that influence the purchasing decision, a Cronbach α value of 0.79 was achieved, with a mean value of 3.30 and a standard deviation value of 1.02. These values show that the respondents were not entirely sure which GM-related factors or general GM-related barriers would influence their purchasing decision of GM food products.

The next section will present the descriptive statistics and EFA results that were performed on Sections B, C and D of the questionnaire, with each section consisting of two sub-sections. Section B has been highlighted in blue, Section C in yellow and Section D in brown.

5.4 RESULTS ON THE GENERAL KNOWLEDGE OF GM FOOD PRODUCTS (Objective 1a)

The following section will describe the data obtained from the first of two sub-sections of statements 14 to 23 from the questionnaire (variables 15 to 24) related to respondents' general knowledge of GM food products. The statements from the first sub-section of Section B from the questionnaire reflect the answers from statements 14 to 23 (variables 15 to 24) which were completed by the respondents. The respondents' general knowledge of GM food products was measured by means of a five-point Likert scale indicating their level of agreement between Strongly Disagree (1) and Strongly Agree (5). However, due to a small difference between 'Strongly Disagree' and 'Disagree', these two categories were merged to form one category namely 'Disagreement'. The two categories, namely 'Strongly Agree' and 'Agree' were also merged together and named 'Agreement'.

An internal consistency reliability test was performed on statements 14 to 23 (variables 15 to 24) which yielded a Cronbach α measurement of 0.72, with a mean value of 3.45 for all the statements in this section as well as a standard deviation of 1.11, as indicated in Table 5.3. This showed that the respondents were not very knowledgeable about the general knowledge statements on GM food products, but were also not completely ignorant of the general knowledge statements on GM food products. Descriptive statistics were performed on statements 14 to 23 (variables 15 to 24) of the questionnaire in order to summarise the responses in terms of the number of responses (n) obtained for each statement on each of the three scale items and the percentage (%) of the responses represented in terms of the total number of respondents (N).

5.4.1 Descriptive Results on the General Knowledge of GM Food Products

The descriptive statistics, including percentages and frequencies, of the statements (14 to 23/variables 15 to 24) on respondents' general knowledge of GM food products are summarised in Table 5.4 and presented in Figure 5.1. The results are discussed and presented in order of the statements that drew the most agreement to those that showed a higher level of uncertainty and disagreement, or agreement as a combined measure as to those statements that showed the least agreement or no particular difference between the scale items.

Table 5.4: Results on the General Knowledge of GM Food Products

Variable Number	Statement	Respondents		
		Disagreement	Neither	Agreement
V15	I know what "genetically modified" means in terms of food products	39 12[1]	46 14	241 74
V16	I do not feel very knowledgeable about genetically modified food products	106 32	59 18	161 50
V17	I know that GM food products are available to purchase in supermarkets	17 5	28 9	281 86
V18	I know a fair amount about GM foods	87 27	77 24	162 49
V19	I know that maize contains a GM component	49 15	51 16	226 69
V20	I have heard about GM food products	23 7	19 6	284 87
V21	I know which food products have been genetically modified	140 43	103 32	83 25
V22	I know that rice contains a GM component	100 31	110 34	116 35
V23	I know a little amount about GM foods	100 31	68 21	158 48
V24	I know that soybean contains a GM component	87 27	92 28	147 45

[1] The first row of the data in Table 5.4 which is in black lettering represents the frequencies (n) obtained for each of the scales pertaining to the particular statement with the percentages (%) given in red below the (n) value.

An overwhelming majority of the respondents were certain that they had heard about GM food products (87%; n=284 agreed), whereas the remainder of the respondents admitted having never heard of GM food products (7%; n=23), and some neither agreed nor disagreed (6%; n=19) that they had heard of GM food products (V20). Deffor (2014) and Jayasuriya and Rathnayaka (2016) obtained similar results from their studies conducted in the Greater Accra Region of Ghana and Sri Lanka, respectively, in which the authors stated that many consumers claimed to have indeed heard about GM foods. Furthermore, an overwhelming majority of the respondents (86%; n=281) agreed that they were sure that they knew GM food products were available to purchase in supermarkets, while only a small percentage of the respondents neither agreed nor disagreed (9%; n=28), showing their uncertainty of whether GM food products were available in store, with an even smaller percentage of respondents disagreeing (5%; n=17) that they knew this (V17). In contrast, Popek and Halagarda (2017) conducted a study in EU countries in which it was concluded that consumers were not fully aware and did not know that GM foods were available to purchase in supermarkets due to insufficient labelling. A fairly large number of the respondents (74%; n=241) also agreed that they thought they knew what 'Genetically Modified' meant in terms of food products, whereas the rest of the respondents either showed uncertainty (14%; n=46 neither agreed nor disagreed) or disagreed (12%; n=39) to knowing what 'Genetically Modified' meant (V15). The majority of the respondents (69%; n=226) agreed that they knew maize contained a GM component, while the remaining respondents were either unsure (16%; n=51 neither agreed

nor disagreed) or did not know (15%; n=49 disagreed) if maize contained a GM component (V19).

Furthermore, less than half of the respondents did not know which foods have been genetically modified (43%; n=140 disagreed) or were unsure if they knew which foods it was (32%; n=103 neither agreed nor disagreed). Only a small percentage of the respondents agreed (25%; n=83) they knew which foods were genetically modified (V21). Slightly less than half of the respondents (45%; n=147 agreed) did indeed know that soybean contained a GM component, whereas 28% (n=92) of the respondents were not sure if they agreed or disagreed, with 27% (n=87) of the respondents who disagreed that they knew soybean contained a GM component (V24). Similarly, a study conducted in the USA by McFadden and Lusk (2016) obtained results which showed that the majority of respondents did not know that soybean was genetically modified. However, a study conducted by Wunderlich and Gatto (2015) in the USA obtained contrary results as more than half of their respondents knew that soybean had indeed been genetically modified. In total, more than half of the respondents did not know if they knew a little about GM food products or conveyed uncertainty about how little they knew about GM foods (31%; n=100 disagreed and 21%; n=68 neither agreed nor disagreed), with less than half of the respondents (48%; n=158 agreed) actually being certain that they knew a little about GM food products (V23). Studies conducted in Switzerland by Lucht (2015) and New Jersey by Wunderlich and Gatto (2015), also established that, generally, consumers considered themselves to know very little about GM food products as well as being uninformed about GM food products.

Furthermore, Table 5.4 indicates that half of the respondents (50%; n=161) indicated that they agreed to not feeling very knowledgeable about genetically modified foods products, whereas the remaining half of respondents were not really sure if they were knowledgeable since 32% (n=106) of the respondents disagreed and 18% (n=59) of the respondents neither agreed nor disagreed (V16). This showed that there was a clear split between the respondents in terms of how certain they were about their knowledge about GM food products. Various other studies conducted in Klang Valley in Malaysia, Hatay in Turkey, USA and in Tamale Metropolis in Ghana obtained similar results in that consumers were not found to be very knowledgeable about GM food products, consumers did not have knowledge about the potential benefits GM food products had to offer and only a few consumers truly understood the concept of GM food products (Tanius & Seng 2015; Celik & Dagistan 2016; McFadden & Lusk 2016; Bonah *et al.* 2017; Cui & Shoemaker 2018).

About half of the respondents (49%; n=162) agreed that they thought they knew a fair amount about GM foods, while only 27% (n=87) indicated they knew very little or did not have an opinion at all (24%; n=77 neither agreed nor disagreed) (V18). There was no particular distinction between the responses given to knowing if rice contained a GM component as 35% (n=116) of the respondents agreed, 34% (n=110) of the respondents neither agreed nor disagreed, and 31% of the respondents (n=100) disagreed (V22). These results are also depicted in Figure 5.1.

As seen in the first positioning question which referred to the *level of exposure* the respondent thought they had in terms of experiencing or being exposed to GM food products, only 53% (n=171) of the respondents thought they had some exposure to GM food products. The third positioning question related to the *level of awareness of GM food products*, and only 48% (n=156) of the respondents had some awareness of GM food products. Therefore, the limited knowledge or understanding that the respondents had of the factual statements given in the first sub-section of Section B from the questionnaire may be a reflection of their limited exposure to and awareness of GM food products.

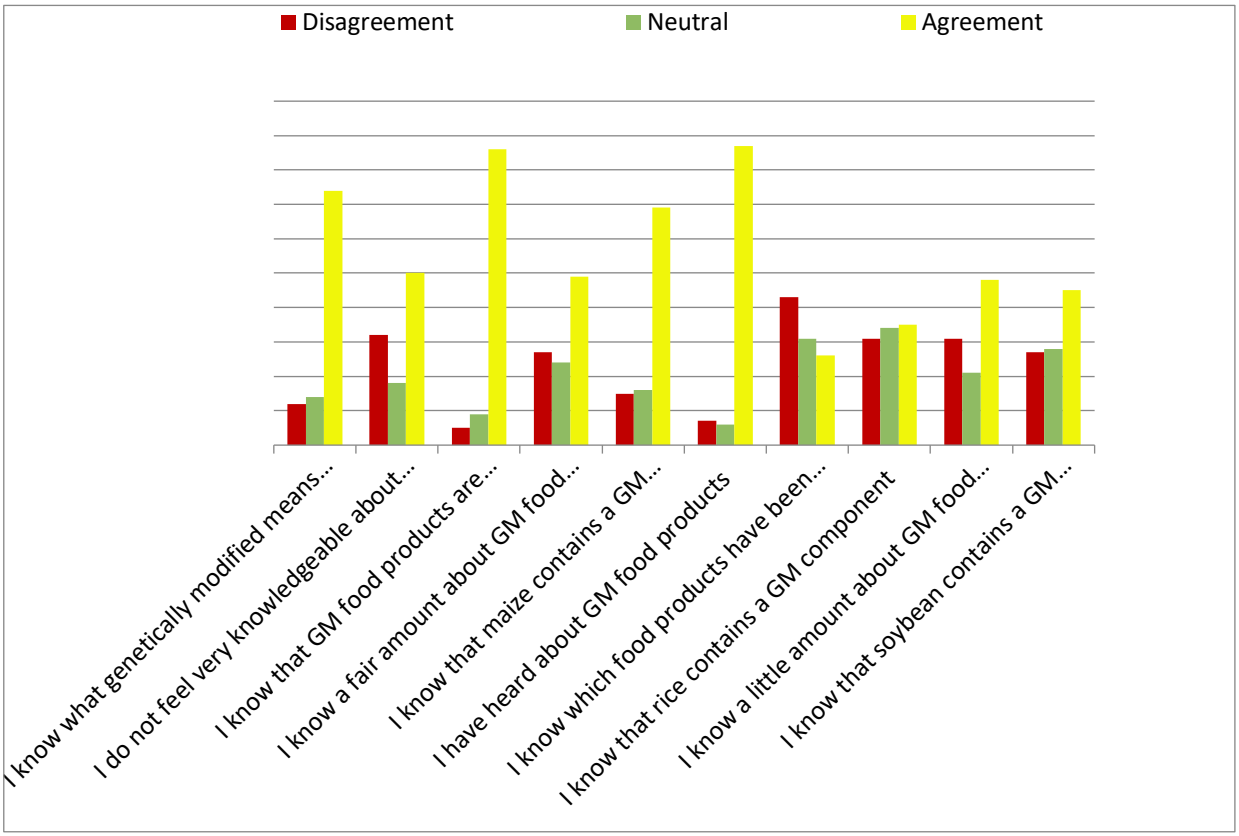

Figure 5.1: Results on the General Knowledge of GM Food Products

After the data were analysed and described using descriptive statistics, it was necessary to determine the underlying relationships between the statements/variables within this section of the data. In order to determine these relationships, it was necessary to determine whether the data were normally distributed or not, which would enable the researcher to determine which statistical tests to perform to find relationships. If data are normally distributed, it will assist with the statistical analysis of the data (Pietersen & Maree 2016a) and is represented in a symmetrical bell curve (Krithikadatta 2014). In order to test for normality, the Shapiro-Wilks test was used as it specifically focuses on the skewness and kurtosis of the variables (Das & Imon 2016). A variable is now equivalent to a statement, and there are 10 variables represented by variables 15 to 24, as an example. The skewness of the variables shows the degree to which a distribution differs from a normal distribution by measuring asymmetry of normality, whereas kurtosis describes the distribution of the variables by measuring and showing the sharpness of the peak of a specific distribution curve of the variables (Mishra *et al.* 2019). The Shapiro-Wilks test results show that the data from the first sub-section of Section B of the questionnaire (variables 15 to 24) were not normally distributed and are presented in Table 5.5.

Table 5.5: Skewness and Kurtosis of the General Knowledge of GM Food Products

Variable Number	Skewness	Kurtosis
V15	-7.25	2.77
V16	-2.10	-3.56
V17	-10.01	9.38
V18	-2.83	-2.57
V19	5.99	0.21
V20	-11.37	10.88
V21	0.00	-3.00
V22	-0.55	-2.32
V23	-2.87	-3.10
V24	-1.09	-2.91

As seen in Table 5.5, variables 15 to 24 were used to measure the respondents' general knowledge of GM food products and the data were not normally distributed and skewed, with some variables highly skewed and tailed off to the left, while others were to the right and or less severe. According to Ghasemi and Zahediasl (2012), skewness is found in the way in which variables tail off to either the left or right. There are indeed statistical tests such as the Kruskal-Wallis test which is used to determine if there are differences between two or more groups (Ostertagova *et al.* 2014) and the Spearman Correlation Analysis test which is used to establish the relationship between two variables (Schober *et al.* 2018), that can be done with skewed data. However, the study did not aim to determine the differences between two or more groups and therefore did not apply these tests. Thus, EFA was conducted on variables

15 to 24 of the questionnaire to establish the relationship between the variables by investigating the underlying drivers of the responses on respondents' general knowledge of GM food products. Therefore, EFA could be used to determine the underlying relationship that existed between variables (Zhang *et al.* 2019), as non-normal distribution is common in data sets, but is still acceptable to be used for data analysis (Watkins 2018).

5.4.2 Exploratory Factor Analysis (EFA) on the General Knowledge of GM Food Products (Objective 1c)

The second phase of the data analysis on the first sub-section of Section B from the questionnaire (variables 15 to 24) was to conduct EFA as seen in the section that follows. The results are provided through the various tables indicating the two factors that emerged.

EFA was done on ten variables on the first sub-section of Section B from the questionnaire, namely variables 15 to 24. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was used to determine if the data were suitable for EFA (Yu & Richardson 2015), and Bartlett's Test of Sphericity was used to determine the significance of the variables in the data (Amerioun *et al.* 2018). There were no specifications indicated as to the number of factors that was desired, it was rather left unspecified. The KMO measured at .879 as shown in Table 5.6, therefore the KMO and Bartlett's Test was commendable as a measure of >.8 was achieved, which indicates that the data were creditable for EFA (Hadi *et al.* 2016) as any value of 0.60 or above is considered to be acceptable (Chan & Idris 2017). According to the KMO values, a value of ≥ 0.80 is considered to be highly desirable, a value of ≥ 0.70 is considered to be middling, a value of ≥ 0.60 is considered to be mediocre, a value of ≥ 0.50 is considered to be miserable, and a value of < 0.50 is considered to be unacceptable. The Bartlett's Test of Sphericity's was .000 which is <.05 (Hadi *et al.* 2016) and therefore significant.

Table 5.6: KMO and Bartlett's Test for the General Knowledge of GM Food Products

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.879
Bartlett's Test of Sphericity	Approx. Chi-Square	1333.239
	df	45
	Sig.	.000

When inspecting the Eigenvalues of this section, which shows how much variance the variables of a factor account for (Watkins 2018), it became clear that two factors loaded

greater than 1. This explained a total variance of just above 60%, as indicated in bold in the last column in Table 5.7.

Table 5.7: Total Variance Explained for the General Knowledge of GM Food Products

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.622	46.220	46.220	4.622	46.220	**46.220**
2	1.390	13.901	60.120	1.390	13.901	**60.120**
3	.846	8.461	68.581			
4	.643	6.426	75.007			
5	.549	5.487	80.495			
6	.490	4.900	85.394			
7	.441	4.414	89.809			
8	.416	4.160	93.969			
9	.308	3.081	97.050			
10	.295	2.950	100.000			

Inspecting the principal component matrix, also known as loadings, is an indication of the estimation of the correlations between variables and component (Watkins 2018). Using the matrix for the ten variables presented in Table 5.8, the two factors as identified by the Eigenvalues (>1) were confirmed.

Table 5.8: Principal Component Matrix for the General Knowledge of GM Food Products

Component Matrix[a]			
		Component	
	Statement	1	2
V15	I know what "genetically modified" means in terms of food products	**.776**	.194
V16	I do not feel very knowledgeable about genetically modified food products	-.588	**.444**
V17	I know that GM food products are available to purchase in supermarkets	**.657**	.438
V18	I know a fair amount about GM food products	**.791**	-.143
V19	I know that maize contains a GM component	**.767**	.179
V20	I have heard about GM food products	**.718**	.401
V21	I know which food products have been genetically modified	**.694**	-.303
V22	I know that rice contains a GM component	**.671**	-.184
V23	I know a little amount about GM food products	-.199	**.791**
V24	I know that soybean contains a GM component	**.736**	
Extraction Method: Principal Component Analysis.			
a. 2 components extracted.			

The component matrix shows the factor loadings which reveal how strong the relationship is between each variable. Chan and Idris (2017) explain that factors with a loading of .400 or less are not included. As seen in Table 5.8, V15, V17 – V22 and V24 can be regarded as Factor 1, while V16 and V23 can be seen as Factor 2, as these factors loaded more than .400.

Factor 1 consisted of statements that were used to determine how much the respondents knew about GM food products. Therefore, Factor 1 indicates respondents' *extent of GM food product knowledge*, while Factor 2 consisted of statements that were used to determine the respondents' lack of knowledge about GM food products and its presence in food products. Therefore, Factor 2 is indicative of consumers' *unfamiliarity with GM food products and its presence in food products*. Although two factors emerged from the EFA, the factors measured the same concept in essence from two different perspectives, namely the extent of the knowledge and ignorance of GM food products and its components, thus re-affirming the Cronbach Alpha's value of .72 as essentially measuring one single attribute in principle.

5.5 RESULTS ON THE SOURCES OF INFORMATION OF GM FOOD PRODUCTS (Objective 1b)

The following section will present the data obtained from the statements in the second sub-section of Section B from the questionnaire (statements 24 to 31/variables 25 to 32), which pertained to the sources of information on GM food products. Statements 24 to 31 (variables 25 to 32) formed part of the second sub-section of Section B from the questionnaire and were completed by the respondents. In this sub-section of the questionnaire, the sources from which the respondents obtained information about GM food products and the most credible sources of information of GM food products were measured by means of a five-point Likert scale indicating the respondents' level of agreement between Strongly Disagree (1) and Strongly Agree (5). As seen in the first sub-section of Section B, there were small differences between 'Strongly Disagree' and 'Disagree', these two categories were merged to form one category namely 'Disagreement'. The two categories, namely 'Strongly Agree' and 'Agree' were also merged together and named 'Agreement'.

The internal consistency reliability test was performed on statements 24 to 31 (variables 25 to 32) in which a Cronbach α measurement of 0.81 was achieved, with a mean value of 2.64 for all the statements in this sub-section, and a standard deviation of 1.13, as seen in Table 5.3. Descriptive statistics were done on statements 24 to 31 (variables 25 to 32) with the intention of analysing responses in terms of the number of responses (n) obtained for each statement

on each of the three scale items and the percentage (%) of the responses represented in terms of the total number of respondents (N).

5.5.1 Descriptive Results on the Sources of Information of GM Food Products

The descriptive statistics, including percentages and frequencies of the statements (24 to 31/variables 25 to 32) on the sources of information of GM food products, are summarised in Table 5.9, with a visual representation of the results in Figure 5.2. The results are discussed and presented in order of the statements that drew the most agreement to disagreement, or showed a higher level of uncertainty and disagreement, or agreement as a combined measure as to those statements that showed the least agreement or no particular difference between the scale items.

Table 5.9: Results on the Sources of Information of GM Food Products

Variable Number	Statement	Respondents		
		Disagreement	Neither	Agreement
V25	I seek information of GM food products from people I know	166 51[1]	74 23	86 26
V26	I look for information about GM food products on the Internet	179 55	47 15	100 30
V27	I look for information about GM food products in newspapers	236 72	55 17	35 11
V28	I look for information about GM food products in scientific papers	238 74	37 11	51 15
V29	I look for information about GM food products in magazines	202 62	53 16	71 22
V30	I receive information about GM food products via television	196 60	72 22	58 18
V31	Environmental groups are the most credible sources of information	84 26	145 44	97 30
V32	Scientists are the most credible source of information	35 11	114 35	177 54

[1] The first row of the data in Table 5.9 which is in black lettering represents the frequencies (n) obtained for each of the scales pertaining to the particular statement with the percentages (%) given in red below the (n) value.

The majority of respondents were sure that they did not look for information about GM food products in scientific papers (74%; n=238 disagreed), while a very small number of the remaining respondents did (15%; n=51 agreed) or were not sure (11%; n=37 neither agreed nor disagreed) if they looked for information about GM food products in scientific papers (V28). Similarly, a large percentage of respondents were sure that they did not look for information about GM food products in newspapers (72%; n=236 disagreed), while the remaining respondents were not sure (17%; n=55 neither agreed nor disagreed) or were sure they looked for information about GM food products in newspapers (11%; n=35 agreed) (V27). A large number of the respondents were sure that they did not look for information about GM food

products in magazines (62%; n=202 disagreed), with fewer respondents who did look for information (22%; n=71 agreed) or who were unsure (16%; n=53 neither agreed nor disagreed) if they looked for information about GM food products in magazines (V29). More than half of the respondents were sure that they did not receive information about GM food products via television (60%; n=196 disagreed), while the other respondents were unsure whether they received information via television (22%; n=72 neither agreed nor disagreed) or sure that they in fact did receive information about GM food products via television (18%; n=58 agreed) (V30).

More than half of the respondents were sure that they did not look for information about GM food products on the Internet (55%; n=179 disagreed), whereas a smaller percentage of respondents did (30%; n=100 agreed) or were uncertain (15%; n=47 neither agreed nor disagreed) whether they actually looked for GM food products on the Internet (V26). Slightly more than half of the respondents were sure they did not obtain information on GM food products from people they knew (51%; n=166 disagreed), while the remaining sample of respondents were sure they did (26%; n=86 agreed) or equally unsure (23%; n=74 neither agreed nor disagreed) whether they approached other people for information on GM food products (V25). In a study conducted in Klang Valley, Malaysia, similar results were obtained, showing that consumers never heard anything about GM food products from the government, TV programs, Internet, newspapers or people they knew, and therefore did not seek information from such sources (Tanius & Seng 2015). Contrarily, various studies conducted in India, Sri Lanka and China established that consumers received the majority of their information about GM food products from sources such as Internet, television, newspapers, magazines and from people with whom they were acquainted (Mandal & Paul 2012, Jayasuriya & Rathnayaka 2016, Cui & Shoemaker 2018). There is therefore no single method of communication about GM food products that can be considered most favourable in terms of disseminating information.

The majority of the respondents were not sure if they thought environmental groups were the most credible source of information (44%; n=145 neither agreed nor disagreed), while the remainder of the respondents were divided between being certain that environmental groups were the most credible source of information (30%; n=97 agreed) or not thinking so at all (26%; n=84 disagreed) (V31). A little more than half of the respondents thought that scientists were the most credible source of information of GM food products (54%; n=177 agreed), with the remaining sample who felt uncertain (35%; n=114 neither agreed nor disagreed) or did not think so (11%; n=35 disagreed) (V32). Similar results were obtained from a study conducted in India by Mandal and Paul (2012) and in China by Cui and Shoemaker (2018), where it was

established that consumers believed scientists were the most credible source of information, but consumer organisational and environmental groups were also considered to be credible sources of information about GM food products. The findings are presented in Figure 5.2.

As seen in the first positioning question which referred to the *level of exposure* the respondent thought they had in terms of experiencing or being exposed to GM food products, only 53% (n=171) of the respondents thought they had some exposure to GM food products. In the third positioning question, which related to the *level of awareness of GM food products*, only 48% (n=156) of the respondents had some awareness of GM food products, which reiterates the fact that the respondents were not looking for information about GM food products and were not entirely sure who to believe regarding the most credible source of information of GM food products. The respondents thought they were not exposed to GM food products to a great extent and had limited awareness of such products.

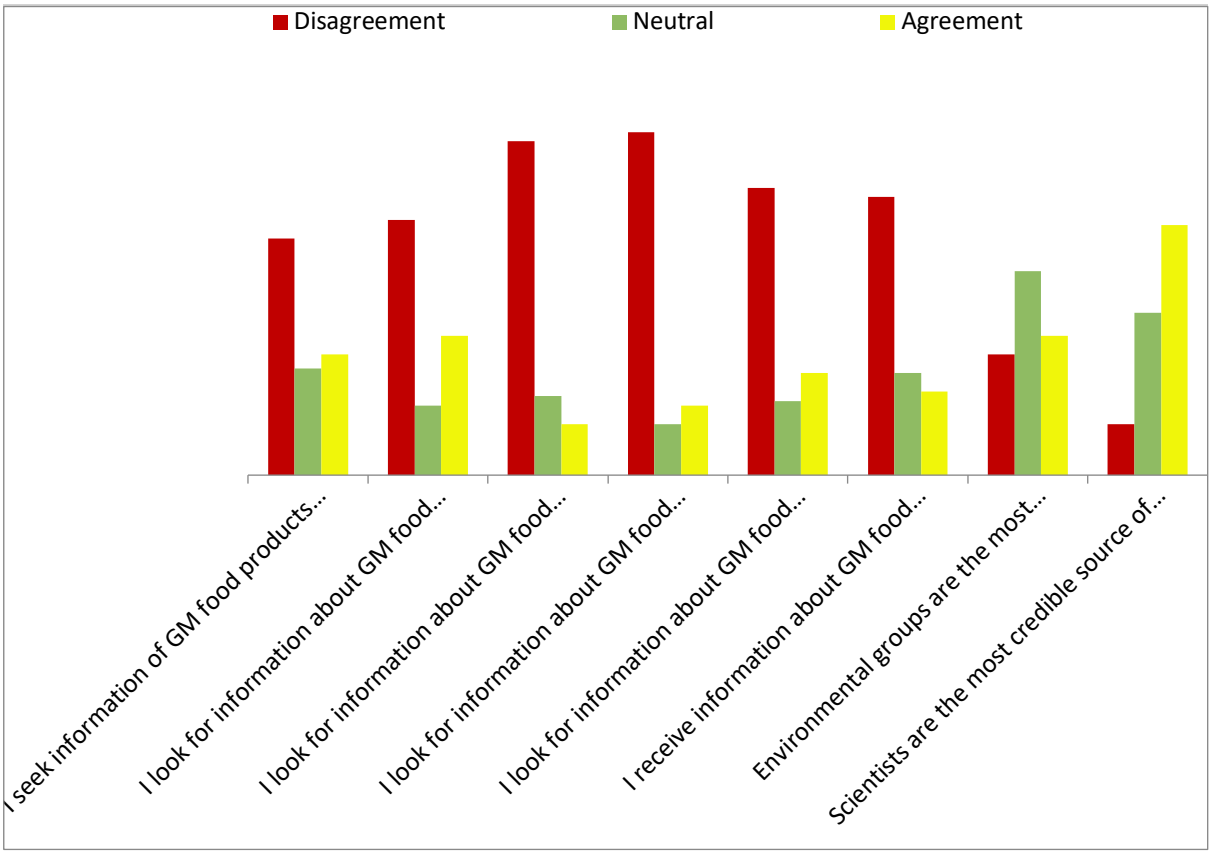

Figure 5.2: Results on the Sources of Information of GM Food Products

After descriptive statistics were conducted on variables 25 to 32, EFA followed as seen in Table 5.10 in order to determine the relationship between the variables by investigating the underlying drivers of the responses on the sources of information of GM food products. Firstly,

variables 25 to 32 were tested to determine if the data obtained were normally distributed and therefore the Shapiro-Wilks test was performed; the results can be seen in Table 5.10.

Table 5.10: Skewness and Kurtosis of the Sources of Information of GM Food Products

Variable Number	Skewness	Kurtosis
V25	1.97	-3.09
V26	2.27	-3.79
V27	6.19	1.48
V28	6.62	0.61
V29	3.55	-2.79
V30	4.05	-1.47
V31	-1.12	-0.61
V32	-2.42	-0.23

As seen in Table 5.10, the data obtained from variables 25 to 32, which were used to measure the sources of information of GM food products, showed that the data were not normally distributed and were skewed.

5.5.2 Exploratory Factor Analysis (EFA) on the Sources of Information of GM Food Products (Objective 1c)

EFA was performed on the second sub-section of Section B from the questionnaire, which consisted of variables 25 to 32. The results of the EFA are presented in tables to show the two factors that emerged. The KMO yielded a value of .822 (>.8), showing that the data were more than acceptable for EFA to be conducted, while Bartlett's Test of Sphericity was measured at .000 (Hadi *et al.* 2016) and was thus significant.

Table 5.11: KMO and Bartlett's Test on the Sources of Information of GM Food Products

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.822
Bartlett's Test of Sphericity	Approx. Chi-Square	912.581
	df	28
	Sig.	.000

The Eigenvalues showed that two factors loaded greater than 1, with a total variance of 59% which can be seen in the last column in Table 5.12 in bold.

Table 5.12: Total Variance Explained for the Sources of Information of GM Food Products

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.638	45.474	45.474	3.638	45.474	**45.474**
2	1.097	13.711	59.186	1.097	13.711	**59.186**
3	.959	11.994	71.179			
4	.644	8.047	79.226			
5	.610	7.629	86.855			
6	.473	5.906	92.761			
7	.329	4.107	96.868			
8	.251	3.132	100.000			

By reviewing the principal component matrix for the eight variables in Table 5.13, the two factors identified by the Eigenvalues (>1) were confirmed.

Table 5.13: Principal Component Matrix for the Sources of Information of GM Food Products

Component Matrix[a]			
		Component	
	Statement	1	2
V25	I seek information of GM food products from people I know	**.694**	-.167
V26	I look for information about GM food products on the Internet	**.782**	-.035
V27	I look for information about GM food products in newspapers	**.823**	-.175
V28	I look for information about GM food products in scientific papers	**.750**	-.190
V29	I look for information about GM food products in magazines	**.851**	-.059
V30	I receive information about GM food products via television	**.658**	.180
V31	Environmental groups are the most credible sources of information	.335	**.682**
V32	Scientists are the most credible source of information	.187	**.707**
Extraction Method: Principal Component Analysis.			
a. 2 components extracted.			

As seen in Table 5.13, V25 to V30 form part of Factor 1, and V31 and V32 form part of Factor 2. The statements that Factor 1 consist of were used to determine which sources of information respondents use to look for information about GM food products. These factors loaded more than .400 and were therefore accepted. Thus, Factor 1 shows the *sources of information on GM food products*.

The statements that Factor 2 consist of were used to determine which sources the respondents felt were the *most credible sources of GM food product information*. Factor 1 related to the sources of information available regarding GM food products – which the

respondents were not very knowledgeable about – while Factor 2 investigated the relevant sources. It was indicative of the most credible sources that the respondents would use to obtain information regarding GM food products.

5.6 RESULTS ON THE PERCEPTION (NUTRITIONAL, SOCIO-ECONOMIC AND PRODUCT QUALITY ASPECTS) OF GM FOOD PRODUCTS (Objective 2a, 2c and 2d)

This section will present the first of two sub-sections of Section C from the questionnaire. The first sub-section consisted of statements 32 to 44 (variables 33 to 45) which investigated the respondents' perception particularly focusing on the nutritional, socio-economic and product quality aspects of GM food products. In this sub-section of the questionnaire, all aspects in statements 32 to 44 (variables 33 to 45) included the benefits of GM food products. For example, the nutritional aspects referred to beneficial nutritional benefits such as reduced malnutrition, nutritional value, decreased nutritional deficiencies and increased macronutrient content. The socio-economic aspects referred to promoting biodiversity, increasing food supplies, boosting the economy and requiring fewer pesticides and herbicides. The product quality aspects referred to longer shelf life and improved taste. A five-point Likert scale was used indicating the respondents' perception between Strongly Disagree (1) and Strongly Agree (5). It became evident from the responses that there were small differences between 'Strongly Disagree' and 'Disagree', these two categories were merged to form one category namely 'Disagreement'. The two categories, namely 'Strongly Agree' and 'Agree' were also merged together and named 'Agreement'.

The internal consistency reliability test was conducted on statements 32 to 44 (variables 33 to 45) in which the Cronbach α measured 0.82, with a mean value of 3.18 of all the statements in the first sub-section of Section C, and a standard deviation of 0.95, as is presented in Table 5.3. The results showed that the majority of respondents had a neutral perception towards GM food products; they were thus unsure about their perception of GM food products in relation to what they perceived GM food products to be. Descriptive statistics were performed on statements 32 to 44 (variables 33 to 45) of the questionnaire in order to examine the data that were obtained in terms of the number of responses (n) for each statement on each of the three scale items and the percentage (%) of the responses represented in terms of the total number of respondents (N).

5.6.1 Descriptive Statistics on the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

The descriptive statistics, which consisted of percentages and frequencies, of the statements (32 to 44/variables 33 to 45) on the respondents' perception in terms of nutritional, socio-economic and product quality aspects of GM food products are presented in Table 5.14 and Figure 5.3. The results are discussed and presented in order of the statements that drew the most agreement to those that showed a higher level of uncertainty and disagreement, or agreement as a combined measure to the least agreement or no particular difference between the scale items.

Table 5.14: Results on the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

Variable Number	Statement	Respondents		
		Disagreement	Neither	Agreement
V33	GM food products have better health benefits as compared to traditional foods	167 51[1]	127 39	32 10
V34	GM food products have increased nutritional value	123 38	135 41	68 21
V35	The consumption of GM food products can assist in reducing nutritional deficiencies such as vitamin A	61 19	168 52	97 29
V36	The consumption of GM food products can assist in reducing nutritional deficiencies such as Zinc	62 19	175 54	89 27
V37	GM food products has a higher macronutrient content as compared to traditional foods	81 25	173 53	72 22
V38	GM food products can assist in reducing malnutrition	45 14	129 40	152 46
V39	The production of GM food products promotes biodiversity	78 24	156 48	92 28
V40	The production of GM food products can increase food supplies in South Africa	16 5	75 23	235 72
V41	Biotechnology can boost the economy	10 3	108 33	208 64
V42	The production of GM food products requires less pesticides	35 11	122 37	169 52
V43	The production of GM food products requires less herbicides	47 14	135 42	144 44
V44	GM food products has a longer shelf life	20 7	104 32	202 61
V45	GM food products tastes better than traditional foods	110 34	184 56	32 10

[1] The first row of the data in Table 5.14 which is in black lettering represents the frequencies (n) obtained for each of the scales pertaining to the particular statement with the percentages (%) given in red below the (n) value.

There were only four statements proposed to the respondents relating to how sure they were about what they perceived GM food products to be (V40, V41, V42 and V44). The first certain perceived benefit of GM food products was that they believed it could increase food supplies

in South Africa (V40). The majority of respondents agreed (72%; n=235 agreed), with a smaller percentage of respondents who were uncertain if this could be the case (23%; n=75 neither agreed nor disagreed) or who disagreed (5%; n=16) with this particular benefit of GM food products. A study conducted in India also found that consumers had a positive perception of the fact that the production of GM food products had the potential to decrease food shortages (Kajale & Becker 2014).

The second statement (V41) with which more than half of the respondents were sure they agreed was their perception of biotechnology being able to boost the economy (64%; n=208 agreed), while a third of respondents were not sure if they perceived this to be the case (33%; n=108 neither agreed nor disagreed), and a very small number of respondents disagreed (3%; n=10) with the statement. Gastrow *et al.* (2018) obtained similar results from a study conducted with South African consumers stating that consumers perceived biotechnology as having the potential to positively influence the economy.

The third statement (V44) with which more than half of respondents again agreed (61%; n=202), was related to GM food products having a longer shelf life, while a third of the rest of the respondents were uncertain if this was the case (32%; n=104 neither agreed nor disagreed), and a smaller number of respondents disagreed (7%; n=20) with the statement. Popek and Halagarda (2017) also found, in a study conducted in European countries, that consumers perceived GM food products as having a longer shelf life as compared to their traditional counterparts.

The fourth statement (V42), with which more than half of the respondents agreed (52%; n=169), was that they perceived that the production of GM food products required fewer pesticides. More than a third of the respondents showed uncertainty if this was the case (37%; n=122 neither agreed nor disagreed), with merely 11% (n=35) of respondents disagreeing with the statement.

Furthermore, there were six statements (V33, V35, V36, V37, V39 and V45) of which the respondents were not sure in terms of perceived nutrition-related aspects and biodiversity-related aspects of GM food products. The first statement (V45) to which the respondents showed uncertainty was their perception of whether GM food products tasted better than traditional foods, as 56% (n=184 neither agreed nor disagreed) of the respondents were not sure if this was the case. About a third of respondents disagreed (34%; n=110) with the statement, and a very small proportion of respondents agreed (10%; n=32) that this was indeed the case. However, a study conducted in Malaysia found that consumers perceived

GM food products as having better taste and aroma (Hassan *et al.* 2016), which is contrary to the current findings.

Slightly more than half (54%; n=175) of the respondents neither agreed nor disagreed with the second statement (V36) that they were not sure if GM food products were able to assist in reducing nutritional deficiencies such as Zinc; 27% (n=89 agreed) of respondents did in fact think so, and the remainder did not think that this could be the case (19%; n=62 disagreed). The third statement (V37), in which just more than half of the respondents showed uncertainty (53%; n=173 neither agreed nor disagreed), was related to whether they perceived GM food products as having a higher macronutrient content as compared to traditional food products. A smaller percentage of respondents disagreed (25%; n=81) that this could be the case, and 22% (n=72) of the respondents agreed with the statement. The fourth statement (V35) showed that slightly more than half (52%; n=168 neither agreed nor disagreed) of the respondents were not sure if they perceived the consumption of GM food products as being able to assist in reducing nutritional deficiencies such as vitamin A, while 29% (n=97 agreed) of the respondents did indeed think so, with a smaller percentage of respondents (19%; n=61) who disagreed that this could be the case. The fifth statement (V33) referred to GM food products having better health benefits as compared to traditional food products. Half (51%; n=167) of the respondents disagreed that this could be the case, while the remainder of the respondents (39%; n=127 neither agreed nor disagreed) were not sure, with only 10% (n=32) of the respondents who in fact agreed with the statement.

The final statement (V39) to which the respondents showed uncertainty referred to whether they perceived the production of GM food products as being able to promote biodiversity. Slightly less than half (48%; n=156 neither agreed nor disagreed) of the respondents were not sure if this could be the case, while 24% (n=78) of the respondents disagreed and 28% (n=92) of the respondents agreed with the statement. Contrarily, a study conducted by Todua *et al.* (2015) in Georgia showed that consumers perceived the production of GM foods as being beneficial to biodiversity.

In the following three statements (V34, V38 and V43), respondents did not know if they thought the statement was true or not, or outright disagreed or agreed with the statements. The respondents either agreed (44%; n=144) or were not sure (42%; n=135 neither agreed nor disagreed) if they perceived the production of GM food products as requiring fewer herbicides, with only a small percentage of respondents (14%; n=47) who disagreed that this could be the case (V43). Once again, the respondents either outright agreed (46%; n=152) or were unsure (40%; n=129 neither agreed nor disagreed) regarding their perception of whether GM food

products are able to assist in reducing malnutrition, with only 14% (n=45) of the respondents who disagreed with the statement (V38). The respondents were not sure (41%; n=135 neither agreed nor disagreed) if they perceived GM food products as having an increased nutritional value, while 38% (n=123) disagreed that this statement was true, and a few (21%; n=68) of the respondents agreed that the statement was, in fact, true (V34).

However, other studies conducted in Georgia, Nigeria and Malaysia achieved results which stated that consumers perceived GM food products as being healthier than their traditional counterparts and consumers perceived GM food products as having increased nutritional values (Todua *et al.* 2015, Eneh *et al.* 2016, Hassan *et al.* 2016). The results are illustrated in Figure 5.3.

The uncertainty of the respondents' perception to the nutritional aspects, socio-economic aspects and product quality aspects of GM food products may explain why only slightly more than half of the respondents (54%; n=177) thought that they sometimes looked for or noticed GM food products as seen in the second positioning question.

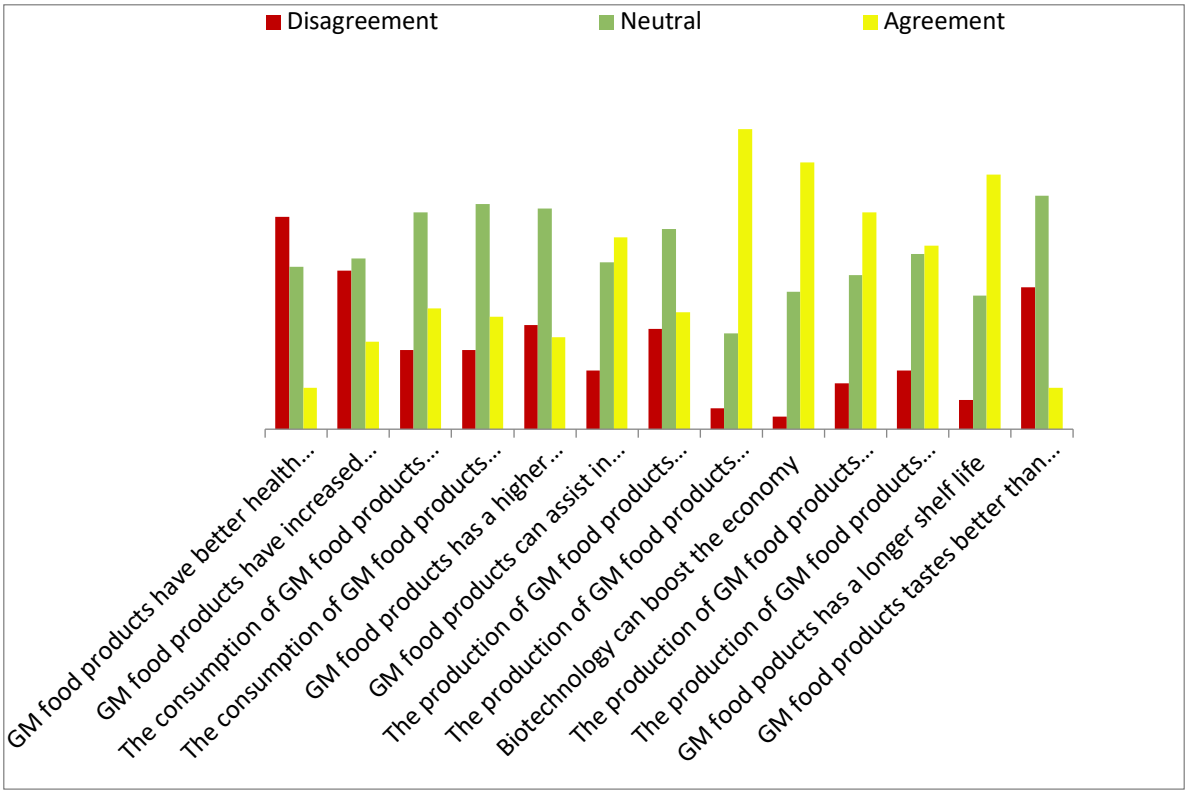

Figure 5.3: Results on the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

EFA was performed on variables 33 to 45 after descriptive statistics in order to determine the relationships between the variables by investigating the underlying drivers to the responses in terms of respondents' perception (nutritional, socio-economic and product quality aspects) of GM food products. In order to determine if the data obtained from variables 33 to 45 were normally distributed, the Shapiro-Wilks test was performed and the results are presented in Table 5.15.

Table 5.15: Skewness and Kurtosis on the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

Variable Number	Skewness	Kurtosis
V33	1.01	-1.00
V34	0.80	-1.78
V35	-3.28	1.50
V36	-2.62	1.84
V37	-2.85	0.75
V38	-2.85	0.59
V39	-2.50	0.05
V40	-5.83	5.37
V41	-2.91	3.15
V42	-2.80	0.75
V43	-1.90	0.05
V44	-3.82	2.42
V45	-1.05	1.79

As evident in Table 5.15, the data were not normally distributed and skewed for variables 33 to 45, which were used to measure the respondents' perception (nutritional, socio-economic and product quality aspects) of GM food products.

5.6.2 Exploratory Factor Analysis (EFA) on the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products (Objective 2g)

EFA was performed on the first sub-section of Section C from the questionnaire, which consisted of variables 33 to 45; results are presented in the form of tables to show the factors that emerged from this sub-section. As seen by the information presented below, two factors emerged.

EFA was conducted on variables 33 to 45, in which the KMO was conducted first on 13 variables, which yielded a value of .769, which is above 0.6 and deemed adequate and acceptable (Chan & Idris 2017) for EFA. This was supported by a significant Bartlett's Test of Sphericity at 0.000 (Hadi *et al.* 2016).

Table 5.16: KMO and Bartlett's Test on the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.769
Bartlett's Test of Sphericity	Approx. Chi-Square	1768.494
	df	78
	Sig.	.000

The Eigenvalues for this section clearly depicted that three factors showed a greater value of 1, which attributed to total variance of 60% as presented in bold in the last column of Table 5.17.

Table 5.17: Total Variance for the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.314	33.183	33.183	4.314	33.183	**33.183**
2	2.178	16.754	49.936	2.178	16.754	**49.936**
3	1.313	10.097	60.034	1.313	10.097	**60.034**
4	.972	7.473	67.507			
5	.844	6.490	73.997			
6	.811	6.238	80.236			
7	.582	4.476	84.711			
8	.529	4.066	88.778			
9	.446	3.432	92.210			
10	.375	2.882	95.092			
11	.248	1.909	97.001			
12	.203	1.562	98.563			
13	.187	1.437	100.000			

The principal component matrix for the 13 variables in the first sub-section of Section C from the questionnaire can be seen in Table 5.18. It is clear that two factors emerged, as the loadings were either on Factor 1 or Factor 2, leaving all the loadings on Factor 3 small. Thus, from Table 5.18, although taking the Eigenvalues into account, it is clear that two factors emerged and not three.

Table 5.18: Principal Component Matrix for the Perception (Nutritional, Socio-Economic and Product Quality Aspects) of GM Food Products

Component Matrix[a]				
	Component			
	Statement	1	2	3
V33	GM food products have better health benefits as compared to traditional foods	**.610**	-.364	.395
V34	GM food products have increased nutritional value	**.740**	-.340	.098
V35	The consumption of GM food products can assist in reducing nutritional deficiencies such as Vitamin A	**.798**	-.216	-.140
V36	The consumption of GM food products can assist in reducing nutritional deficiencies such as Zinc	**.784**	-.134	-.114
V37	GM food products has a higher macronutrient content as compared to traditional foods	**.750**	-.268	-.073
V38	GM food products can assist in reducing malnutrition	**.690**	.130	-.288
V39	The production of GM food products promotes biodiversity	**.471**	.019	.052
V40	The production of GM food products can increase food supplies in South Africa	**.482**	.543	-.375
V41	Biotechnology can boost the economy	**.458**	.467	-.406
V42	The production of GM food products requires less pesticides	.339	**.694**	.493
V43	The production of GM food products requires less herbicides	.266	**.719**	.521
V44	GM food products has a longer shelf life	.219	**.414**	-.099
V45	GM food products tastes better than traditional foods	**.453**	-.305	.440
Extraction Method: Principal Component Analysis.				
a. 3 components extracted.				

The component matrix shows the factor loadings which reveal how strong the relationship is between each statement. In Table 5.18, it is evident that V33-V41 and V45 can be regarded as Factor 1, whereas V42-V44 can be regarded as Factor 2, as these factors loaded more than .400, with no variables loading more strongly on the third factor compared to the first two factors.

Factor 1 consisted of statements that were used to test the perception of the respondents in terms of nutritional, socio-economic and product quality of GM food products. Therefore, Factor 1 refers to the *favourable nutritional aspects of GM food products*. Factor 2 consisted of statements that were used to test the respondents' perception of GM food products, but particularly pertaining to the production and product characteristics of GM food products. Therefore, Factor 2 refers to the *production-related aspects of GM food products*.

5.7 RESULTS ON THE PERCEPTION (HEALTH, ETHICAL AND CONSUMPTION ASPECTS) OF GM FOOD PRODUCTS (Objective 2b, 2e and 2f)

This section presents the second sub-section of Section C from the questionnaire, which consisted of statements 45 to 61 (variables 46 to 62). This sub-section of the questionnaire was used to test the respondents' perception of health, ethical and consumption aspects of GM food products. In this sub-section, all aspects involved the negative connotations to GM food products, and therefore the health and consumption aspects included negative health effects, damage and safety after the consumption of GM food products. This included GM food products being dangerous and risky, cancer development, toxicity, allergic reactions, alterations in kidney function, immune malfunction and infertility problems. The ethical aspects referred to the contradiction of religious beliefs, unnatural production, genetic make-up being altered, technology being used and the harmful effect on the environment.

This section was measured by using a five-point Likert scale indicating the respondents' level of fear between 'My Greatest Fear' (1) and 'Not Afraid At All' (5). Due to the minor differences between the responses in the 'My Greatest Fear' and 'Very Afraid' category, the responses were grouped together and called 'Very Fearful'. There were also minor differences between the 'Slightly Afraid' category and the 'Not Afraid At All' category, therefore these responses were also grouped together into one category and renamed as 'Not Afraid'.

The internal consistency reliability test was performed on statements 45 to 61 (variables 46 to 62), which achieved a Cronbach α score of 0.97, a mean value of 3.44 of all the statements in the second sub-section of Section C from the questionnaire, with a standard deviation of 1.18, which can be seen in Table 5.3. These scores showed that the majority of the respondents had a neutral (not fearful) perception of GM food products. Descriptive statistics were conducted on statements 45 to 61 (variables 46 to 62) of the questionnaire in order to analyse the data that were obtained from the respondents in terms of the number of responses (n) obtained for each statement on each of the three scale items. It also included the percentage (%) of the responses represented in terms of the total number of respondents (N).

5.7.1 Descriptive Statistics on the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

The descriptive statistics made use of percentages and frequencies to analyse the second sub-section of Section C of the questionnaire, statements 45 to 61 (variables 46 to 62), that pertained to the respondents' perception in terms of health, ethical and consumption aspects

of GM food products. These are summarised in Table 5.19, and presented in Figure 5.4. The results are discussed and presented in order of the statements from no fear to the respondents who were afraid or who showed great fear, or as a combined measure where there was no particular difference between the scale items.

Table 5.19: Results on the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

Variable Number	Statement	Respondents		
		Very Fearful	Afraid	Not Afraid
V46	I am concerned about the effect of GM food products on my health after consumption	45 14[1]	97 30	184 56
V47	The production of GM food products contradict religious beliefs	18 6	51 15	257 79
V48	The production of GM seeds/crops by factories is unethical	30 9	77 24	219 67
V49	The consumption of GM food products are dangerous and risky to all living things	51 16	84 26	191 58
V50	GM food products can jeopardise human health	63 19	93 29	170 52
V51	I am sceptical about the safety of GM food products for consumption purposes	60 18	92 28	174 54
V52	The process of producing GM crops is unnatural	78 24	96 29	152 47
V53	The genetic make-up of GM food products is altered	90 28	83 25	153 47
V54	Technology is used to create GM food products	68 21	81 25	177 54
V55	The consumption of GM food products can cause health damage	95 29	88 27	143 44
V56	I am more susceptible to cancer after consuming GM food products as compared to traditional foods	96 30	86 26	144 44
V57	The consumption of GM food products may cause toxicity	80 25	101 31	145 44
V58	The consumption of GM food products may cause allergic reactions	94 29	87 27	145 44
V59	The consumption of GM food products may cause alterations in kidney functions	83 26	91 28	152 46
V60	The consumption of GM food products may cause immune malfunction	85 26	96 29	145 45
V61	The consumption of GM food products may cause infertility problems	82 25	103 32	141 43
V62	The production/growing of GM crops is harmful to the environment	80 25	96 29	150 46

[1] The first row of the data of Table 5.19 which is in black lettering represents the frequencies (n) obtained for each of the scales pertaining to the particular statement with the percentages (%) given in red below the (n) value.

There were only four statements (V46 to V49), relating to religious beliefs, ethical position and the general risk of consuming GM food products, and the respondents portrayed certainty that they were not afraid regarding their position to each of these statements. The first statement (V47) to which respondents showed the certainty of not being afraid related to the production

of GM food products contradicting religious beliefs. The majority (79%; n=257) of respondents were not afraid, with the remaining sample of respondents being afraid (15%; n=51) or very fearful (6%; n=18) that this was the case. Deffor (2014) achieved different results in a study conducted in the Greater Accra Region in Ghana which concluded that many consumers perceived that the production of GM food products contradicted their religious beliefs.

The second statement (V48) in which respondents felt certain of not being afraid referred to the unethical production of GM seeds/crops by factories; significantly more than half of the respondents were not afraid (67%; n=219), with 24% (n=77) of the respondents being afraid of this and only 9% (n=30) being very fearful that this was the case. In the third statement (V49), where respondents positioned themselves as being certain about not being afraid, more than half (58%; n=191) of the respondents were not afraid that the consumption of GM food products was dangerous to all living things, with the remaining sample of respondents being afraid (26%; n=84) or very fearful (16%; n=51) that this was indeed the case. However, other studies conducted in Turkey achieved results that showed consumers did indeed perceive GM food products as being dangerous to all living things (Wunderlich & Gatto 2015). The fourth statement (V46) referred to the effect on health after the consumption of GM food products and 56% (n=184) of the respondents were not afraid of the health consequences, while 30% (n=97) of the respondents were afraid or very fearful (14%; n=45) about the effect on their health after consuming GM food products.

There were three statements to which the respondents showed a slight difference about being not afraid and afraid; these referred to health effects, safety and technological development (V50, V51 and V54). The first statement (V51), in which slight differences between not being afraid and afraid were present, referred to being sceptical about the safety of GM food products for consumption. Fifty-four per cent (n=174) of the respondents indicated that they were not afraid of the safety of GM food products after consumption, while 28% (n=92) of the respondents were afraid or very fearful (18%; n=60) that this could indeed be the case. Various other studies conducted in Turkey, USA, Nigeria and China achieved results which stated that consumers were becoming unsure about the safety of GM food products and therefore perceived GM food products as being unsafe for human consumption (Celik & Dagistan 2016, Eneh *et al.* 2016, McFadden & Lusk 2016, Deng *et al.* 2019).

The second statement (V54), in which respondents indicated slight differences between not being afraid and being afraid, referred to the fact that technology was used to create GM food products; 54% (n=177) of the respondents were not afraid, while 25% (n=81) were afraid and 21% (n=68) were very fearful about technological involvement in the production of GM food

products. The third statement (V50), in which slight differences between not being afraid and afraid were present, referred to GM food products jeopardising human health. About half of the respondents were not afraid (52%; n=170) that this could be the case, while 29% (n=93) of the respondents were afraid or very fearful (19%; n=63) that this could in fact happen. A study conducted in Georgia by Todua *et al.* (2015), also showed that consumers perceived GM food products as having the potential to jeopardise human health.

The 'very fearful' and 'afraid' responses were grouped together and referred to as 'afraid' as each of these responses ultimately still indicates fear. There are 10 statements that related to health, environmental and production implications of GM food products, to which the respondents generally indicated that they positioned themselves as being afraid in relation to the statements (V52, V53, V55 to V62). In total, more than half of the respondents were afraid (57%; n=185) that the consumption of GM food products could cause infertility problems, with less than half (43%; n=141) of the respondents being unafraid of potentially having infertility problems (V61). In total, more than half of the respondents (56%; n=183) were afraid that the consumption of GM food products could cause health damage, whereas 44% (n=143) of the respondents were not afraid that health damage could occur (V55). Eneh *et al.* (2016) established from a study conducted in Nigeria that consumers were very concerned with the health damage that may be caused by consuming GM food products.

In total, slightly more than half of the respondents (56%; n=182) were afraid of being more susceptible to cancer after consuming GM food products as compared to traditional foods, while 44% (n=144) of the respondents were not afraid of possible cancer development (V56). Similarly, in total, more than half of the respondents were afraid (56%; n=181) that the consumption of GM food products could cause toxicity, with less than half of the respondents (44%; n=145) being unafraid that this could be the case (V57). Once again, in total, just more than half of the respondents (56%; n=181) were afraid that the consumption of GM food products could cause allergic reactions (V58), while 44% (n=145) of the respondents were not afraid of experiencing allergic reactions after consuming GM food products.

Overall, more than half of the respondents (55%; n=181) were afraid that the consumption of GM food products could cause immune malfunctions, while less than half of the respondents (45%; n=145) were not afraid of experiencing immune malfunctions (V60). An almost clear split was evident between the respondents' perception towards the consumption of GM food products causing alterations in kidney function (V59), as slightly more than half of the respondents were afraid (54%; n=174) of this occurrence, whereas 46% (n=152) of the respondents were not afraid that this could be the case. Similarly, another clear split emerged

in the respondents' perception towards the production/growing of GM crops that could be harmful to the environment (V62); slightly more than half of the respondents were afraid (54%; n=176) of the environmental implications, while 46% (n=150) of the respondents were not afraid of this effect. These results were echoed by Kajale and Becker (2014) and Todua *et al.* (2015) who conducted studies in India and Georgia in which it was found that consumers perceived the production of GM food products as being harmful to the environment.

In total, just more than half of the respondents (53%; n=174) were afraid that the process of producing GM crops was considered as being unnatural, with slightly less than half of the respondents (47%; n=152) being unafraid of the unnatural production of GM food products (V52). A study conducted by Eneh *et al.* (2016) in Nigeria established that consumers perceived GM food products as being artificial. The statement pertaining to the alteration of the genetic make-up of GM food products (V53) showed that 53% (n=173) of the respondents were afraid of this, while 47% (n=153) of the respondents were not afraid. These results are presented in Figure 5.4.

The respondents' lack of confidence in their perception of the health, ethical and consumption aspects of GM food products, may explain why only more than half of the respondents (54%; n=177) thought that they sometimes looked for or noticed GM food products as seen in the second positioning question. The respondents were not particularly sure if they had a fearful or unfearful perception of GM food products.

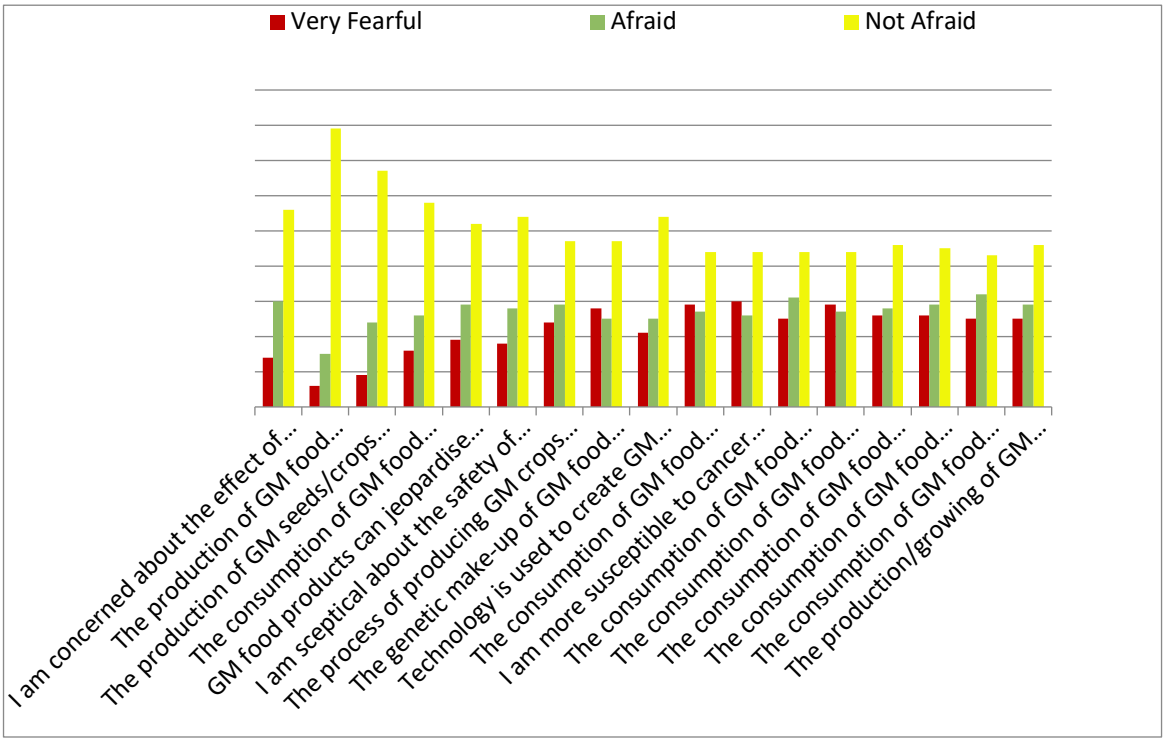

Figure 5.4: Results on the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

After the descriptive statistics was done, EFA was conducted on variables 46 to 62 in order to examine the relationship between the variables by establishing the underlying drivers to the respondents in terms of their perception (health, ethical and consumption aspects) of GM food products. In order to determine if the information gathered from variables 46 to 62 was normally distributed, the Shapiro-Wilks test was performed and the results are presented in Table 5.20.

Table 5.20: Skewness and Kurtosis of the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

Variable Number	Skewness	Kurtosis
V46	-4.22	-0.22
V47	-11.02	5.86
V48	-6.26	0.34
V49	-3.99	-1.51
V50	-3.28	-1.68
V51	-3.41	-1.66
V52	-2.23	-3.03
V53	-2.02	-3.24
V54	-3.71	-3.00
V55	-1.65	-3.31
V56	-1.70	-3.66
V57	-2.16	-2.83
V58	-1.45	-3.24
V59	-2.28	-3.07
V60	-1.95	-2.88
V61	-1.78	-2.92
V62	-2.46	-2.75

As seen in Table 5.20, variables 46 to 62 that were used to measure the respondents' perception (health, ethical and consumption aspects) of GM food products indicated that the data were not normally distributed and skewed.

5.7.2 Exploratory Factor Analysis (EFA) on the Perception (Health, Ethical and Consumption Aspects) of GM Food Products (Objective 2g)

EFA was performed on the second sub-section of Section C from the questionnaire, which comprised of variables 46 to 62. Tables were used to present the results of the EFA and the two factors that emerged. EFA was done on 17 variables, namely variables 46 to 62. The KMO value was measured at .959, which indicated that the variables were viable to perform EFA (Chan & Idris 2017). Bartlett's Test of Sphericity Sig value was measured at .000 and therefore deemed significant.

Table 5.21: KMO and Bartlett's Test on the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.959
Bartlett's Test of Sphericity	Approx. Chi-Square	6134.907
	df	136
	Sig.	.000

The Eigenvalues showed that two factors emerged which loaded a greater value than 1, accounting for a total variance of just more than 74%, depicted in bold in the last column of Table 5.22.

Table 5.22: Total Variance Explained for the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.458	67.399	67.399	11.458	67.399	**67.399**
2	1.165	6.853	74.253	1.165	6.853	**74.253**
3	.837	4.923	79.175			
4	.595	3.500	82.675			
5	.462	2.719	85.394			
6	.388	2.282	87.676			
7	.344	2.023	89.699			
8	.325	1.913	91.612			
9	.231	1.360	92.972			
10	.228	1.339	94.311			
11	.213	1.251	95.562			
12	.190	1.116	96.678			
13	.151	.887	97.565			
14	.140	.821	98.386			
15	.108	.634	99.020			
16	.098	.578	99.598			
17	.068	.402	100.000			

The principal component matrix for the 17 variables in the second sub-section of Section C confirms that two factors were identified by their Eigenvalues (>1), although only one variable, namely V47, loaded on the second factor.

Table 5.23: Principal Component Matrix for the Perception (Health, Ethical and Consumption Aspects) of GM Food Products

Component Matrix[a]			
		Component	
	Statement	1	2
V46	I am concerned about the effect of GM food products on my health after consumption	**.757**	.134
V47	The production of GM food products contradict religious beliefs	.466	**.548**
V48	The production of GM seeds/crops by factories is unethical	**.670**	.508
V49	The consumption of GM food products are dangerous and risky to all living things	**.839**	.210
V50	GM food products can jeopardise human health	**.875**	.168
V51	I am sceptical about the safety of GM food products for consumption purposes	**.860**	.205
V52	The process of producing GM crops is unnatural	**.780**	.229
V53	The genetic make-up of GM food products is altered	**.819**	.117
V54	Technology is used to create GM food products	**.763**	.072
V55	The consumption of GM food products can cause health damage	**.896**	-.096
V56	I am more susceptible to cancer after consuming GM food products as compared to traditional foods	**.898**	-.211
V57	The consumption of GM food products may cause toxicity	**.890**	-.227
V58	The consumption of GM food products may cause allergic reactiond	**.876**	-.213
V59	The consumption of GM food products may cause alterations in kidney functions	**.883**	-.288
V60	The consumption of GM food products may cause immune malfunction	**.892**	-.278
V61	The consumption of GM food products may cause infertility problems	**.864**	-.244
V62	The production/growing of GM crops is harmful to the environment	**.812**	-.183
Extraction Method: Principal Component Analysis.			
a. 2 components extracted.			

As seen in Table 5.23, V46 and V48-V62 can be regarded as Factor 1, whereas the single variable i.e. V47 can be regarded as Factor 2, as these factors loaded more than .400.

Factor 1 comprised of statements that were used to determine the respondents' perception of GM food products, particularly focusing on health-related aspects as well as the consumption of GM food products and the development of GM components. Therefore, Factor 1 indicates the respondents' perception of the overall influence of GM food products, through the development of GM components, on the *wellbeing of consumers' in relation to GM food products*. Factor 2 consisted of a single statement that was used to determine the respondents' religious views on GM food products. Factor 2, although considering the ethical perceptions of GM food products, did not load much stronger than on Factor 1. Considering that religious construct is associated with the development of GM components that are found in GM food products, this section might be regarded as the influence of religion on the consumption of GM food products. The factor is therefore named *religious beliefs and consumption of GM food products***.**

5.8 RESULTS ON THE GM-RELATED FACTORS THAT INFLUENCE THE PURCHASING DECISION OF GM FOOD PRODUCTS (Objective 3a)

The following section will discuss the first of two sub-sections of Section D from the questionnaire, which consisted of statements 62 to 74 (variables 63 to 75) that involved the GM-related factors that influence the respondents' purchasing decision of GM food products. These GM-related factors pertained to a broad spectrum of aspects related to price, health, nutritional, ethical, product quality and consumption of GM food products which hold benefits to the consumer. However, some of the aspects also pertain to risks involved for the consumer. A five-point Likert scale was used to measure the responses of the statements in the first sub-section of Section D, indicating the respondents' level of agreement between Strongly Disagree (1) and Strongly Agree (5). Once again 'Strongly Disagree' and 'Disagree' were merged into one category namely 'Disagreement'. The 'Strongly Agree' and 'Agree' categories were also merged to form 'Agreement'.

The internal consistency reliability test was performed on the statements of the first sub-section of Section D of the questionnaire, namely statements 62 to 74 (variables 63 to 75). The Cronbach α measured 0.72, while a mean value of 3.35 of all the statements in this sub-section of the questionnaire was achieved and a standard deviation of 1.05, which can be seen in Table 5.3. The results showed that the respondents were not particularly in agreement or disagreement with all the factors related to GM food products. However, some factors did indeed influence the respondents' purchasing decision. EFA was performed on statements 62 to 74 (variables 63 to 75), with the intention of examining the information that was obtained from respondents in terms of the number of responses (n) for each statement on each of the three scale items and the percentage (%) of the responses represented in terms of the total number of respondents (N).

5.8.1 Descriptive Statistics on the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

The descriptive statistics used percentages and frequencies to analyse the data obtained from statements 62 to 74 (variables 63 to 75) of the questionnaire that involved the GM-related factors that influence the respondents' purchasing decision of GM food products, summarised in Table 5.24, and presented in Figure 5.5. The results are discussed and presented in order of the statements that drew the most agreement to those that showed a higher level of uncertainty and disagreement, or agreement as a combined measure as to those statements that showed the least agreement or no particular difference between the scale items.

Table 5.24: Results on the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

Variable Number	Statement	Respondents		
		Disagreement	Neither	Agreement
V63	Reduced price	75 23[1]	98 30	153 47
V64	Increased nutritional value	77 24	96 29	153 47
V65	Improved taste	85 26	112 35	129 39
V66	Longer shelf life	60 19	101 31	165 50
V67	Availability of foods in different colours	118 36	118 36	90 28
V68	Possible allergic reaction after consumption	65 20	101 31	160 49
V69	Possible cancer development after consumption	65 20	92 28	169 52
V70	Possible cause of allergenicity after consumption	60 18	100 31	166 51
V71	Reduced usage of pesticides	33 10	115 35	178 55
V72	Harmful effect on the environment	59 18	100 31	167 51
V73	The development of GM food products is unethical	80 25	147 45	99 30
V74	The development of GM food products is unnatural	58 18	105 32	163 50
V75	The production of GM food products can increase food supplies	18 6	91 28	217 66

[1] The first row of the data in Table 5.24 which is in black lettering represents the frequencies (n) obtained for each of the scales pertaining to the particular statement with the percentages (%) given in red below the (n) value

There was only one statement the majority of respondents were very sure about (V75). This statement referred to the fact that the production of GM food products could increase food supplies; 66% (n=217) of the respondents agreed that this was the case, whereas 28% (n=91 neither agreed nor disagreed) were not sure if this was true, and only 6% (n=18) of the respondents disagreed with the statement. Lopez *et al.* (2016) achieved similar results in a study conducted in Mexico which showed that consumers' purchasing decision was influenced by the fact that the production of GM food products could assist in combatting food shortages.

There were six statements asking whether respondents agreed or disagreed with the statements (V66, V69-V72 and V74). These statements pertained to a range of topics that are related and debated within GM food production and the development of GM food products. When the respondents were asked about these respective statements, the responses were split between half showing a confident answer and the rest of the responses being reflective or uncertain (not knowing if they are sure about this or not); only a smaller number of respondents were confident it is not true. This can be seen in the statement pertaining to the

reduced usage of pesticides (V71), as 55% (n=178) of the respondents agreed that this was true, while 35% (n=115 neither agreed nor disagreed) of the respondents were not sure if this was in fact true, and 10% (n=33) of the respondents disagreed with the statement. Popek and Halagarda (2017) also found that other factors such as resistance to pests and climatic conditions influenced consumers' purchasing decision of GM food products. Only 52% (n=169) of the respondents agreed that the possible development of cancer after the consumption of GM food products was a factor that would influence their purchasing decision of GM food products (V69); the rest of the respondents were not sure if this could occur (28%; n=92 neither agreed nor disagreed) and the remainder of respondents disagreed (20%; n=65) with the statement. A study conducted in Turkey by Tas *et al.* (2015) obtained similar results showing that the respondents' main concern about GM food products was the possible carcinogenic effect on the human body.

Approximately half of the respondents agreed (51%; n=166) that possible allergenicity after consumption was a factor that would influence their purchasing decision of GM food products (V70), with a smaller percentage of respondents who were not sure if this was the case (31%; n=100 neither agreed nor disagreed) or who disagreed (18%; n=60) that allergenicity could actually occur after consuming GM food products. Studies conducted in the USA and European countries concluded that possible allergenicity was indeed a big concern for consumers and it therefore influenced their purchasing decision of GM food products (Wunderlich & Gatto 2015; Popek & Halagarda 2017).

An almost clear split between responses again occurred as approximately half of the respondents (51%; n=167) agreed that the harmful effect on the environment (V72) was a factor that would influence their purchasing decision of GM food products, while about a third of respondents (31%; n=100 neither agreed nor disagreed) were unsure if this was true, and 18% (n=59) of the respondents disagreed with the statement. Similar results were acquired by a study conducted in Georgia by Todua *et al.* (2015), in which it was discovered that the majority of the respondents believed that by using GM food products, the environment was being damaged.

Exactly half of the respondents (50%; n=165) agreed that longer shelf life (V66) was a factor that would influence their purchasing decision of GM food products, with the remaining sample of respondents being unsure if GM food products did indeed have a longer shelf life (31%; n=101 neither agreed nor disagreed), while 19% (n=60) of the respondents disagreed with the statement. A study conducted in European countries by Popek and Halagarda (2017) determined that the majority of respondents thought that longer shelf life was one of the major

advantages of GM food products. In this study, half of the respondents were sure of the unnatural development of GM food products (V74) as 50% (n=163) agreed, while 32% (n=105 neither agreed nor disagreed) were not sure if this was in fact true, and 18% (n=58) of the respondents disagreed that this was true. Lucht (2015) highlighted a very important factor in which the unnatural order of producing GM food products conflicted with many consumers' moral beliefs, thereby affecting their purchasing decision of GM food products.

There was one statement where the respondents did not take up a position on the ethical approach to GM food components and food products as there was a split between the belief whether it is ethical or not (V73). This is seen in the statement which referred to the unethical development of GM food products (V73) as 45% (n=147 neither agreed nor disagreed) of the respondents were unsure about their position in relation to this statement, 30% (n=99) of the respondents agreed that this was the case, and 25% (n=80 disagreed) of the respondents did not think that this was true. Contrarily, a study conducted in Ghana by Bonah *et al.* (2017) acquired results which indicated that their respondents felt that GM food products had ethical implications.

There were five statements that showed a stronger inclination made towards disagreement among respondents; once again, an almost equal number of respondents were neutral or disagreed with the statement (V63-V65, V67 and V68). This was seen in the statement pertaining to possible allergic reaction after the consumption of GM food products (V68) as 49% (n=160) of the respondents agreed that this was the case, 31% (n=101 neither agreed nor disagreed) of the respondents were not sure if allergic reactions could occur, and 20% (n=65) of the respondents disagreed that this could be the case. This was also seen in the statement pertaining to reduced price (V63) as slightly less than half of the respondents (47%; n=153) agreed that this was true, while almost a third of the respondents (30%; n=98 neither agreed nor disagreed) did not know if GM food products did in fact cost less, and 23% (n=75) of the respondents disagreed with the statement. Similarly, 47% (n=153) of the respondents agreed that GM food products had increased nutritional value (V64), 29% (n=96 neither agreed nor disagreed) of the respondents were unsure if this was the case, while 24% (n=77) of the respondents disagreed with the statement. Bray and Ankeny (2017) conducted a study in Australia in which the results showed that the respondents were willing to purchase GM food products due to their increased nutritional value and improved taste.

Approximately a third of respondents either disagreed (36%; n=118) or were not sure (36%; n=118 neither agreed nor disagreed) if the availability of foods in different colours (V67) was a factor that would influence their purchasing decision of GM food products, whereas the

remainder of respondents (28%; n=90) agreed that this would be the case. More than a third of the respondents (39%; n=129) agreed that improved taste (V65) was a factor that would influence their purchasing decision of GM food products, while the other respondents (35%; n=112 neither agreed nor disagreed) were not sure if this would be the case, or (26%; n=85) disagreed with the statement. These results are illustrated in Figure 5.5.

As seen by the limited number of GM-related factors that influenced the respondents' purchasing decisions of GM food products, it confirms that a great many of the respondents (79%; n=258) thought that they were only sometimes using GM food products, as seen in the fourth positioning question.

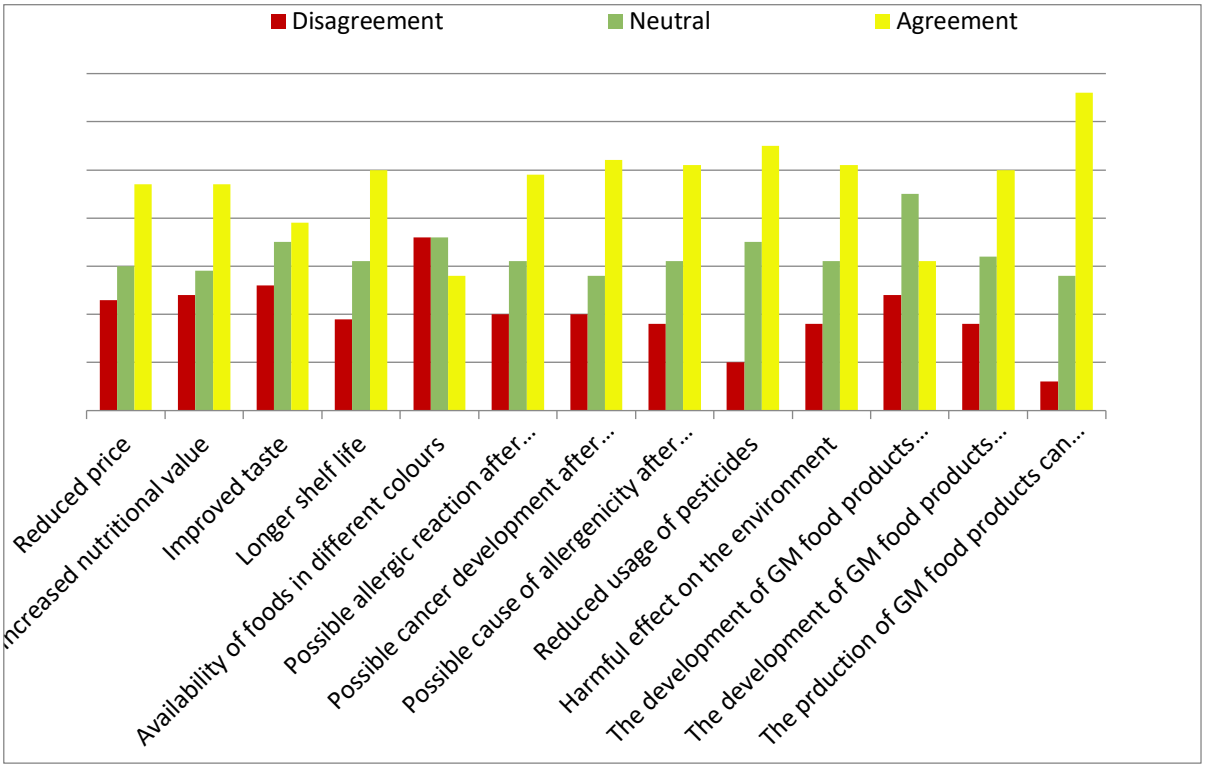

Figure 5.5: Results on the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

After the descriptive statistics were conducted on variables 63 to 75, EFA followed in order to determine the relationship between the variables by investigating what the underlying drivers were to the responses to the GM-related factors that influence respondents' purchasing decision of GM food products. In order to determine if variables 63 to 75 were normally distributed, the Shapiro-Wilks test was performed and the results are presented in Table 5.25.

Table 5.25: Skewness and Kurtosis of the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

Variable Number	Skewness	Kurtosis
V63	-2.05	-2.33
V64	-2.72	-1.91
V65	-1.94	-1.89
V66	-3.07	-1.14
V67	-0.74	-2.67
V68	-2.59	-1.84
V69	-3.09	-2.21
V70	-3.08	-1.54
V71	-2.31	-0.13
V72	-3.17	-1.45
V73	-0.37	-0.99
V74	-3.17	-0.97
V75	-4.51	2.37

As seen in Table 5.25, variables 63 to 75 were used to measure the GM-related factors that influence the respondents' purchasing decision of GM food products. It showed that the data was skewed.

5.8.2 Exploratory Factor Analysis (EFA) on the GM-Related Factors that Influence the Purchasing Decision of GM Food Products (Objective 3c)

EFA was conducted on the first sub-section of Section D from the questionnaire, which consisted of variables 63 to 75. Four factors emerged and are presented in the tables that follow.

This sub-section of the questionnaire consisted of 13 variables (variables 63 to 75) in which the KMO was measured at .779. It can be referred to as middling and was acceptable to perform EFA (Chan & Idris 2017), and Bartlett's Test of Sphericity's Sig value was measured at .000 and thus significant.

Table 5.26: KMO and Bartlett's Test on the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.779
Bartlett's Test of Sphericity	Approx. Chi-Square	2146.742
	df	78
	Sig.	.000

After inspection of the Eigenvalues of this section, it was concluded that four factors emerged that loaded more than 1. This explained a total variance of 71% as seen in bold in the last column of Table 5.27.

Table 5.27: Total Variance Explained for the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.926	30.201	30.201	3.926	30.201	**30.201**
2	3.017	23.210	53.411	3.017	23.210	**53.411**
3	1.216	9.356	62.767	1.216	9.356	**62.767**
4	1.078	8.289	71.056	1.078	8.289	**71.056**
5	.879	6.758	77.815			
6	.641	4.934	82.749			
7	.621	4.774	87.523			
8	.417	3.205	90.728			
9	.400	3.073	93.801			
10	.268	2.061	95.862			
11	.221	1.701	97.563			
12	.207	1.594	99.157			
13	.110	.843	100.000			

After visual inspection of the principal component matrix for the 13 variables in this sub-section of the questionnaire in Table 5.28, the four factors as identified by the Eigenvalues (>1) were confirmed.

Table 5.28: Principal Component Matrix for the GM-Related Factors that Influence the Purchasing Decision of GM Food Products

Component Matrix[a]					
		Component			
	Statement	1	2	3	4
V63	Reduced price	-.409	**.550**		
V64	Increased nutritional value	-.504	**.637**		.120
V65	Improved taste	-.463	**.651**		
V66	Longer shelf life	-.396	**.625**	.373	-.195
V67	Availability of foods in different colours	-.178	.437	**.580**	-.408
V68	Possible allergic reaction after consumption	**.645**	.526	-.236	-.281
V69	Possible cancer development after consumption	**.774**	.465	-.245	-.145
V70	Possible cause of allergenicity after consumption	**.773**	.449	-.234	-.185
V71	Reduced usage of pesticides		.492		**.669**
V72	Harmful effect on the environment	**.734**	.332		.127
V73	The development of GM food products is unethical	**.692**		.491	.198
V74	The development of GM food products is unnatural	**.659**		.560	.267
V75	The production of GM food products can increase food supplies	-.194	**.507**		.385
Extraction Method: Principal Component Analysis.					
a. 4 components extracted.					

As seen in Table 5.28, V68-V70 and V72-V74 form part of Factor 1. Variables 63-66 and V75 form part of Factor 2, V67 forms part of Factor 3, and the single variable of V71 makes up Factor 4, as these factors loaded more than .400.

Factor 1 consists of statements that were used to determine which GM-related factors affected the respondents' purchasing decisions of GM food products in terms of health implications, environmental implications and the development of GM food products. Therefore, Factor 1 refers to *consumer implications resulting from GM food product development*.

Factor 2 consists of statements that were used to determine which GM-related factors influenced the respondents' purchasing decisions of GM food products in terms of product quality and the production of GM food products. Factor 2 therefore represents the *consumer advantages of GM food products.*

Factor 3 consists of statements that determined the GM-related factors affecting the respondents' purchasing decisions of GM food products in terms of the colour of GM food products. Factor 3 therefore represents the visual appearance of *market identification of GM food products*.

Factor 4 consists of a single statement that was used to determine which GM-related factors influenced the respondents' purchasing decisions of GM food products in terms of pesticide usage. Factor 4 thus only loaded one statement, which classifies perceptions of *agricultural pesticide practices*, but it loaded quite strongly, and therefore needs to be considered as a separate factor than that of Factor 1 to Factor 3.

5.9 RESULTS ON THE GENERAL GM-RELATED BARRIERS OF GM FOOD PRODUCTS THAT INFLUENCE THE PURCHASING DECISION (Objective 3b)

In this section, the second sub-section of Section D from the questionnaire is discussed, which consisted of statements 75 to 83 (variables 76 to 84). This section included the general GM-related barriers of GM food products that influenced the respondents' purchasing decision of GM food products. The responses to statements 75 to 83 (variables 76 to 84) in the second sub-section of Section D from the questionnaire were measured using a five-point Likert scale indicating the respondents' level of agreement between Strongly Disagree (1) and Strongly Agree (5). Once again, 'Strongly Disagree' and 'Disagree' were grouped into one single 'Disagreement' construct, and 'Strongly 'Agree' and 'Agree' was grouped into 'Agreement', while keeping a neutral response.

The internal consistency reliability test was done on this sub-section of the questionnaire, which consisted of statements 75 to 83 (variables 76 to 84). The Cronbach α for these statements achieved a score of 0.79, while the mean value was 3.30, with a standard deviation of 1.02, which can be seen in Table 5.3. The results showed that the respondents' purchasing decision of GM food products were not particularly influenced by the general GM-related barriers of GM food products, but some general GM-related barriers did in fact emerge that influenced the respondents' purchasing decision of GM food products. Firstly, descriptive statistics were performed on statements 75 to 83 (variables 76 to 84), and secondly EFA was conducted in order to analyse the data that were gathered from respondents in terms of the number of responses (n) obtained for each statement on each of the three scale items and the percentage (%) of the responses represented in terms of the total number of respondents (N).

5.9.1 Descriptive Statistics on the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

The descriptive statistics, which included percentages and frequencies, were used to analyse the data gathered from statements 75 to 83 (variables 76 to 84) which involved the general GM-related barriers of GM food products that influenced the respondents' purchasing decision, seen in Table 5.29 and Figure 5.6. The results are discussed and presented in order of the statements that drew the most agreement to those that showed a higher level of uncertainty and disagreement, or agreement as a combined measure as to those statements that showed the least agreement or no particular difference between the scale items.

Table 5.29: Results on the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

Variable Number	Statement	Respondents		
		Disagreement	Neither	Agreement
V76	I know too little about GM food products	65 20[1]	69 21	192 59
V77	There are too many disadvantages of GM food products	58 18	151 46	117 36
V78	There are too many concerns about GM food products	64 20	122 37	140 43
V79	I am not familiar with any GM food products on the shelf	108 33	88 27	130 40
V80	I don't look out for GM food products in particular	49 15	63 19	214 66
V81	I don't have a particular interest in GM food products	73 22	89 27	164 51
V82	I am unsure of what GM food products consist of	92 28	91 28	143 44
V83	I am unsure about the difference between GM food products and traditional foods	151 46	75 23	100 31
V84	I never know if a product contains GM ingredients or not	75 23	87 27	164 50

[1]The first row of the data in Table 5.29 which is in black lettering represents the frequencies (n) obtained for each of the scales pertaining to the particular statement with the percentages (%) given in red below the (n) value.

There were two statements (V76 and V80) where the respondents showed certainty regarding their position, as 66% (n=214) of the respondents agreed that not looking out for GM food products in particular was considered a general barrier that would influence their purchasing decision of GM food products (V80). A smaller percentage of respondents (19%; n=63 neither agreed nor disagreed) were not sure if this would be the case, while 15% (n=49) of the respondents disagreed. This was also seen in the statement referring to knowing too little about GM food products (V76) as more than half of the respondents (59%; n=192) agreed that this was the case, while 21% (n=69 neither agreed nor disagreed) of the respondents were unsure if this was the case, and 20% (n=65) of the respondents disagreed with the statement.

There were six statements related to disadvantages, concerns, uncertainty, unfamiliarity and interest of GM food products in which the majority of the respondents either agreed or were unsure as to whether the statement was in fact true or not (V77-V79, V81-V82 and V84). The first statement where this occurred showed that just more than half of the respondents (51%; n=164) agreed that not having a particular interest in GM food products (V81) was a general barrier of purchasing GM food products, while the remaining sample of respondents showed uncertainty as to whether this was true (27%; n=89 neither agreed nor disagree), or the respondents disagreed (22%; n=73) with the statement. Secondly, the statement pertaining to never knowing if a product contains GM ingredients or not (V84) showed that half of the

respondents (50%; n=164) agreed that this was true, with a smaller percentage of the respondents being unsure if this was true (27%; n=87 neither agreed nor disagreed); only 23% (n=75) of the respondents disagreed with the statement. Similar results were obtained from other studies conducted in Sri Lanka, the USA and European countries in which it was concluded that consumers did not have a significant interest in GM foods; consumers knew too little about GM foods, particularly regarding the benefits associated with the production and consumption of GM foods; consumers had limited awareness and familiarity with the GM food products that were available for purchase in supermarkets; and consumers did not know which food products contained a GM component due to insufficient labelling of GM foods. This consequently does not give consumers the opportunity to familiarise themselves with the GM foods that are available in supermarkets (Lucht 2015; Jayasuriya & Rathnayaka 2016; McFadden & Lusk 2016; Popek & Halagarda 2017).

The third statement referred to there being too many disadvantages of GM food products (V77) as slightly less than half of the respondents (46%; n=151 neither agreed nor disagreed) were not sure if this was true or not, approximately one-third of respondents (36%; n=117) agreed that this was true, and 18% (n=58) of the respondents disagreed with the statement. The fourth statement referred to being unsure of what GM food products consist of (V82), and 44% (n=143) of the respondents agreed that this was the case, whereas a clear split emerged in the responses where 28% (n=91 neither agreed nor disagreed) were not sure if this was indeed the case, or disagreed (28%; n=92) with the statement. The fifth statement referred to there being too many concerns about GM food products (V78) in which 43% (n=140) of the respondents agreed that this was indeed the case, 37% (n=122 neither agreed nor disagreed) of the respondents were not sure if this was true, and 20% (n=64) of the respondents disagreed with the statement. Lastly, only 40% (n=130) of the respondents agreed that not being familiar with any GM food products on the shelf (V79) was a general barrier that would influence their purchasing decision, approximately a third of respondents (33%; n=108) disagreed with the statement, and 27% (n=88 neither agreed nor disagreed) of the respondents were not sure if this was true.

There was one statement (V83) in which more respondents disagreed than agreed. This statement referred to being unsure about the difference between GM food products and traditional food products (V83); 46% (n=151) disagreed that this was true, a third of the respondents (31%; n=100) in fact agreed, and 23% (n=75 neither agreed nor disagreed) of the respondents were unsure if this was true. These results are depicted in Figure 5.6.

As seen by the general GM-related barriers that influenced the respondents' decision to purchase GM food products, it confirms that the vast majority of the respondents (79%; n=258) thought that they were only sometimes using GM food products, as seen in the fourth positioning question.

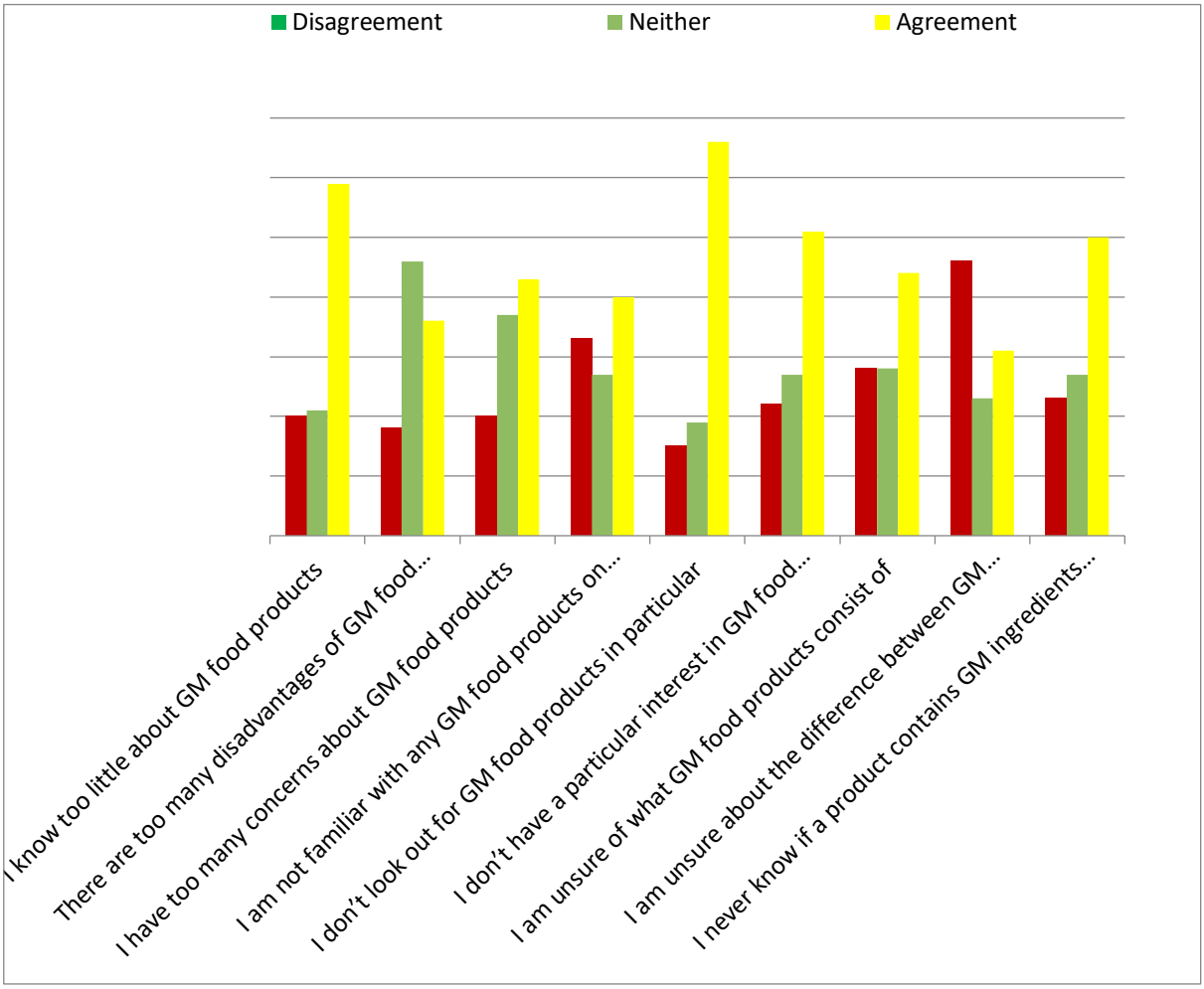

Figure 5.6: Results on the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

After the descriptive statistics were completed on variables 76 to 84, EFA was performed to determine the relationship between the variables by exploring the underlying drivers that emerged from the responses to the general GM-related barriers of GM food products that influenced their purchasing decision. In order to determine if the data gathered from variables 76 to 84 were normally distributed, the Shapiro-Wilks test was performed and the results are presented in Table 5.30.

Table 5.30: Skewness and Kurtosis of the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

Variable Number	Skewness	Kurtosis
V76	-3.76	-1.76
V77	-0.46	-0.78
V78	-1.14	-1.43
V79	0.01	-3.25
V80	-5.52	0.43
V81	-2.48	-2.14
V82	-1.11	-2.89
V83	1.72	-3.24
V84	-1.65	-2.78

As seen in Table 5.30, variables 76 to 84 were used to measure the general GM-related barriers of GM food products that would influence the purchasing decision. These showed that the data was skewed.

5.9.2 Exploratory Factor Analysis (EFA) on the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision (Objective 3c)

After descriptive statistics were performed on variables 76 to 84, EFA was conducted as seen in the section that follows. Tables were included to present the two factors that emerged.

EFA was conducted on the second sub-section of Section D from the questionnaire (variables 76 to 84) which consisted of nine variables. The KMO for these variables was measured at .804, which showed that these variables were more than acceptable and adequate for EFA (Chan & Idris 2017). The Bartlett's Test of Sphericity's Sig value was .000 and therefore considered to be significant.

Table 5.31: KMO and Bartlett's Test on the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.804
Bartlett's Test of Sphericity	Approx. Chi-Square	1223.547
	df	36
	Sig.	.000

The Eigenvalues for this section showed that two factors loaded greater than 1 and accounted for 63% of the total variance, as seen in bold in the last column of Table 5.32.

Table 5.32: Total Variance Explained for the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.800	42.223	42.223	3.800	42.223	**42.223**
2	1.877	20.855	63.078	1.877	20.855	**63.078**
3	.854	9.488	72.566			
4	.638	7.085	79.651			
5	.501	5.569	85.220			
6	.422	4.685	89.905			
7	.358	3.981	93.886			
8	.294	3.266	97.152			
9	.256	2.848	100.000			

The principal component matrix for the nine variables, as seen in the second sub-section of Section D from the questionnaire, Table 5.33, confirmed that there were two factors as identified by the Eigenvalues (>1).

Table 5.33: Principal Component Matrix for the General GM-Related Barriers of GM Food Products that Influence the Purchasing Decision

Component Matrix[a]			
		Component	
	Statement	1	2
V76	I know too little about GM food products	**.660**	.244
V77	There are too many disadvantages of GM food products		**.904**
V78	I have too many concerns about GM food products		**.916**
V79	I am not familiar with any GM food products on the shelf	**.804**	.168
V80	I don't look out for GM food products in particular	**.693**	-.279
V81	I don't have a particular interest in GM food products	**.608**	-.212
V82	I am unsure of what GM food products consist of	**.840**	
V83	I am unsure about the difference between GM food products and traditional foods	**.769**	
V84	I never know if a product contains GM ingredients or not	**.755**	
Extraction Method: Principal Component Analysis.			
a. 2 components extracted.			

The component matrix shows the factor loadings, which reveal how strong the relationship is between each variable. As seen in Table 5.33, V76 and V79-V84 can be referred to as Factor 1, and V77 and V78 can be referred to as Factor 2, as these factors loaded more than .400.

Factor 1 consisted of statements that were used to identify which general GM-related barriers of GM food products would influence the respondents' purchasing decision of these food

products in terms of lack of knowledge, unfamiliarity and absence of interest of GM food products. Therefore, Factor 1 indicates the *unawareness of GM food products*.

Factor 2 consisted of statements that were used to identify which general GM-related barriers of GM food products would influence the respondents' purchasing decision in terms of disadvantages and concerns related to GM food products. Therefore, Factor 2 is indicative of the *negativity associated with GM food products*.

5.10 SUMMARY OF THE FACTORS THAT DRIVE PROCEDURAL KNOWLEDGE, PERCEPTION AND FACTORS THAT INFLUENCE THE PURCHASING DECISION OF GM FOOD PRODUCTS

In order to have an overall impression of the main drivers of each of the concepts of the study (procedural knowledge and perception of GM food products and the factors that influence the purchasing decision), a summary of these factors is presented in Table 5.34 as identified through EFA for each sub-section of the questionnaire. This will also assist in the discussion of the final conclusions of the study.

Table 5.34: Main Drivers of each Concept of the Study

Section	Cronbach Alpha	Mean	Standard Deviation	Factors	Name
B – General Knowledge of GM Food Products (Objective 1a) (Variables 15 to 24)	0.72	3.45	1.11	Factor 1	Extent of GM food product knowledge
				Factor 2	Unfamiliarity with GM food products and its presence in food products
B – Sources of Information of GM Food Products (Objective 1b) (Variables 25 to 32)	0.81	2.64	1.13	Factor 1	Sources of information on GM food products
				Factor 2	Most credible sources of GM food product information
C - Perception (Nutritional, Socio-Economic and Product Quality aspects) of GM Food Products (Objective 2a, 2c and 2d) (Variables 33 to 45)	0.82	3.18	0.95	Factor 1	Favourable nutritional aspects of GM food products
				Factor 2	Production-related aspects of GM food products
C - Perception (Health, Ethical and Consumption aspects) of GM Food Products (Objective 2b, 2e, 2f) (Variables 46 to 62)	0.97	3.44	1.18	Factor 1	Wellbeing of consumers' in relation to GM food products
				Factor 2	Religious beliefs and consumption of GM food products
D – GM-Related Factors that				Factor 1	Consumer implications

Section	Cronbach Alpha	Mean	Standard Deviation	Factors	Name
Influence Purchasing Decision of GM Food Products (Objective 3a) (Variables 63 to 75)	0.72	3.35	1.05		resulting from GM food product development
				Factor 2	Consumer advantages of GM food products
				Factor 3	Market identification of GM food products
				Factor 4	Agricultural pesticide practises
D - General GM-Related Barriers of GM Food Products (Objective 3b) (Variables 76 to 84)	0.79	3.30	1.02	Factor 1	Unawareness of GM food products
				Factor 2	Negativity associated with GM food products

As indicated, the three sections, each with its two sub-sections, could indeed be divided into several factors. All of the sections, apart from Section C, second sub-section, loaded with two factors, while Section C, second sub-section, loaded with four factors. The factors identified complement one another to show the main drivers of each sub-section.

5.11 SIMPLE LINEAR REGRESSION

According to literature, as seen in Chapter 3, procedural knowledge and perception have an influence on purchasing decisions. In order to establish whether this was in fact the case in this study, simple linear regression was performed, firstly to determine whether procedural knowledge of GM food products had a significant relationship with the factors that influence the purchasing decision of GM food products, and secondly, to determine whether perception of GM food products had a significant relationship with the factors that influence the purchasing decision of GM food products. Simple linear regression was also performed to determine if procedural knowledge of GM food products affected the perception of GM food products. Simple linear regression was therefore used to measure and determine if there is a significant relationship or association between two variables (Aggarwal & Ranganathan 2017). The simple linear regression results of the relationship between procedural knowledge of GM food products and the factors that influence the purchasing decision will be discussed first, followed by the results of the relationship between perception of GM food products and the factors that influence the purchasing decision. Finally, the results of the simple linear regression performed on the relationship between procedural knowledge and perception of GM food products will be discussed.

5.11.1 Procedural Knowledge and the Factors that Influence the Purchasing Decision (Objective 4a)

Simple linear regression was performed in order to measure whether there is any link between procedural knowledge of GM food products and the factors that influence the purchasing decision, with the results presented in Table 5.35, Table 5.36 and Table 5.37.

Table 5.35: Model Summary of Procedural Knowledge

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.088[a]	.008	.006	.652
a. Predictors: (Constant), Procedural Knowledge				

Table 5.36: ANOVA Test on the Significance between Procedural Knowledge and the Factors that Influence the Purchasing Decision

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.168	1	2.168	5.095	.024[b]
	Residual	276.609	650	.426		
	Total	278.778	651			
a. Dependent Variable: Factors that Influence Purchasing Decision						
b. Predictors: (Constant), Procedural Knowledge						

Table 5.37: Coefficients of Procedural Knowledge and the Factors that Influence the Purchasing Decision

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.558	.103		34.564	.000
	Procedural Knowledge	-.072	.032	-.088	-2.257	.024
a. Dependent Variable: Factors that Influence the Purchasing Decision						

As seen in Table 5.35 and Table 5.36, simple linear regression showed that there is a significant relationship between procedural knowledge of GM food products and the factors that influence the purchasing decision (p-value). The R^2 value was 0.008, meaning that 0.8% of the variation in the factors that influence the purchasing decision can be explained by

procedural knowledge. As seen in Table 5.37, the p-value (0.024) is less than alpha (0.05), therefore the model is significant. Therefore, there is a significant relationship between the variables, but this relationship cannot be explained by procedural knowledge only as the relationship is very small.

5.11.2 Perception and Factors that Influence the Purchasing Decision (Objective 4b)

Simple linear regression was performed in order to measure whether there is any link between the perception of GM food products and the factors that influence the purchasing decision, as presented in Table 5.38, Table 5.39 and Table 5.40.

Table 5.38: Model Summary of Perception

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.003[a]	.000	-.002	.655
a. Predictors: (Constant), Perception				

Table 5.39: ANOVA Test on the Significance between Perception and Factors that Influence the Purchasing Decision

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.003	1	.003	.006	.937[b]
	Residual	278.775	650	.429		
	Total	278.778	651			
a. Dependent Variable: Factors that Influence Purchasing Decision						
b. Predictors: (Constant), Perception						

Table 5.40: Coefficients of Perception and the Factors that Influence the Purchasing Decision

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.325	.105		31.603	.000
	Perception	.002	.031	.003	.079	.937
a. Dependent Variable: Factors that Influence Purchasing Decision						

According to Table 5.38 and Table 5.39, simple linear regression showed that there is not a significant relationship between perception of GM food products and the factors that influence the purchasing decision (p-value). The R^2 value was 0.000, meaning that 0% of the variation in the factors that influence the purchasing decision can be explained by perception. As seen in Table 5.40, the p-value (0.937) is more than alpha (0.05), therefore the model is not significant. Perception of GM food products is thus not a predictor of the factors that influence the purchasing decision.

5.11.3 Procedural Knowledge and Perception of GM Food Products (Objective 4c)

Simple linear regression was also conducted to establish if procedural knowledge has any influence on the perception of GM food products, with the results presented in Table 5.41, Table 5.42 and Table 5.43.

Table 5.41: Model Summary of Procedural Knowledge

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.151[a]	.023	.021	.824
a. Predictors: (Constant), Procedural Knowledge				

Table 5.42: ANOVA Test on the Significance between Procedural Knowledge and Perception

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.370	1	10.370	15.257	.000[b]
	Residual	441.801	650	.680		
	Total	452.172	651			
a. Dependent Variable: Perception						
b. Predictors: (Constant), Procedural Knowledge						

Table 5.43: Coefficients of Procedural Knowledge and Perception

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.805	.130		29.249	.000
	Procedural Knowledge	-.158	.041	-.151	-3.906	.000
a. Dependent Variable: Perception						

As seen by Table 5.41 and Table 5.42, simple linear regression showed that there was a minimal relationship between procedural knowledge and perception of GM food products (p value). The R^2 value was 0.023, meaning that 2.3% of the variation in perception can be explained by procedural knowledge of GM food products. As seen in Table 5.43, the p-value (0.000) is less than alpha (0.05), therefore the model is indeed significant. Therefore, there is a significant relationship between the variables, but this relationship cannot be explained by procedural knowledge only, meaning that other elements such as attitudes and opinions could also influence this relationship.

5.12 CONCLUDING THE DESCRIPTIVE STATISTICS, EFA AND SIMPLE LINEAR REGRESSION OF THE QUESTIONNAIRE

This chapter represented the respondents' demographics, positioning questions as well as the descriptive and inferential statistics that were performed regarding the data of the study. The respondents' demographics showed that they were either male or female, of a working-age group, with an average monthly household income of R27 602, predominantly of white ethnic affiliation, they either had Grade 12 or further qualifications, were married or living with a partner and employed. The positioning questions revealed that the respondents' exposure and awareness, in their opinion, was limited, while they sometimes looked at or noticed GM food products in store and infrequently used GM food products. The internal consistency reliability test showed that all sub-sections of the questionnaire achieved acceptable scores, except the second sub-section of Section B achieving a mean value of approximately 3, with a standard deviation ranging from 0.95 to 1.18. The Shapiro-Wilks test also revealed that the data from each sub-section of the questionnaire was skewed.

The results from Section B of the questionnaire showed that the respondents were not particularly knowledgeable about GM food products, they did not look for GM-related information, and were not sure which sources of information were the most credible. Section C of the questionnaire showed that respondents had a positive, yet uncertain perception towards GM food products. The results also showed that the respondents had a somewhat fearful perception of GM food products. The results from Section D of the questionnaire revealed that the respondents' purchasing decision of GM food products was not particularly influenced by specific GM-related factors or general GM-related barriers associated with GM food products, although some factors did stand out. The information is therefore somewhat contradictory in some instances, whereby some respondents were knowledgeable, had favourable perceptions of GM food products and did not really experience many barriers towards purchasing GM food products. Other respondents were either more neutral/uncertain

towards GM food products, and a further group felt completely the opposite about these aspects of GM food products.

The EFA showed that in the first and second sub-sections of Section B two factors emerged as being the underlying drivers of the general knowledge and sources of information on GM food products, respectively. In Section C, the EFA showed that both sub-sections also had two underlying factors of nutritional, socio-economic and product quality aspects as well as health, ethical and consumption aspects of GM food products. In the first sub-section of Section D four factors were presented as being underlying drivers of the GM-related factors that influence the purchasing decision of GM food products, and in the second sub-section only two factors loaded as being underlying drivers of the general GM-related barriers that influence the purchasing decision of GM food products. The results of the simple linear regression test showed that there was a minimal relationship between procedural knowledge and the factors that influence the purchasing decision of GM food products. The results, however, showed that there was no relationship between perception and the factors that influence the purchasing decision. The simple linear regression results furthermore showed that procedural knowledge of GM food products did indeed have an influence on perception of GM food products, but this was indeed very minimal.

In the next chapter, the conclusions of the results are presented, followed by the recommendations, the contribution of the study, conceptual framework, limitations of the study and recommendations for future research.

CHAPTER 6

CONCLUSIONS

The purpose of a Conclusion Chapter is to interpret the results in terms of the objectives of the study (Iskander *et al.* 2018).

In this chapter, an interpretation of the results of this study is presented in accordance with each objective of the study. Thereafter, recommendations that can be applied by the food industry using GM food products are made, and the study's contribution and new conceptual framework are provided. Lastly, the limitations of the study and recommendations for future research are given.

6.1 INTRODUCTION

In the previous chapter, the results of the study were presented, supported by a discussion of evidence obtained from academic sources and relevant studies. In this concluding chapter, the researcher will provide an interpretation of the results based on each objective. The contribution of the study is discussed in terms of its contribution to the method, theory and body of knowledge in the GM food product literature and general GM food industry. Recommendations to the food industry are made where GM food products are manufactured for general consumption. Thereafter, the study limitations are presented in terms of the research methodology and theoretical application. An interpretation of the conceptual framework is provided based on the results of the study. The chapter concludes with recommendations for future consumer research to be conducted on GM foods and GM food products.

6.2 DISCUSSION DERIVED FROM THE RESULTS

Objective 1 set out to determine the respondents' procedural knowledge of GM food products by establishing consumers' general knowledge of GM food products and where they looked for information (information acquisition) about GM food products; it also included the most credible sources of information. Objective 2 investigated the respondents' perception of GM food products, including their perception of nutritional, socio-economic and product quality

aspects of GM food products which were related to the benefits of GM food products. Objective 2 also centred on the perception of health, ethical and consumption aspects of GM food products, which involved the negatives associated with such food products. Objective 3 aimed to identify the factors that influenced the respondents' purchasing decision of GM food products by considering GM-related factors and the general GM-related barriers associated with GM food products. Finally, Objective 4 aimed to identify if there was any relationship between procedural knowledge of GM food products and the factors that influence the purchasing decision, between perception of GM food products and the factors that influence the purchasing decision, and between procedural knowledge and perception of GM food products. The discussion will start with a recap of the demographic profile of the respondents.

6.2.1 Demographic Profile Summary of the Respondents

The demographic profile of the respondents showed that they were either male or female, of a working-age, with an average monthly household income of R27 602, predominantly of white ethnic affiliation, either had Grade 12 or further qualifications, married or living with a partner and employed. This profile should be kept in mind throughout the interpretation of the data as it provides a view of the type of respondents to which the data belong. The positioning questions were also used to describe the demographic profile of the respondents, which highlighted that many respondents were unaware whether they have been exposed to GM food products or not, only sometimes looked for or noticed GM food products in store, were unaware of GM food products, and not actively seeking to purchase, consume and use GM food products. The position of the respondents who took part in the study were therefore not purposively active users of GM food products nor were they very aware or involved with the product.

6.2.2 Objective 1 - Procedural Knowledge of GM Food Products

Two categories of procedural knowledge statements were presented to the respondents to determine their general knowledge of GM food products, followed by respondents' information acquisition sources where GM-related information was concerned.

6.2.2.1 General Knowledge of GM Food Products

In this study, respondents' general knowledge of GM food products seemed certain, and they could convincingly respond to having heard about GM food products and knowing about the availability of GM food products in stores (supermarkets). They were less convinced about

their general knowledge of GM food products when it came to the term 'Genetically Modified' and if maize contained a GM component. Furthermore, responses to three of the general knowledge questions that enquired about how much they thought they knew about GM food products, show that half of the respondents could not convincingly account for what they knew about GM food products. In the same vein, their knowledge whether soybean and rice contained a GM component is a clear indication of their lack of knowledge about which products have thus far been introduced to genetic modification. This is supported by half of the respondents who did not know with certainty which products were genetically modified.

Although respondents were clear in terms of knowing that GM food products are in store and thus available to purchase, and they acknowledged that they had been exposed to information about GM food products by having heard about it, the extent of the knowledge they perceive to have is limited. The respondents' seems neither to know with certainty or not know at all what the status of specific GM introduced products, such as soy and rice, are. It means their knowledge either lacked specifics or they have not kept updated about the developments in the GM food product field. This is clear in respondents' ability to indicate with certainty that maize was a GM food product as this was the first product introduced, which points to their lack of updates to further product developments. Respondents' general knowledge of GM food products were captured by two factors that emerged from the EFA, showing the extent of GM food product knowledge and their unfamiliarity with GM food products and its presence in GM food products as the two main underlying drivers that epitomise the state of the general knowledge of respondents who took part in the study. In fact, through this state of lack of knowledge and uncertainty of procedural knowledge, respondents cannot make a well-informed decision about GM food products. Consumers should be assisted in solving the problem of deciding between two products, of which one may be a GM food product and the other a non-GM food product.

6.2.2.2 Information Sources of GM Food Products

The acquisition of information about GM food products for the respondents in this study was not likely to come from published and Internet sources, nor from personal exchanges with people they know. However, scientists were considered the most credible source of information the respondents would approach. This may suggest that as they are not certain about what they know and what they do not know about GM food products; they are more inclined to find solace in scientific information as a more credible source providing them with scientifically justified and rigorous facts rather than speculative or hearsay from less scientific

sources. Very little trust was placed in environmental groups as credible sources of information as they may be linked to specific agendas where GM foods are concerned.

The results also suggest that respondents had no interest in broadening their knowledge nor obtaining more information on GM food products. Since they did not see the value in approaching any published, Internet or personal sources for information, their procedural knowledge of GM food products may also be limited in assisting them with a well-informed GM food product decision. Therefore underlying information acquisition where GM food products are concerned, relates to the source from which the information is obtained, as well as the credibility of this source. This will clearly engage the respondents in the information communicated from these sources and improve their procedural knowledge.

6.2.3 Objective 2 - Perception of GM Food Products

In order to investigate the respondents' perception of GM food products, their responses to various statements pertaining to the nutritional, health, socio-economic, product quality, ethical and consumption aspects of GM food products was determined.

6.2.3.1 Nutritional Aspects of GM Food Products

In this study, the respondents conveyed great uncertainty about the nutrition-related aspects of GM food products as they could not position themselves in terms of what they believed the GM nutritional status of such products were. This was particularly evident in their uncertain responses to whether GM food products had better health benefits as compared to traditional foods, assist in the reduction of nutritional deficiencies such as Vitamin A and Zinc, and contain a higher level of macronutrient content than traditional foods. As respondents did not have a specific understanding or position about the nutritional value of GM food products, they were therefore unable to say with certainty from their understanding of GM food products that these products would be able to alleviate malnutrition through the presence of increased nutritional value. Therefore, the respondents' perception of GM food products did not include a nutrition-related understanding, which does not allow them to apply value to such areas as malnutrition.

6.2.3.2 Socio-Economic Aspects of GM Food Products

From a socio-economic point of view of GM food production, respondents did not perceive GM food products as being of any economic value to the farmer through lowering herbicide and pesticide use during cultivation, subsequently promoting biodiversity. This may be

attributed to their low general knowledge about GM food production and the resistant aspects that could be manipulated in GM food products. They were, however, more positive of the contribution GM food products could make to increase food supplies, thus boosting the economy through biotechnology. This could be due to consumers becoming increasingly aware of the strain that climate change has placed and will continue to place on farmers and the cultivation of their crops and livestock, thereby realising the importance of increasing food supplies to assist in the prevention of food shortages.

6.2.3.3 Product Quality-Related Aspects of GM Food Products

Respondents' perception about the product quality of GM food products is clearly found in their uncertainty about whether it tastes different or are more palatable than general food products or whether it has a longer shelf life than general food products. However, the respondents did perceive GM food products as having a longer shelf life. Respondents' inability to clearly perceive such product quality improvement may be attributed to their lack of experience and exposure to GM food products; they might not be attentive to specifically purchasing GM food products in store, therefore being unable to compare product qualities as they admitted.

The EFA conducted of these three aspects yielded combined results showing that two drivers were prominent in the respondents' responses to their perception, namely the favourable nutritional aspects of GM food products and the production-related aspects of GM food products. This is an indication of the two foremost factors that are underlying respondents' perceptions of GM food products; nutritional and cultivation uncertainty about GM are the main elements forming their perceptions.

6.2.3.4 Health Aspects of GM Food Products

Respondents' perception of the health-related matters related to GM food products were determined in terms of how fearful they were that GM food products could have an effect on their health. Some doubt still remains as to what the effect of GM food products might be after consumption. This may be attributed to a lack of knowledge and understanding of what GM components are and what, if any, the effect on their health may be. The respondents may also have chosen the middle option as a response, namely neither agree nor disagree, in order to avoid admitting their true opinion. The certain fear of susceptibility to cancer, toxicity, allergic reactions, alterations in kidney functions, immune malfunction and especially infertility problems may be based on their own perceived idea of the impact of GM food products and

its association with other negative effects rather than factual and well-founded knowledge about the subject. Since the respondents were not particularly knowledgeable about GM food products, lacked awareness in terms of the various health benefits, and were not particularly experienced in noticing or looking for GM food products in store, it could reflect their own preconceived notion of GM food products.

6.2.3.5 Ethical Aspects of GM Food Products

The ethical theme associated with GM food products did not show fear of its production, contradicting religious beliefs, factory production of GM seeds/crops being unethical, nor that technological involvement has resulted in GM food products. This may mean that consumers were accepting of technological advancement rather than condemning it. Contrary to this, respondents were more assertive in their perceptual fear of genetic modification if the genetic make-up of GM food products were altered, rendering it an unnatural process that could lead to harming the environment. Although technological advancement was found acceptable and not feared, the concern resulting from technological interference and manipulation was more profound. This may be attributed to their uncertainty and lack of knowledge on what the process of genetic modification entails as well as its effect after cultivation.

6.2.3.6 Consumption Aspects of GM Food Products

In this study, the respondents did not perceive the consumption of GM food products to hold any threats in terms of being dangerous to all living things, but they were sceptical about the safety of GM food products for consumption purposes. It is quite contradictory to how fearful they were perceived to be when considering all the health-related concerns they raised in Section 6.2.3.4. They also remained fearful that the consumption of GM food products could cause health damage.

When the EFA was performed on the combined three aspects, the respondents' perception on the wellbeing of consumers in relation to GM food products and religious beliefs and consumption of GM food products were highlighted as the two main drivers of the respondents' answers. This showed that the respondents were concerned with their wellbeing after consuming GM food products and that religious beliefs and the consumption of GM food products do form their perception, but may not negatively hinder technological involvement and consumption.

6.2.4 Objective 3 - Factors that Influence Consumers' Purchasing Decision of GM Food Products

6.2.4.1 General GM-Related Factors

The factors that influence consumers' purchasing decision of GM food products were considered in terms of the factors they were asked to give an opinion about. It is evident that in all instances except one, half or near half of the respondents agreed that GM food products were at a reduced price, increased nutritional value, had a longer shelf life, could result in possible allergic reactions and cancer after consumption, would reduce pesticide usage, was harmful to the environment and was an unnatural product. In this instance, respondents were forming seesaw behaviour between not knowing whether they agreed or not and actually being certain that they agreed with the statement. This seesaw behaviour is a reflection of their insufficient knowledge regarding the genetic modification of food products and its effect on product quality, health and the environment. The same indecisiveness and lack of knowledge were also found in the perception of most of these aspects previously discussed. The lack of procedural knowledge that could assist them in making more informed decisions regarding their position on the factors that may influence their GM food product decision is thus emphasised. Respondents were, however, more certain that GM food products could increase food supplies since becoming aware of the possible food shortages South Africa and the world could face.

However, the EFA indicated that four major factors were prevalent in the GM-related factors' influence on the respondents' purchasing decision, namely consumer implications resulting from GM food product development, consumer advantages of GM food products, market identification of GM food products, and agricultural pesticides practises. Although respondents indicated a seesaw behavioural approach between being sure or uncertain if they were considering GM food products, the four factors that were found rather point to the main underlying elements that would be considered if they were presented with GM food products. This would be the effect of GM food products, how the consumer may benefit from GM food products, what the market should do to make the product more noticeable and stand out among other products, and how it is cultivated.

6.2.4.2 General GM-Related Barriers of GM Food Products

In this study, there were general GM-related barriers of GM food products that the respondents identified as being factors that would affect their purchasing decision, specifically pertaining

to GM food products. The respondents' self-admitted lack of knowledge seems to be a pertinent barrier in consumers' decision to purchase GM food products. This may also be the reason why the largest proportion of respondents admitted to not looking out for or noticing GM food products. Respondents self-admitted lack of interest in GM food products remains a barrier in purchasing GM food products. This may explain their lack of knowledge and experience of GM food products, subsequently resulting in respondents not being able to identify GM food products or knowing which contain GM ingredients.

The EFA indicated that unawareness of GM food products and the negativity associated with GM food products were the two factors that influenced general GM-related barriers when purchasing such food products. This points to the main underlying elements that would hinder respondents from considering GM food products.

6.2.5 Objective 4 - Statistical Significant Relationships between the Concepts of the Study

The results of this study showed that there was a minimal relationship between procedural knowledge and the factors that influence the purchasing decision of GM food products, but that procedural knowledge could not alone predict the factors that influence the purchasing decision of GM food products. The results indicated that perception was not a predictor of the factors that influence the purchasing decision of GM food products, meaning that the perception that respondents had towards GM food products also did not have an effect on the factors that influenced their purchasing decision. The results also displayed that there was a minimal relationship between procedural knowledge and perception of GM food products, but that procedural knowledge could not alone account for the perception formation.

6.3 RECOMMENDATIONS

The following recommendations are proposed based on the discussions of the results in the previous section. The recommendations are presented specifically with the consumer in mind. As this was a consumer study, the information may be more meaningful in specifically addressing the consumer from which the results of this study were derived.

It is clear that the respondents' may not know enough about GM food products to make an informed decision about the purchase and consumption of food products on the market. It is important to reinstate the awareness of GM food products to improve consumers' existing but outdated knowledge and provide new knowledge to those consumers who are not familiar with

the concept of genetic modification and GM food products. Educational campaigns supported by scientifically based findings are a credible source of information for the consumer that will create the necessary stimuli about GM food products to attract the consumer. These educational campaigns will also assist in improving consumers' knowledge of GM food products. Product labelling is another in-store product communication tool that can be used to attract the attention of the consumer to the inclusion of GM food components in the food product, as well as to educate the consumer, which will also build their knowledge. Manufacturers and marketers should be attentive to the importance of GM food labelling to assist the consumer in determining the content and comparative distinction between different food products, as indicated by Tanius and Seng (2015).

As it is important to revitalise the GM concept among consumers, GM food manufacturers and marketers should focus advertising and marketing campaigns of GM food products on product quality, in terms of shelf life, taste and other consumer-sensory requirements. This will improve their understanding of the enhanced quality of the product which may be a strategic consideration when deciding between different products in a product category as quality is always a key factor in product selection. This will consequently also improve consumers' knowledge of the benefits associated with GM food products. It may also be necessary to promote GM food products in store through informational posters, product displays, banners and other visual aids in order to allow consumers to familiarise themselves with GM food products and what they have to offer. Through this a greater awareness may be created in favour of GM food products. It is recommended that in-store awareness should be adopted to leave the consumer to find out for themselves about GM food products as they are not keen to consult published, Internet or personal sources for information. As a result, consumers can learn more about GM food products and increase their knowledge by doing so.

It is clear that consumers' perception of GM food products is also outdated and lacks clarity and certainty in terms of what is correct or not. In particular, more attention should be given to the nutritional content of GM food products and the improvements of any particular nutritional levels. This can be done through product labelling, product swing tags and product-specific brochures indicating the nutritional content of such products. More specific clarity on health-related concerns such as the development of cancer and allergies should be provided for consumers to be more informed in their engagement with GM food products. By developing specific information campaigns that address nutrition and health in relation to GM food products, consumers' perception of GM food products may be shaped more positively, while simultaneously allowing consumers to gain more confidence in their ability to make an assertive decision about these products. Consumers are also becoming increasingly more

health and environmentally conscious, as highlighted by Zhang *et al.* (2016), which emphasises the point of addressing the impact GM food production has on agriculture and the cultivation of such products on the environment. As indicated by Kikulwe *et al*. (2011), pesticide and herbicide use in the cultivation of GM food products is a leveraging factor that should be used to advocate the advantages of such food products to the health and environmentally conscious consumer.

The environmental advantage of GM crops requiring fewer herbicides and pesticides during the production stages lends a significant advantage to farmers as well, as mentioned by Schutte *et al.* (2017), which consumers should be made aware of. Many South African consumers are becoming increasingly aware of the possibility of food shortages in South Africa and across the globe. Therefore, consumers should be informed about the financial advantage of cultivating GM crops which would possibly create a more favourable perception of the product and how it can support farmers to become more sustainable, subsequently addressing food shortages and the economic wellbeing of the country. This may subsequently influence consumers' perception of GM food products in a positive manner, thereby encouraging South African consumers to engage in the purchasing of GM food products. This was particularly evident in this study as the majority of the respondents felt that the production of GM food products can increase food supplies in South Africa and that biotechnology can boost the economy.

Furthermore, although the respondents in this study did not particularly have a positive or negative perception of the ethical aspects of GM food products**,** South African consumers consist of different cultural and religious groups. The complex creation and production process of GM food products should thus be communicated to consumers in order to make them fully aware of GM food products so that consumers can, with confidence, make the correct purchasing decision, morally and ethically. Therefore, the GM food industry should educate and inform consumers on how GM food products are made, giving consumers the opportunity to be better equipped with GM food products in general. Although safety was not highlighted in this study, the safety of GM food products remains an essential factor for the GM food industry to consider at all times. They should provide consumers with safe food products on the shelf, which in turn, creates consumer loyalty and trust in GM food products as well as the GM food industry as a whole.

Since respondents in this study had the opinion that the production of GM food products can increase food supplies in South Africa, which was a factor that would influence their purchasing decision, it is suggested that marketing techniques focus on the production of GM

food products' ability to supply consumers with an adequate amount of food in the future. The GM food industry could also perhaps advertise the availability of GM food products in various different colours in the form of images in order to give consumers a visual depiction of these products. This may encourage consumers to purchase a different coloured food product as to what they were originally familiar with for example orange sweet potato which is enriched with Vitamin A. It is also essential to encourage mandatory labelling of GM food products in order for consumers to know what food products they are actually purchasing and consuming. A recommendation made to the GM food industry is to reduce the anxiety among consumers regarding their health and environmental implications of consuming GM food products by providing them with relevant studies on the various GM food products that have already been proven safe to produce and consume. The respondents in this study trusted scientists in the GM context; therefore the studies published by scientists can be used to reduce anxiety towards GM food products. This, once again, points to the fact that the GM food industry should label GM food products and thoroughly inform consumers about the positives and negatives pertaining to such products. Thereby, they will be giving consumers the opportunity to acquire sufficient knowledge of GM food products prior to and when purchasing food. In South Africa, GM food products are labelled, but the efficiency thereof is debatable as many consumers do not frequently read food labels or are unsure how to interpret the information on food labels (Goyal & Deshmukh 2018).

It is therefore essential to revitalise GM food products' information through educating the consumer to increase their knowledge on how GM food products are created and the processes involved. Emphasis should be placed on the major benefit of using fewer pesticides for example, and focusing on the other consumer advantages of GM food products which will also allow consumers to feel more comfortable in purchasing and consuming GM-related food products.

The respondents in this study highlighted that there are indeed barriers that influence their purchasing decision of GM food products, such as their lack of interest. A way for the GM food industry to increase consumers' interest is to negate the disadvantages associated with GM food products that may be self-imposed due to their lack of knowledge. Consumers should receive more scientific information about GM food products and a clear scientific justification of the benefits of GM food products and a rationale for developing it.

Consumers specifically need to be updated in terms of how far GM food products have been developed as the certainty of only maize products is no longer correct. It is recommended that the GM industry develop ways to inform consumers about GM food products, the various GM

food products that are available to purchase in supermarkets, and ensure that all such products are labelled. This can allow consumers to differentiate between GM and non-GM food products, which can assist consumers in familiarising themselves with GM food products, thereby allowing them to make informed purchasing decisions about these products. It is also imperative to increase consumers' awareness of GM food products, the availability of these products and all the benefits that these products have to offer, which will allow consumers to refute any negative associations or opinions that they have specifically relating to GM food products.

6.4 CONTRIBUTIONS OF THE STUDY

From the literature review, it is clear that research regarding consumers' procedural knowledge, perception and factors influencing their purchasing decision of GM food products remains limited in the South African context. This study has made a contribution to expanding on South African based consumers' position on GM food products. This study gave insight as to the procedural knowledge and perception that consumers have towards GM food products from a rural consumer's perspective. It also clarified the factors that influence their purchasing decision as studies nationally and internationally have only considered the views of urban consumers on GM and GM-related topics.

The study has clearly identified the lack of knowledge that a portion of consumers in the rural setting has of GM food products. It has identified the necessity of reinstating the awareness of GM food products which should include basic production information, the effects of GM food products on health and the environment, as well as nutritional awareness resulting from GM food products. The GM food industry may benefit from implementing the results of this study during the development of their information and advertising campaigns as the study highlighted specific information about GM food products on which they should focus. The study has also emphasised the importance of labelling legislation being enforced to assist consumers in identifying the product and understanding the ingredients of the GM food product in order to make a more informed decision.

6.4.1 New Conceptual Framework

When considering the conceptual framework proposed for this study as seen in Section 3.5, Figure 3.4, it was suggested that as the framework was founded on the consumer decision-making model of Schiffman and Wisenblit (2019), the process of decision making flows naturally from the need identification stage through to the purchase and trial of the product.

External and internal influences were acknowledged in feeding into the decision-making process. The conceptual model further proposed that certain factors and GM-related barriers were also feeding into the consumer's decision-making process to decide whether to purchase GM food products. However, from the results it is clear that an amended decision-making model can now be presented which indicates that the external, individual and GM-related influences are potential influencing factors in the decision-making process as presented in Figure 6.1. Due to the lack of knowledge and certainty of what the consumer should do when confronted with GM food products, the influences become limited resulting in all of the influences being limited in influencing the purchase decision-making process. Subsequently, the restricted flow indicated by the broken arrow to the decision-making process limits the consumer in making the decision to purchase. Therefore, the decision-making process is unable to result in the purchase of the product. The trial of a GM food product and the repeat purchase of the GM food product may thus be limited only to those with better procedural knowledge and perception of GM food products. The contribution of this study is thus a new proposed framework of the way in which limited procedural knowledge and perception, as well as GM-related influences, affect the decision-making process in terms of GM food products, as seen in Figure 6.1.

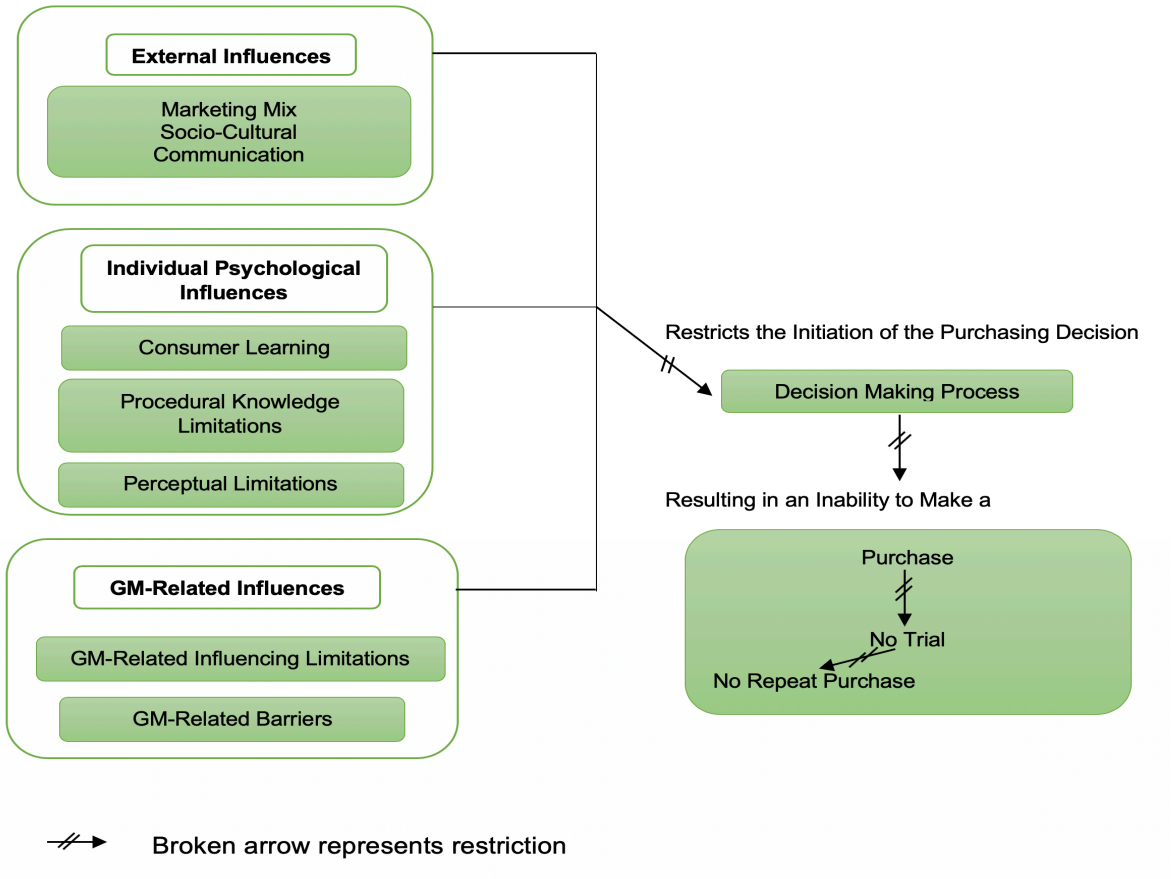

Figure 6.1: New Proposed Conceptual Framework for this Study

6.6 LIMITATIONS OF THE STUDY

Firstly, due to the exploratory nature of the study and the use of non-probability sampling strategies and snowball sampling, the respondents were recruited in a subjective manner and therefore the sample cannot be generalised to the entire population. Secondly, this study was conducted as a quantitative research design and qualitative information has thus not been included. As a result, the participants were not given the opportunity to voice their opinions and the researcher did not obtain any explanation or clarification from the participants regarding their responses due to the preselected statements in the questionnaire. The study was limited to the Mooi River research area which does not represent consumers' opinions from other areas as this was also a rural setting. Furthermore, the results of the study primarily represent the opinions of white respondents and very few black respondents, which may be considered as a limitation.

Lastly, the results of this study cannot be used to predict consumers' purchasing behaviour or decision making of GM food products as the study was conducted on a very specific target sample, not large enough to say with certainty that this is how consumers in general will react. Although procedural knowledge, perception and factors that influence purchasing decision of GM food products were measured, there may be other underlying factors that might influence consumers when purchasing GM food products.

6.7 FUTURE RESEARCH

As mentioned, information regarding consumers' procedural knowledge and perception of GM food products, as well as the factors that influence their purchasing decision of GM food products, is currently limited in the South African context. It is, however, extremely important to acquire information about the views and opinions that South African consumers have on GM food products in order to determine the viability and potential that exists in terms of the future of GM food products in South Africa. Therefore, further research can be conducted using a qualitative research design in order to obtain an in-depth understanding of consumers' opinions and views of GM food products. Due to the results showing that the respondents did, in fact, lack knowledge of GM food products and showed doubt and uncertainty in their perception of GM food products, it could indicate that the respondents had specific attitudes towards GM food products. The respondents' attitudes could influence their lack of interest in GM food products, which subsequently halters their actions in acquiring more information on GM food products. Therefore, future research could focus on investigating consumers' attitudes towards GM food products. A larger sample of consumers should also be included

in future studies which represent more areas in South Africa with the opportunity to include a diversity of respondents in the sample and specifically ensure that a better demographic representation is achieved. It may be useful to standardise the instrument for future studies to ensure the validation of the instrument if a quantitative study should be undertaken with the aim of generalising the data to the South African population. It may also be necessary to consider the usefulness of a qualitative study to clarify some of the quantitative results from the study through verbal explanations, clarifications or opinions from the participants. Therefore, a mixed-method study is proposed for future research with a two-fold aim, namely to gather in-depth information regarding the consumers' opinions on GM food products and secondly to generalise the findings to the larger South African population.

6.8 CONCLUSION

In this chapter, the results of each objective of the study were discussed which showed that the respondents had limited knowledge of GM food products and did not look for GM-related information from a particular source, but that scientists were the most credible source of information. In terms of the respondents, doubt and uncertainty was conveyed relating to their perception of GM food products, with a few GM-related factors and GM-related barriers that were highlighted as being influential in their purchasing decision of GM food products.

The results also showed that procedural knowledge had a minimal relationship with the factors that influence the purchasing decision, but that perception did not have a relationship with the factors that influence the purchasing decision. There was also a minimal relationship between procedural knowledge and perception of GM food products. The new conceptual framework propsed for this study was also presented. This framework suggests that limited knowledge and perception restricts purchasing decisions, resulting in limited trial and repeat purchasing of GM food products. The recommendations and limitations of this study were discussed as well as future research suggestions.

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APPENDIX A: QUESTIONNAIRE

Cover Letter:

Exploring Consumers' Procedural Knowledge and Perception of Genetically Modified (GM) Food Products as well as the Factors that Influence their Purchasing Decisions

Soné van Zuydam is a post-graduate student at the University of South Africa (UNISA) and is currently doing a research **study regarding consumers' procedural knowledge and perception of genetically modified (GM) food products as well as the factors that influence their purchasing decisions**, in order to obtain her Master of Consumer Sciences Degree. The results may contribute to the pursuit of providing producers and retailers with a better understanding of the procedural knowledge and perception that consumers possess regarding GM food products as well as the factors (advantages and disadvantages of GM food products) that influence their purchasing decisions. Your support and participation will enable her to conduct her study and will be greatly appreciated.

Your participation is anonymous and voluntary, and the information provided will be handled with strict confidentiality. Please read the following 6-page questionnaire and complete the questions with care. This should take approximately 15 minutes of your time. There are no wrong answers. You may withdraw from the study at any given time without penalty. This study cannot be done without your valued opinion.

Thank you for your support in this regard.

Instructions:

- Please answer all the questions.

For more information:

- Soné van Zuydam 55439594@mylife.unisa.ac.za
- Supervisor: Prof. E. Kempen kempeel@unisa.ac.za
- Co-Supervisor: Dr. L. Christie

SECTION A
Demographics

Please complete Section A by marking (**X**) in the appropriate box.

For Office Use Only

Respondent Number **V1**

DEMOGRAPHICS											For office use only	
1.	**What is your gender?**				Male	1	Female	2			V2	
2.	**What is your age?**											
	18-24 years	1	25-30 years	2	31-40 years	3	41-50 years	4	51 years or older	5	V3	
3.	**What is your approximate total monthly HOUSEHOLD income?**								Rand		V4	
4.	**Please indicate your ethnic affiliation**											
	Black	1	White	2	Coloured	3	Indian	4	Other	5	V5	
5.	**What is your highest level of education?**											
									Lower than matric/ Grade 12	1	V6	
									Matric/ Grade 12	2		
									Grade 12 + a degree/ diploma	3		
6.	**Please indicate your marital status**											
									Single	1	V7	
									Married/living with a partner	2		
									Divorced/ separated	3		
									Widow(er)	4		
7.	**Please indicate your status of employment**											
									Permanent full time	1	V8	
									Permanent part time	2		
									Contract work	3		
									Self- employed	4		
									Unemployed	5		
8.	**Which of following best describes the type of organisation you work for?**											
	Privately Owned	1	Public Company	2	Local Government	3	Other	4			V9	
9.	**What is the core business of your establishment?**											
	Agriculture	1	Education	2					Construction	3	V10	
	Food	4	Finance	5	Medical	6	Other	7				

POSITIONING QUESTIONS								For office use only	
10.	**Indicate what you think your level of exposure is to GM food products**								
	A little	1	Some	2	A lot	3		V11	
11.	**Indicate the level to which you think you look at or notice at GM food products in stores**								
	Never	1	Sometimes	2	Always	3		V12	
12.	**Indicate what you think your level of awareness of GM food products is**								
	A little	1	Some	2	A lot	3		V13	
13.	**Indicate how often you think you use GM food products**								
	Never	1	Sometimes	2	Always	3		V14	

SECTION B
Procedural Knowledge

Please complete Section B by marking (**X**) in the appropriate box.

Indicate the degree to which you agree/disagree with each of the following statements **concerning your general knowledge of Genetically Modified (GM) food products**. Please mark X for each of the statements below	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	For Office Use Only	
14. I know what "genetically modified" means in terms of food products	1	2	3	4	5	V15	
15. I do not feel very knowledgeable about genetically modified food products	1	2	3	4	5	V16	
16. I know that GM food products are available to purchase in supermarkets	1	2	3	4	5	V17	
17. I know a fair amount about GM foods	1	2	3	4	5	V18	
18. I know that maize contains a GM component	1	2	3	4	5	V19	
19. I have heard about GM food products	1	2	3	4	5	V20	
20. I know which food products have been genetically modified	1	2	3	4	5	V21	
21. I know that rice contains a GM component	1	2	3	4	5	V22	
22. I know a little amount about GM foods	1	2	3	4	5	V23	
23. I know that soybean contains a GM component	1	2	3	4	5	V24	

Indicate the degree to which you agree/disagree with each of the following statements **pertaining to information about GM food products**. Please mark X for each of the statements below	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	For Office Use Only	
24. I seek information of GM food products from people I know	1	2	3	4	5	V25	
25. I look for information about GM food products on the Internet	1	2	3	4	5	V26	
26. I look for information about GM food products in newspapers	1	2	3	4	5	V27	
27. I look for information about GM food products in scientific papers	1	2	3	4	5	V28	

28. I look for information about GM food products in magazines	1	2	3	4	5	V29	
29. I receive information about GM food products via television	1	2	3	4	5	V30	
30. Environmental groups are the most credible sources of information	1	2	3	4	5	V31	
31. Scientists are the most credible source of information	1	2	3	4	5	V32	

SECTION C
Perception

Please complete Section C by marking (**X**) in the appropriate box.

Indicate your **perception on nutritional, socio-economic and product quality aspects of GM food products.** Please mark X for each of the statements below	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	For Office Use Only	
32. GM food products have better health benefits as compared to traditional foods	1	2	3	4	5	V33	
33. GM food products have increased nutritional value	1	2	3	4	5	V34	
34. The consumption of GM food products can assist in reducing nutritional deficiencies such as vitamin A	1	2	3	4	5	V35	
35. The consumption of GM food products can assist in reducing nutritional deficiencies such as Zinc	1	2	3	4	5	V36	
36. GM food products has a higher macronutrient content as compared to traditional foods	1	2	3	4	5	V37	
37. GM food products can assist in reducing malnutrition	1	2	3	4	5	V38	
38. The production of GM food products promotes biodiversity	1	2	3	4	5	V39	
39. The production of GM food products can increase food supplies in South Africa	1	2	3	4	5	V40	
40. Biotechnology can boost the economy	1	2	3	4	5	V41	
41. The production of GM food products requires less pesticides	1	2	3	4	5	V42	
42. The production of GM food products requires less herbicides	1	2	3	4	5	V43	

43. GM food products has a longer shelf life	1	2	3	4	5	V44	
44. GM food products tastes better than traditional foods	1	2	3	4	5	V45	

Indicate your **perception on the health aspects, ethical aspects and consumption aspects of GM food products.** Please mark X for each of the statements below	My Greatest Fear	Very Afraid	Afraid	Slightly Afraid	Not Afraid At All	For Office Use Only	
45. I am concerned about the effect of GM food products on my health after consumption	1	2	3	4	5	V46	
46. The production of GM food products contradict religious beliefs	1	2	3	4	5	V47	
47. The production of GM seeds/crops by factories is unethical	1	2	3	4	5	V48	
48. The consumption of GM food products are dangerous and risky to all living things	1	2	3	4	5	V49	
49. GM food products can jeopardise human health	1	2	3	4	5	V50	
50. I am sceptical about the safety of GM food products for consumption purposes	1	2	3	4	5	V51	
51. The process of producing GM crops is unnatural	1	2	3	4	5	V52	
52. The genetic make-up of GM food products is altered	1	2	3	4	5	V53	
53. Technology is used to create GM food products	1	2	3	4	5	V54	
54. The consumption of GM food products can cause health damage	1	2	3	4	5	V55	
55. I am more susceptible to cancer after consuming GM food products as compared to traditional foods	1	2	3	4	5	V56	
56. The consumption of GM food products may cause toxicity	1	2	3	4	5	V57	
57. The consumption of GM food products may cause allergic reactions	1	2	3	4	5	V58	
58. The consumption of GM food products may cause alterations in kidney functions	1	2	3	4	5	V59	
59. The consumption of GM food products may cause immune malfunction	1	2	3	4	5	V60	
60. The consumption of GM food products may cause infertility problems	1	2	3	4	5	V61	

61. The production/growing of GM crops is harmful to the environment	1	2	3	4	5	V62	

SECTION D
Factors Influencing Purchasing Decisions
Please complete Section D by marking (**X**) in the appropriate box.

Indicate, by marking X in the appropriate box, whether the following **GM-related factors will influence your purchasing decision of GM food products**	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	For Office Use Only	
62. Reduced price	1	2	3	4	5	V63	
63. Increased nutritional value	1	2	3	4	5	V64	
64. Improved taste	1	2	3	4	5	V65	
65. Longer shelf life	1	2	3	4	5	V66	
66. Availability of foods in different colours	1	2	3	4	5	V67	
67. Possible allergic reaction after consumption	1	2	3	4	5	V68	
68. Possible cancer development after consumption	1	2	3	4	5	V69	
69. Possible cause of allergenicity after consumption	1	2	3	4	5	V70	
70. Reduced usage of pesticides	1	2	3	4	5	V71	
71. Harmful effect on the environment	1	2	3	4	5	V72	
72. The development of GM food products is unethical	1	2	3	4	5	V73	
73. The development of GM food products is unnatural	1	2	3	4	5	V74	
74. The production of GM food products can increase food supplies	1	2	3	4	5	V75	

Indicate, by marking X in the appropriate box, **whether the following general GM-related barriers of GM food products will influence your purchasing decision**	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	For Office Use Only	
75. I know too little about GM food products	1	2	3	4	5	V76	

76. There are too many disadvantages of GM food products	1	2	3	4	5	V77	
77. I have too many concerns about GM food products	1	2	3	4	5	V78	
78. I am not familiar with any GM food products on the shelf	1	2	3	4	5	V79	
79. I don't look out for GM food products in particular	1	2	3	4	5	V80	
80. I don't have a particular interest in GM food products	1	2	3	4	5	V81	
81. I am unsure of what GM food products consist of	1	2	3	4	5	V82	
82. I am unsure about the difference between GM food products and traditional foods	1	2	3	4	5	V83	
83. I never know if a product contains GM ingredients or not	1	2	3	4	5	V84	

Thank you for your valued participation!

If you would like feedback, please provide your email address below:

_____

APPENDIX B: CAES ETHICS APPROVAL

UNISA university of south africa

CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 03/12/2018

Dear Ms Van Zuydam

NHREC Registration # : REC-170616-051
REC Reference # : 2018/CAES/162
Name : Ms SC Van Zuydam
Student #: 55439594

Decision: Ethics Approval from 01/12/2018 to 30/11/2019

Researcher(s): Ms SC Van Zuydam
55439594@mylife.unisa.ac.za

Supervisor (s): Prof EL Kempen
kempeel@unisa.ac.za; 011-471-2241

Dr L Christie
chrisl@unisa.ac.za; 011-471-2811

Working title of research:

Exploring consumers' procedural knowledge and perception of genetically modified (GM) food products as well as the factors that influence their purchasing decision

Qualification: M Consumer Science

Thank you for the application for research ethics clearance by the CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is granted for a one-year period. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 30 November 2019

*The **low risk application** was **reviewed** by the CAES Health Research Ethics Committee on 29 November 2018 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

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Preller Street, Muckleneuk Ridge, City of Tshwane
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2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **2018/CAES/162** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Prof MA Antwi
Deputy Chair of CAES Health REC
E-mail: antwima@unisa.ac.za
Tel: (011) 670-9391

Prof MJ Linington
Executive Dean : CAES
E-mail: lininmj@unisa.ac.za
Tel: (011) 471-3806

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APPENDIX C: CONSENT FORM

PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: **2018/CAES/162**
Research permission reference number: **2018/CAES/162**

03 December 2018

Exploring Consumers' Procedural Knowledge and Perception of Genetically Modified (GM) Food Products as well as the Factors that Influence their Purchasing Decision

Dear Prospective Participant

Exploring Consumers' Procedural Knowledge and Perception of Genetically Modified (GM) Food Products as well as the Factors that Influence their Purchasing Decision

My name is Soné van Zuydam and I am doing research with Prof Elizabeth Kempen and Dr Lorna Christie in the Department of Life and Consumer Sciences towards a Master of Consumer Science Degree at the University of South Africa. We are inviting you to participate in a study entitled Exploring Consumers' Procedural Knowledge and Perception of Genetically Modified (GM) Food Products as well as the Factors that Influence their Purchasing Decision.

WHAT IS THE PURPOSE OF THE STUDY?

I am conducting this research to find out what procedural knowledge and perception consumers have pertaining to Genetically Modified (GM) food products. I am also conducting this research to establish which factors influence consumers purchasing decision when purchasing GM foods in terms of advantages of GM food products and disadvantages of GM food products.

WHY AM I BEING INVITED TO PARTICIPATE?

You have been chosen to participate in the study as you are above the age of 18, reside in Mooi River, you have heard of or are aware of GM foods, you are a general consumer from Mooi River, you have experience with purchasing and consuming GM and non-GM foods and

are exposed to GM foods in store whilst doing your food purchases and are possibly aware of GM foods in store. Your contact details were obtained from your Manager/Headmaster/Owner of organisation. Approximately 400 participates will be asked to participate in this study.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

This study involves a questionnaire which includes four sections. You will be asked to complete Section A, B, C and D by marking 'X' in the appropriate box. The questionnaire will take approximately 15-20 minutes to complete.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participate. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

A benefit of this study is that it will create an insight to the society and food industry as to the procedural knowledge and perception that consumers portray towards GM food stuffs from a rural consumers perspective which may differ from consumers residing in large urban cities. Another benefit of this study is that it can assist in establishing the degree to which the production of GM foods can assist in food security in South Africa in the future. This is particularly important as the genetically modified food industry aims to improve and enhance nutrients in staple food products, which is consumed and purchased by the majority of rural consumers. This study will lead to understanding consumer's procedural knowledge and perception of GM foods as well as the factors that influence their purchasing decisions which will give producers in the food industry the opportunity to establish whether GM food stuffs will boost the food industry in the future and whether these food products can potentially assist in increasing South Africa's food security and consumer's nutritional intake.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

There are no negative consequences associated with the participation in the research project.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your name will not be recorded anywhere and no one will be able to connect you to the answers you give. Your answers will be given a code number and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

Your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Committee. The data obtained in this study may be used for other purposes, such as a research report, journal articles and/or conference proceedings, but your personal information will not be identifiable in any way.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet in Mooi River, Kwa Zulu Natal for future research or academic purposes. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. The information will be destroyed by shredding the hard copies.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

Participation in this study is voluntary and no incentives or compensation will be awarded to the participants.

HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received written approval from the Health Research Ethics Committee of the College of Agriculture and Environmental Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Soné van Zuydam on 083 5200 615 or 55439594@mylife.unisa.ac.za. The findings are accessible for 5 years.

Should you require any further information or want to contact the researcher about any aspect of this study, please contact Soné van Zuydam on 083 5200 615 or 55439594@mylife.unisa.ac.za .

Should you have concerns about the way in which the research has been conducted, you may contact Prof EL Kempen on 011-471-2241 or kempeel@unisa.ac.za. Contact the research ethics chairperson of the CAES Health Research Ethics Committee, Prof M Antwi antwima@unisa.ac.za if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Soné van Zuydam

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the questionnaire.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname…… (please print)

Participant Signature……..Date……

Researcher's Name & Surname……(please print)

Researcher's signature……..Date……

APPENDIX D: EDITING CERTIFICATE

Between the lines editing

Leatitia Romero
Professional Copy-Editor, Translator and Proofreader
(BA HONS)

Cell: 083 236 4536
leatitiaromero@gmail.com
www.betweenthelineseditting.co.za

15 November 2019

To whom it may concern:

I hereby confirm that I have edited the dissertation entitled: "EXPLORING CONSUMERS' PROCEDURAL KNOWLEDGE AND PERCEPTION OF GENETICALLY MODIFIED (GM) FOOD PRODUCTS AND THE FACTORS THAT INFLUENCE THEIR PURCHASING DECISION". Any amendments introduced by the author hereafter are not covered by this confirmation. The author ultimately decided whether to accept or decline any recommendations made by the editor, and it remains the author's responsibility at all times to confirm the accuracy and originality of the completed work.

Leatitia Romero
(Electronically sent – no signature)

Affiliations

PEG: Professional Editors Group (ROM001)
EASA: English Academy of South Africa
SATI: South African Translators' Institute (1003002)
SfEP: Society for Editors and Proofreaders (15687)
REASA: Research Ethics Committee Association of Southern Africa (104)

APPENDIX C: TURNITIN REPORT

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

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Assignment title:	LCS 2019 Submissions
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Word count:	75,895
Character count:	414,268
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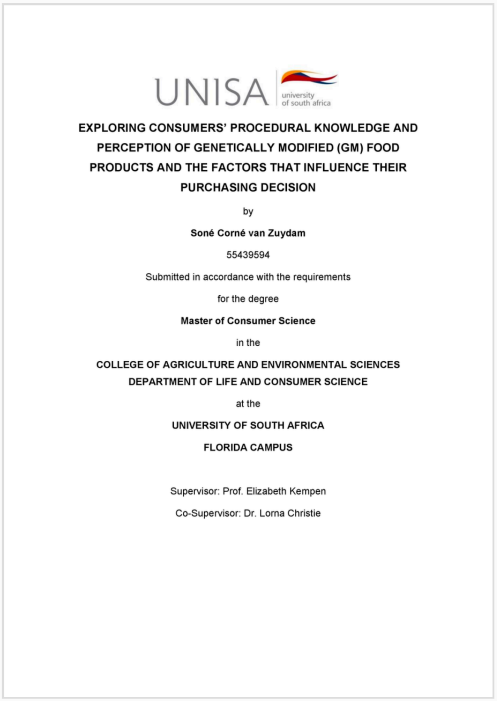

UNISA university of south africa

EXPLORING CONSUMERS' PROCEDURAL KNOWLEDGE AND PERCEPTION OF GENETICALLY MODIFIED (GM) FOOD PRODUCTS AND THE FACTORS THAT INFLUENCE THEIR PURCHASING DECISION

by

Soné Corné van Zuydam

55439594

Submitted in accordance with the requirements

for the degree

Master of Consumer Science

in the

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES
DEPARTMENT OF LIFE AND CONSUMER SCIENCE

at the

UNIVERSITY OF SOUTH AFRICA
FLORIDA CAMPUS

Supervisor: Prof. Elizabeth Kempen

Co-Supervisor: Dr. Lorna Christie