Consumers' subjective and objective knowledge of genetically modified food in a South African context

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DECLARATION

I, Izelri Marx, hereby declare that:

CONSUMERS' SUBJECTIVE AND OBJECTIVE KNOWLEDGE OF GENETICALLY MODIFIED FOOD WITHIN A SOUTH AFRICAN CONTEXT

is my own work and that this dissertation submitted for degree purposes at the North-West University has not previously been submitted for degree purposes to any other higher education institution and that, except for sources acknowledged, the work is entirely that of the researcher.

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Izelri Marx

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Rom 12:12 – Be joyful in hope, patient in affliction, faithful in prayer.

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OPSOMMING

Genetiese gemodifiseerde (GM) gewasse is ontwikkel as ’n oplossing om volhoubare voedselproduksie te verseker vir ’n ewig toenemende wêreldpopulasie, veral in ontwikkelende lande. Daarom is produkte soos GM voedsel deel van Suid-Afrikaanse verbruikers se daaglikse lewe. Soja en mielies is twee van die mees algemene GM gewasse in Suid-Afrika. Mielies is ’n stapelvoedsel in Suid-Afrika omdat dit bekostigbaar, beskikbaar en maklik is om voor te berei. Soja is ’n belangrike bron van proteïne en ’n effektiewe stabiliseerder en vuller in geprosesseerde Suid-Afrikaanse voedselprodukte. Die gevolg hiervan is dat dit byna onvermydelik is om GM voedsel in te neem vir Suid-Afrikaanse verbruikers en dat hulle nie noodwendig bewus is daarvan nie.

Die verbruikersbeskermingswet (VBW) (2008) vereis verpligte etikettering van GM voedsel in Suid-Afrika. Die VBW dui ook aan dat verbruikers ’n reg het om te kies en dat inligting bekend gemaak moet word. Vorige studies het egter gedemonstreer dat verbruikers se kennis oor GM gewasse relatief laag is, wat die vraag ontlok of Suid-Afrikaanse verbruikers genoegsame kennis en die vermoë het om ingeligte besluite te neem oor spesifiek GM voedselprodukte. Dit is ook nog nie bekend of verpligte GM- etikettering bygedra het tot Suid-Afrikaanse verbruikers se kennis oor GM voedsel nie. Verbruikers dink dalk dat hulle baie weet van GM voedsel maar hulle kennis kan moontlik nie gebaseer wees op feite nie. Wetlik verpligte etikettering van GM voedsel is oneffektief as dit nie verbruikers bemagtig om ingeligte besluite te neem nie.

Die doel van die studie was om ondersoek in te stel oor Suid-Afrikaanse verbruikers se subjektiewe en objektiewe kennis van GM voedsel, terwyl hul demografiese eienskappe ook in ag geneem is. Die kwantitatiewe, deursnit, verkennende opname is gebruik om inligting te verkry van Suid-Afrikaanse verbruikers 18 jaar en ouer se GM voedsel kennis. ’n Nie-waarskynlike, doelgerigte steekproef metode is gebruik en respondente het vrywillig die aanlyn vraelys voltooi, wat per e-pos aan hul gestuur is deur die verbruikers konsultasie agentskap, AskAfrika. Respondente wat voldoen het aan die insluitingskriteria het vraelyste voltooi en ingedien waarna hulle terugvoer gestoor is op ’n databasis. Data is statisties geanaliseer deur gebruik te maak van frekwensies, gemiddeldes, t-toetse, ANOVA’s en kruis-tabulering met effekgroottes.

Dit is bevind dat Suid-Afrikaanse verbruikers bo-gemiddelde subjektiewe kennis en gemiddelde objektiewe kennis van GM voedsel het. Objektiewe kennis stellings, wat ’n invloed op verbruikers se daaglikse lewe mag hê, het hoër waardes gehad as tegniese feite van GM voedsel. Daar was ’n verband tussen respondente se subjektiewe en objektiewe kennis wat aandui dat verbruikers met hoë vlakke van subjektiewe kennis, ook hoë vlakke objektiewe

kennis gehad het. Baie verbruikers was egter nie bewus van hulle GM voedsel inname nie, maar dié wat wel bewus was van hulle GM inname, het hoër subjektiewe en objektiewe kennis gehad as diegene wat nie daarvan geweet het nie. Aangesien verbruikers hulle aankoopbesluite op kennis baseer, dui die resultate van hierdie studie daarop dat hierdie besluite nie noodwendig gebaseer is op feite nie en daarom daarop dui dat respondente nie die vermoë het om ingeligte besluite oor GM voedsel te kan neem nie.

Hoewel respondente se demografiese eienskappe geen korrelasie met hulle kennis gehad het nie, dui die demografiese profiel van respondente daarop dat die meerderheid van die respondente meer gegoede verbruikers was met tersiêre opleiding. Indien meer gegoede, opgeleide verbruikers nie voldoende GM voedsel kennis het om ingeligte besluite te kan neem nie, word die vermoë van die minder gegoede verbruikers om ingeligte besluite gebaseer om GM kennis te neem, bevraagteken. Dit is veral kommerwekkend aangesien hulle dikwels afhanklik is van mielies en soja stapelvoedselprodukte in hulle daaglikse lewe. Hierdie studie kan dien as ’n fondament vir toekomstige navorsing om ’n beter begrip te kry van die inligting waarop verbruikers staat maak gedurende hul GM voedsel aankoop besluite. ’n Behoefte aan verbruikers opleiding oor die teenwoordigheid van GM bestanddele in voedselprodukte is geïdentifiseer en verdere studies kan ondersoek instel oor metodes om verbruikers op te lei oor GM voedsel ten einde ingeligte aankoopbesluitneming te fasiliteer. Die voedselindustrie kan voordeel trek uit hierdie studie aangesien resultate gebruik kan word om verbruikers toe te rus met betroubare inligting van GM voedselprodukte om sodoende verbruikers lojaliteit te verseker en verbruikerswelstand in Suid-Afrika aan te moedig.

ABSTRACT

Genetically modified (GM) crops were developed as a solution to ensure sustainable food production for an ever-increasing world population, especially in developing countries. As such, products such as GM foods are now part of South African consumers' daily lives. Soy and maize are two of the most common GM food crops in South Africa. Maize is a staple food in South Africa since it is affordable, readily available and easy to prepare, and soy is an important source of protein and an effective stabiliser and filler in processed food in South Africa. As a result, it is inevitable that GM food will be consumed by South African consumers, without them necessarily knowing it.

The Consumer Protection Act (CPA) (2008) requires mandatory labelling of GM-containing food products in South Africa. In addition, the CPA states that consumers have the right to choose and to the disclosure of information. However, previous studies have demonstrated that consumer knowledge of GM crops is relatively low and raises the question of whether South Africans have sufficient knowledge and the ability to make informed decisions with regard to GM food products. Furthermore, it is unknown whether mandatory GM labelling has contributed toward South African consumers' knowledge of GM foods. Consumers may think they know about GM foods, but their knowledge might not be based on facts. Regulatory GM food labelling is ineffective if it does not empower consumers to make informed purchasing decisions.

The purpose of this study was thus to investigate South African consumers' subjective and objective knowledge of GM food, taking their demographic characteristics into account. The quantitative, cross-sectional, exploratory survey was used to obtain information about the GM food knowledge of South African consumers (18 years and older). A non-probability, purposive sampling method was used and respondents voluntarily completed an online questionnaire that was emailed to them by the consumer consultancy agency AskAfrika. Respondents who met the inclusion criteria completed and submitted the questionnaire, where after it was stored on a database. Data was analysed by means of inferential statistics including frequencies and means, and inferential statistics including t-test, ANOVAs and cross tabulations, which yielded effect sizes.

It was found that consumers had above average subjective knowledge and average objective knowledge of GM food. Objective knowledge statements that may be related to their daily lives scored higher than technical facts about GM food. Respondents' subjective and objective knowledge were related, indicating that consumers with high levels of subjective knowledge also had high levels of objective knowledge. Although many respondents were not aware of

their GM food consumption, those who were aware of their GM consumption had higher subjective and objective knowledge levels than those who did not know. As consumers base their purchasing decisions on knowledge, the results of this study indicate that these decisions might not be based on facts, and we therefore conclude that respondents are not able to make informed decisions with regards to GM food.

Although respondents' demographic characteristics had no correlations with their knowledge, the demographic profile of respondents indicated that the majority of respondents were more affluent consumers with tertiary education. If more affluent, educated consumers do not have sufficient GM food knowledge, which enables them to make informed decisions, then the ability of less affluent consumers to make informed decisions based on their GM knowledge is questionable – which is troublesome, since these less affluent and less educated consumers are often dependent on maize and soy staple food products in their daily lives. This research might serve as a foundation for future studies to gain a better understanding of the information consumers rely on to make GM food purchasing decisions. A need for consumer education on the presence of GM ingredients in food products was identified, and future studies could explore methods to educate consumers about GM food in order to facilitate informed purchasing decisions. The food industry could also benefit from this study, as the results can aid in providing consumers with trustworthy information about GM-containing food products, ensuring consumer loyalty and encouraging consumer wellbeing in South Africa.

KEYWORDS

Consumer

Consumer Protection Act (CPA)

Consumption

Demographics

Genetically modified (GM) food

Objective knowledge

Subjective knowledge

South Africa

CONCEPT CLARIFICATIONS

Consumer: An individual who purchases and uses goods or services according to his/her needs (Solomon, 2013:647).

Consumerism: The movement developed for the protection of consumer rights and interests through various groups in society (Erasmus, 2013:355; Muthulakshmi, 2012:149).

Consumer protection: A social action aimed at improving the wellbeing of an individual or a group of individuals in society (Muthulakshmi, 2012:149).

Consumer Protection Act (CPA): A South African law (Melville, 2011:21) that establishes the norms and standards of consumer protection through different rights (CPA, 2011).

Genetically modified (GM) food: Food derived from organisms with DNA that has been genetically modified in a way that does not occur naturally (WHO, 2014), with the main purpose of addressing hunger and providing nutritious and inexpensive food products (Mondello, 2013:4589).

Objective knowledge: Consumers' actual knowledge based on facts regarding a certain topic (House *et al.*, 2004:114; Park *et al.,* 1994:71).

Subjective knowledge: Consumers' perception of their own knowledge (House *et al.*, 2004:114; Park *et al.*, 1994:71), or what they think they know.

LIST OF ACRONYMS

ANOVA	Analysis of variance
BRICS	Brazil, Russia, India, China, South Africa
CPA	Consumer Protection Act
EU	European Union
FDA	Food and Drug Administration
FOP	Front of packaging
GM	Genetically modified
GMO	Genetically modified organisms
GMO-free	Free from genetically modified organisms
IDK	I do not know
KMO	Keiser-Meyer-Olkin
Non-GMO	No genetically modified organisms present
SD	Standard deviation
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

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CHAPTER 1: INTRODUCTION

1.1 Background and motivation

Food that has been subject to technological alteration, including genetically modified (GM) food products, is part of South African consumers' daily lives. Genetic modification has been used in South African agriculture for the past 20 years (Monsanto, 2015), with its original focus on ensuring food security in developing countries (Brown, 2015:15) by means of producing more sustainable food crops (Mondello, 2013:4589). Maize and soy are two of the most commonly used GM ingredients in South African processed food (Viljoen & Marx, 2013:389). Indeed, the most consumed food product by South African consumers is maize, as it is affordable, always available, nutritious and easy to prepare – even without electricity, as many South African consumers cannot afford a stove or other cooking appliances (Klemz *et al.,* 2005:591). Because maize and soy are two of the most commonly used GM ingredients in processed food products (James, 2011:130), the consumption of GM foods is almost inevitable, despite a worldwide debate over the use GM foods (Linnhoff *et al*., 2017:371).

In terms of legislation, the Consumer Protection Act 68 of 2008 (CPA) of South Africa states that any product containing more than 5% GM ingredients has to be labelled as GM-containing, thus products containing up to 4.9% GM ingredients do not have to be labelled as such (Viljoen & Marx, 2013:389) and consumers therefore will not be aware of possibly up to 4.9% content of GM ingredients in food products. However, it is unknown if South African consumers are aware of the use and labelling legislation of GM ingredients in food products, and whether they have sufficient knowledge to make informed food purchasing decisions, regardless of their choice whether or not to consume GM containing food. Moreover, while consumers may claim that they have knowledge regarding genetic modification (i.e. subjective knowledge), it might not be factually correct (or objective knowledge). If consumers do not have sufficient or correct knowledge of GM food, they are deprived of their basic right to choose (Gibson & Hull, 2013:4) between GM and non-GM food items.

1.1.1 Genetically modified (GM) food

GM foods are those derived from organisms whose DNA has been genetically modified (World Health Organisation (WHO), 2016). This process is done through genetic modification technology, where one or more genes from a plant or animal are transferred to another in

order to provide the GM organism with a commercially beneficial trait (Okigbo *et al.*, 2011:30). The predominant traits of GM food crops include insect resistance (in approximately 25% of commercial GM crops) and herbicide tolerance (in approximately 75% of commercial GM crops). Insect resistant crops have been genetically engineered to produce a protein that acts as an endotoxin to a specific gene of insects and protects the crop from insect damage, thus minimises yield loss. Herbicide tolerance crops are tolerant to herbicides used in weed control and allow for weed management during the growing season (Viljoen *et al.,* 2006:73). In South Africa, commercially produced GM crops include soybeans, cotton and maize. A study conducted in 2011 in South Africa indicated that 100% of cotton production is genetically modified, as is 85% of soybean and 77% of maize production (James, 2011:130).

GM crops and regulations differ worldwide and some consumers oppose the use of GM food (Linnhoff, et al., 2017:371). For instance, some European countries oppose the use of GM technologies in food products and have regulations to prevent such use, because the long-term effects of GM on humans have not been determined. In contrast, some states in USA are completely supportive of the use of GM technologies, as such technology ensures food security in these states (Costa-Font & Mossialos, 2008:174). Consumers' knowledge of GM food may also differ (Aleksejeva, 2014:501), making it necessary to explore consumers' knowledge of GM food in an emerging economy country such as South African, as such knowledge may influence their buying behaviour (Pieniak *et al*., 2010:485; Polonsky *et al.,* 2012:243).

1.1.2 Knowledge influencing consumer decisions

Consumers' knowledge is an important construct used to understand consumer behaviour. Essentially, knowledge increases when consumers gain experience. Cognitive frameworks guide consumers' understanding of concepts (Baron & Branscombe, 2012:44), and problem recognition then serves as a motivation to act on the stimulus in order to fulfil the need. In other words, the cognitive consumer decision-making process starts with problem recognition (Solomon, 2013:154), and when consumers decide to act on the stimulus, the information gathering process about the product or service commences (Dellaert & Häubl, 2012:277). When a decision is based on factual information, the consumer will use objective knowledge to make an informed decision. However, it is not always possible to have all the necessary information, therefore consumers cease their information search when they think they have sufficient information (Ungerer, 2014:417) to make an informed decision. If information is insufficient or not available, subjective knowledge will be used to guide consumers' decision-

making processes. When purchasing food products, consumers need to be equipped with factual information (objective knowledge) about the presence of GM ingredients in processed foods in order to make an informed decision, as it is their consumer right.

However, consumers may be overconfident in their knowledge about a subject when they think they know more than they actually do (Alba & Hutchinson, 2000:123). Although knowledge can be divided into several categories, those focused on in this study are objective knowledge (knowledge about factual information), subjective knowledge (perception of their knowledge) and consumption knowledge. It is important to differentiate between these types of knowledge, as they may influence consumers' purchasing choices (Donoghue *et al.,* 2016:387; Lee & Lee, 2009:138).

In this study, consumers' consumption (procedural) knowledge as part of objective knowledge of GM food is explored. Consumption knowledge is based on consumers' past experiences, which influence their subjective and objective knowledge (Brucks, 1985:3). Because subjective knowledge is related to consumers' confidence (what they think they know) whereas objective knowledge relates to the accuracy of their knowledge (Alba & Hutchinson, 2000:124; Donoghue *et al.,* 2016:387), there can be a difference between subjective and objective knowledge (Carlson *et al.,* 2008:2; Guo & Meng, 2008:261). However, both subjective and objective knowledge are partially the result of consumption experiences (Donoghue *et al.,* 2016:387), and can be directly linked to consumer behaviour (Brucks, 1985:2). Yet literature shows that consumers' behaviour changes when their subjective knowledge rather than their objective knowledge increases (Pieniak *et al*., 2010:485). The accuracy of consumers' knowledge and confidence in their knowledge is dependent on their abilities and expertise, even though experience may alter consumers' confidence without influencing the accuracy of their knowledge (Carlson *et al.,* 2008:2). As such, when consumers base their purchasing decisions on their subjective knowledge, they may not be equipped with factual information to make informed decisions (Alba & Hutchinson, 2000:123).

Objective knowledge is thus important for consumers to make informed choices (Polonsky *et al.,* 2012:243). With a lack of objective knowledge of GM food, consumers can be easily misled and make uninformed decisions. Yet although objective knowledge is a crucial part of decision making, it is not always an accurate representation of public understanding. Consumers only need to know and understand information that has a direct impact on their purchases (Ladwig *et al*., 2012:2), making some technical information of GM technology irrelevant for consumers.

In addition, some demographic characteristics have an impact on consumers' knowledge of GM food. For example, consumers' objective knowledge of GM food can be related to their

level of education, as higher levels of education have been shown to contribute to higher levels of objective knowledge (Zhang & Liu, 2015:1202). Other demographic characteristics that have correlations with subjective and objective knowledge include consumers' gender, age, residency, culture, and income (Donoghue *et al.,* 2016:391; House *et al.,* 2004:118, Lu *et al.,* 2016:156; Siegrist *et al.*, 2000:197). These characteristics were explored in this study to determine if consumers' subjective and objective knowledge of GM food have correlations with the samples' demographic characteristics.

1.1.3 Differences in consumers' knowledge

Consumer knowledge has recently been a popular subject of research (Guo & Meng, 2008:260). However, many studies exploring consumers' knowledge are not representative of South African consumers' knowledge of GM food, and previous studies exploring consumers' behaviour towards GM food have mostly focused on consumers residing in the USA and European Union (EU). Results have shown that these consumers seem to be educated on the technical aspects of GM food (Aleksejeva, 2014:500; Van der Werff, 2014:24). Moreover, the consumers in the USA tend to have positive stances towards GM food owing to the reduced use of insecticides, increased food production and possibility of increased nutritional value of GM foods (Evans & Ballen, 2013:5). EU consumers, in contrast, are risk-averse and do not generally support the use of GM foods. As a result, it is mandatory to label processed food containing GM ingredients in the EU (O'Fallon *et al.,* 2007:118) and the USA (Hemphill & Banerjee, 2015:436). EU consumers apply a cautionary principle to the use of GM foods.

Similar to those in the USA, consumers in BRICS countries have been found to be pro-GM. These consumers are also pro-GM as it increases food production, which will ultimately improve their countries' economies (Van der Werff, 2014:29). South Africa, a BRICS country, is classified as a developing country with an emerging economy (Momberg *et al.*, 2012:409; Rajagopal, 2010:96), supporting the use of GM foods in the production of staple foods. An emerging economy is characterised by fast developments in its economy and a change in economic and political systems (Fan, 2008:354), and usually includes better living conditions for residents in urban and rural areas (Klemz *et al.,* 2005:591). However, it does not necessarily suggest proper education for consumers, especially about their consumer rights.

Indeed, studies conducted on South African consumers' knowledge of GM food conclude that the majority of South African consumers are not aware of the existence of GM foods (Peter & Karodia, 2014:265), yet many of these consumers consume GM foods on a daily basis through a variety of food items (James, 2006; Viljoen *et al.,* 2006:77). Moreover, although the CPA

instigated mandatory GM-ingredient labelling practices in South African processed foods, it is unknown whether it has affected South African consumers' knowledge of GM foods.

1.1.4 The consumer Protection Act of South Africa

The CPA of South Africa is designed to promote a fair and sustainable marketplace where consumers can practice responsible consumer behaviour (Gibson & Hull, 2013:4). The Act aims to provide consumers with eight basic consumer rights. One consumer right that is applicable to this study is the right to choose (food items based on available information) (Cant *et al.,* 2006:46; Gibson & Hull, 2013:4; Miller *et al.,* 1976:25; Tower, 1994:192). Another consumer right is the right to disclosure of information, which entails the right to product labelling and trade description that is not misleading. This requirement means that suppliers must display the contents of the product as well as the packaging without misleading the consumer. Suppliers may not remove, conceal or alter information to mislead the consumer (Gibson & Hull, 2013:8). The GM ingredient-labelling regulations are provided in Regulation 293 of the CPA. However, the labelling requirements can be confusing to a consumer, and when consumers do not understand the labelling regulations, they can easily be misled if they do not know how to interpret GM label information.

Moreover, the food industry in South Africa is considered to be self-regulating, which includes the implementation of the CPA. Since there is no enforced of compliance to the CPA, it is up to the consumer to implement their rights under the CPA (Viljoen & Marx, 2013:388). Yet consumers are not necessarily able to determine the validity of GM-related labels on South African foods, as GM food is not readily distinguishable from non-GM food. Moreover, although the CPA regulations should have compelled companies to label the presence of GM ingredients in processed or packaged food products (Botha & Viljoen, 2008:1060), it has been found that not all soy and maize ingredients are labelled as GM-containing according to these regulations (Viljoen & Marx, 2013:390). If consumers are aware of the mandatory GM labelling regulations and the use of soy and maize in processed food items, it could contribute towards their subjective and objective knowledge of GM foods, enabling them to make informed purchasing decisions.

1.2 Problem statement

Genetically modified food crops, mainly maize and soy beans, are a part of the South African agriculture. In 2011, it was determined that 77% of South African maize crops and 85% of soy

bean crops are genetically modified, and are the staple foods for many South African consumers. Maize and soy are also used in many of South Africa's processed and packaged food owing to their stabilising and protein-enhancing properties, making it inevitable that consumers consume GM ingredients on a daily basis. However, it is not known if consumers' knowledge of GM food has increased since it became mandatory in the CPA for manufacturers to label GM ingredients in processed food products.

The CPA also states the eight basic consumer rights, including the right to choose. Consumers base their choices of food products on their knowledge of the product. Yet what consumers know (objective knowledge) and what they think they know (subjective knowledge) may not be the same, as subjective knowledge, unlike objective knowledge, is not necessarily inherently correct. Thus when consumers think they know about GM food (subjective), they might base their choices on incorrect information.

Yet, as indicated above, not all expert information of GM technology has a direct impact on consumers' knowledge. Thus, only expert knowledge of GM food that might have an influence on the consumer should be considered. Consumers' consumption knowledge of GM food and the presence of GM ingredients in everyday food products should also be explored to obtain a comprehensive understanding of South African consumers' knowledge of GM food. If consumers base their purchasing decisions on incorrect information about GM food, their ability to make informed product choices is jeopardised, which in turn affects their ability to act as informed consumers in the marketplace and ultimately affects their well-being.

1.3 Aim and objectives

The study aims to explore South African consumers' subjective and objective knowledge of GM food. The following objectives have been identified:

1. To explore and describe consumers' subjective knowledge of GM food.
2. To explore and discuss consumers' objective knowledge of GM food.
3. To explore and describe correlations between consumers' demographic characteristics and their knowledge of GM food.

The purpose of this study was to explore whether South African consumers are able to make informed decisions when purchasing GM-containing food products. If consumers base their decisions on factual information, they will be equipped to make informed decisions, which can ultimately lead to consumer well-being. The findings of the study could be used for academic

purposes to further research on consumers' knowledge and other behavioural aspects of GM food.

1.4 Demarcation of the field of study

The target population for this study was consumers residing in South Africa who were 18 years and older at the time of research, from any gender, race, education and income group. Respondents who have made food purchases for their household could participate in the study, as long as they had knowledge of GM food or GM technology. As the online questionnaire was only available in English, the respondents had to be English-literate, mobile-literate, have internet access and be registered on the AskAfrika respondent database.

1.5 Method of investigation

An exploratory research approach using electronic online questionnaires to collect quantitative data was used in this study. The questionnaire was distributed through AskAfrika, who emailed the questionnaire to potential respondents, and 310 completed questionnaires were returned. The questionnaire was self-designed, using scales described in previous studies and statements collected through literature research. Non-probability, purposive sampling was used, as a large sample had to be reached. Since the research was exploratory, it did not aim to be representative, and the findings were not generalised to the larger South African population. Statistical methods such as frequencies, means, standard deviations, t-tests and ANOVAs with effect sizes were used to analyse the collected data.

1.6 Conceptual framework

A conceptual framework provides a guideline to the scope of the study, as indicated in Figure 1.1. Consumers often need to gain an understanding of a topic with which they are not familiar. When they show interest in a topic, they search for and obtain relevant information and knowledge about it. The type and degree of information that is obtained on GM food then determines whether consumers' subjective knowledge or objective knowledge is influenced. Consumption (experience-based) knowledge influence consumers' subjective and objective knowledge and behaviour, which determines consumers' knowledge of the consumption of,

for example, GM food on a daily basis. These types of knowledge should be explored together to obtain an overall indication of consumers' knowledge of GM food.

Moreover, although it is mandatory for manufacturers to label GM ingredients according to the CPA regulations, it is not known if South Africans have since the implementation of the Act become more knowledgeable of GM technology and GM ingredients used in everyday food items. If consumers are not aware of the presence of GM ingredients, it deprives them of their right to choose. Thus, consumers' knowledge of GM food should be explored to determine if they are able to make informed purchasing decisions, and which expert knowledge they regard as necessary for them to make informed decisions. As South Africa is a diverse country, respondents' demographic characteristics were also explored to determine if there are relevant associations between such characteristics and their knowledge of GM food.

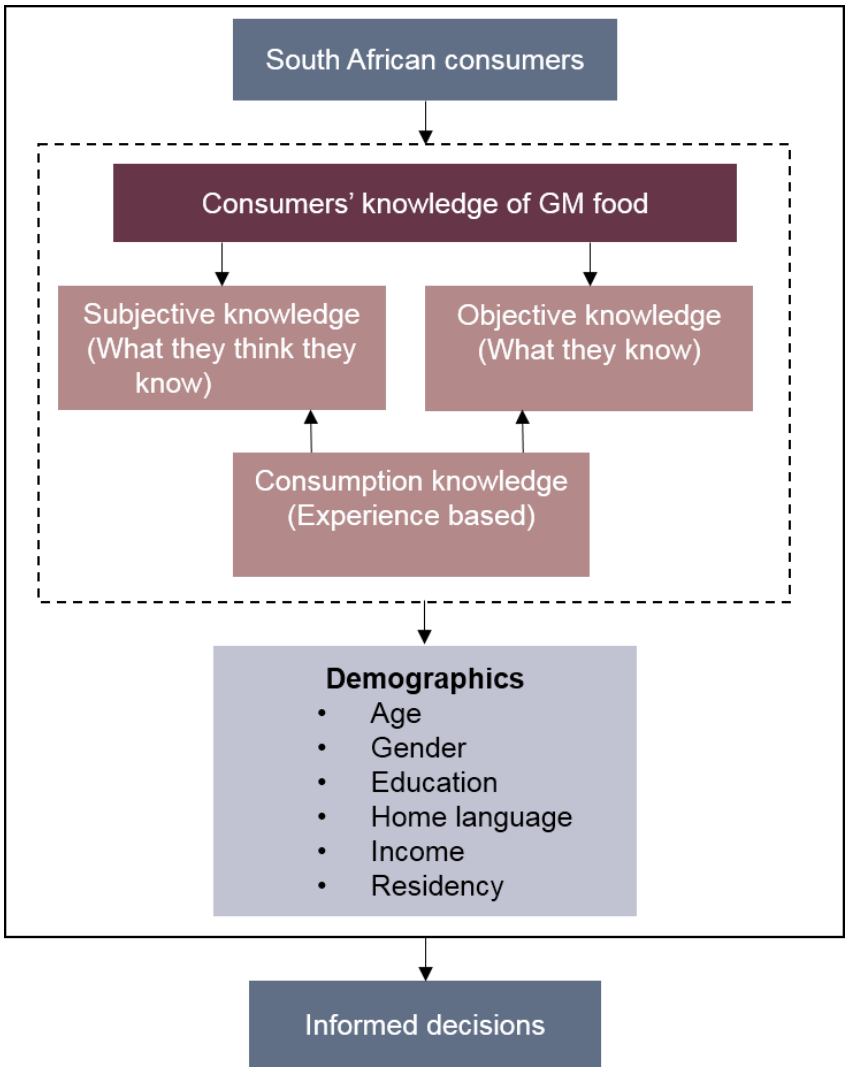


Figure 1.1 Conceptual framework of South African consumers' subjective and objective knowledge of GM food and the influences thereof on their purchasing choices

1.7 Structure of dissertation

This research project is presented in a dissertation format. **Chapter 1** served as an introduction to the research project, including a background and motivation, conceptual framework, problem statement, aim, objectives, and a brief overview of the methodology. A thorough literature study is presented in **Chapter 2,** where concepts such as consumers' decision-making process, subjective and objective knowledge, GM technology, GM food and labelling, and demographics are discussed. **Chapter 3** provides an in-depth discussion and motivation of the methodology used in this study. The results obtained after data collection is then presented and discussed in **Chapter 4**. The concluding chapter for this study, **Chapter 5,** summarises the limitations and recommendations for this and future studies. Each chapter contains its own list of references used in that chapter. A bibliography for the dissertation is presented after Chapter 5 and, as required by the North-West University, it is referenced according to the Harvard referencing style. Any additional information including the questionnaire, conference acceptance letters, letter from the language editor, Turnitin report, and plagiarism declaration are attached as annexures.

1.8 Contributors

This dissertation presents a study that was planned and executed by a research team. The contribution of each member is outlined in the table below:

Table 1.1 Contributions of team members

Name	Contribution
I Marx	First author, responsible for literature research, design of the questionnaire, data collection, analysis and interpretation of data, and writing of the dissertation.
L Wyma	Supervisor and co-author. Provided supervision for the first author's activities and offered advice and direction throughout the study. Assisted in obtaining ethical approval for the study. Assisted in obtaining funds for the study by means of NRF bursaries.
E Botha	Co-supervisor and co-author for the study, supervising the author's activities during the duration of the study. Assisted in obtaining ethical approval for the study.
CD Viljoen	Co-supervisor and co-author for the dissertation. Co-supervised the first author's activities. Provided insight and advice during the development of the questionnaire, and gave insight into GM technology.

Below is a declaration by the co-authors to confirm their individual roles in the study:

I hereby declare that my role in this study, as indicated, is a correct representation of my contribution.

Ms I Marx	**Ms L Wyma**
Ms E Botha	**Prof. CD Viljoen**

1.9 References

Alba, J. & Hutchinson, J.W. 2000. Knowledge calibration: what consumers know and what they think they know. *Journal of consumer research*, 27(2):123-156.

Aleksejeva, I. 2014. EU experts' attitude towards use of GMO in food and feed and other industries. *Procedia-social and behavioral sciences*, 110:494-501.

Baron, R.A. & Branscombe, N.R. 2012. Social psychology. 13th ed. Upper Saddle River, NJ: Pearson.

Botha, G.M. & Viljoen, C.D. 2008. South Africa: a case study for voluntary GM labelling. *Food chemistry,* 112(4):1060-1064.

Brown, A. 2015. Understanding food: principles and preparation. 5th ed. Stamford, CT: Cengage Learning.

Brucks, M. 1985. The effects of product class knowledge on information search behavior. *Journal of consumer research*, 12(1):1-16.

Cant, M.C., Brink, A. & Brijball, S. 2006. Consumer behaviour. Cape Town: Juta.

Carlson, J.P., Vinvent, L.H., Hardesty, D.M. & Bearden, W.O. 2008. Objective and subjective knowledge relationships: a quantitative analysis of consumer research findings. *Journal of consumer research,* 35(5):864-876.

Costa-Font, J. & Mossialos, E. 2008. Are perceptions of risks and benefits of genetically modified food (in)dependent. *Food quality and preference*: 18(2):173-182.

CPA – *see South Africa*

Dellaert, B.G.C. & Häubl, G. 2012. Searching in choice mode: consumer decision processes in product search with recommendations. *Journal of marketing research,* 49(2):277-288.

Donoghue, S., Van Oordt, C. & Strydom, N. 2016 Consumers' subjective and objective consumerism knowledge and subsequent complaint behaviour concerning consumer

electronics: a South African perspective. *International journal of consumer studies*, 40(4):385-399.

Evans, E.A. & Ballen, F.H. 2013. A synopsis of US consumer perception of genetically modified (Biotech) crops. http://edis.ifas.ufl.edu/pdffiles/FE/FE93400.pdf Date of access: 23 Aug. 2015.

Fan, Y. 2008. The rise of emerging market multi-dimensional and the impact on marketing. *Marketing intelligence & planning*, 26(4):353-358.

Gibson, C. & Hull, G. 2013. Everyone's guide to the Consumer Protection Act. Cape Town: Zebra Press.

Guo, L. & Meng, X. 2008. Consumer knowledge and its consequences: an international comparison. *International journal of consumer studies*, 32(3):260-268.

Hemphill, T.A. & Banerjee, S. 2015. Genetically modified organisms and the U.S. retail food labeling controversy: consumer perceptions, regulation, and public policy. *Business and society review*, 120(3):435-464.

House, L., Lusk, J., Jaeger, S., Traill, W.B., Moore, M., Valli, C., Morrow, B. & Yee, W.M.S. 2004. Objective and subjective knowledge: impacts on consumer demand for genetically modified foods in the United States and the European Union. *The journal of agrobiotechnology management & economics*, 7(3):113-123.

James, C. 2006. Global status of commercialized biotech/GM crops, 2006. (ISAAA Brief no. 35). Ithaca, NY: ISAAA.

James, C. 2011. Global status of commercialized biotech/GM crops, 2011. (ISAAA Brief no. 43). http://www.isaaa.org/resources/publications/briefs/43/download/isaaa-brief-432011.pdf Date of access: 25 Aug. 2015.

Klemz, B.R., Boshoff, C. & Mazibuko, N. 2005. Emerging markets in black South African townships. *European journal of marketing,* 40(5/6):590-610.

Ladwig, P., Dalrymple, K.E., Brossard, D., Scheufele, D. & Corley, E.A. 2012. Perceived familiarity or factual knowledge? Comparing operationalizations of scientific understanding. *Science and public policy*, 39(6):761-774.

Lee, J.K. & Lee, W. 2009. Country-of-origin effects on consumer product evaluation and purchase intention: the role of objective versus subjective knowledge. *Journal of international consumer marketing*, 21(2):137-151.

Linnhoff, S., Volovich, E., Martin, H.M., Smiths, L.M. 2017. An examination of millennials' attitudes toward genetically modified organism (GMO) foods: is it Franken-food or super-food? *International journal of agricultural resources, governance and ecology*, 13(4):371-390.

Lu, L., Rahman, I. & Chi, C.G. 2016. Can knowledge and product identity shift sensory perceptions and patronage intentions? The case of genetically modified wines. *International journal of hospitality management,* 53:152-160.

Miller, J.A., Topel, D.G. & Rust, R.E. 1976. USDA beef grading: a failure in consumer information? *Journal of marketing,* 40(1):25-31.

Momberg, D., Jacobs, B. & Sonnenberg, N. 2012. The role of environmental knowledge in young female consumers' evaluation and selection of apparel in South Africa. *International journal of consumer studies,* 36(4):408-415.

Mondello, L. 2013. Nutraceuticals and separations. *Analytical and bioanalytical chemistry,* 405(13):4589-4590.

Monsanto. 2015. Glyphosate and roundup brand herbicides. http://www.monsanto.com /glyphosate/pages/default.aspx Date of access: 30 Jan. 2017.

O'Fallon, M.J., Gursoy, D. & Swanger, N. 2007. To buy or not to buy: impact of labelling on purchasing intentions of genetically modified foods. *Hospitality management,* 26(1):117-130.

Okigbo, R.N., Iwube, J.C. & Putheti, R. 2011. An extensive review on genetically modified (GM) foods for sustainable development in Africa. *e-Journal of science and technology*, 21. http://e-jst.teiath.gr Date of access: 16 Mar. 2015.

Peter, L. & Karodia, A.M. 2014. An investigation into the consumer acceptance of genetically modified foods at the Chris Hani district municipality, Eastern Cape, South Africa. *Kuwait chapter of Arabian journal of business management review,* 3(11):264-296.

Pieniak, Z., Verbeke, W. & Scholderer, J. 2010. Health-related beliefs and consumer knowledge as determinants of fish consumption. *Journal of human nutrition and dietetics,* 23(5):480-488.

Polonsky, M.J., Vocino, A., Grau, S.L., Garma, R. & Ferdous, A.S. 2012. The impact of general and carbon-related environmental knowledge on attitudes and behaviour of US consumers. *Journal of marketing management,* 28(3-4):238-263.

Rajagopal, P. 2010. Consumer behavior: global shifts and local effects. New York, NY: Nova Science.

Siegrist, M., Cvetkovich, G. & Roth, C. 2000. Salient values similarity, social trust, and risk/benefit perceptions. *Risk analysis,* 20(3):195-203.

Solomon, M.R. 2013. Consumer behavior: buying, having, and being. 10th ed. Boston: Pearson.

South Africa. 2011. Consumer Protection Act 68 of 2008 regulations. (Notice 293). *Government gazette*, 34180, 1 Apr.

Tower, K.D. 1994. Consumer-centered social work practice: restoring client self-determination. *Social work,* 39(2):191-196.

Ungerer, L. 2014. Consumer decision making and beyond. (*In* Schiffman, L. & Kanuk, L., *eds*. Global and Southern African perspectives: consumer behaviour. Essex, England: Pearson Education Limited. p. 404-441).

Van der Werff, M. 2014. Institutions of the societal acceptance of genetically modified crops in emerging economies: the case of Brazil, India and China. *Journal of world systems research*, 21(1):88-105. http://jwsr.pitt.edu/ojs/index.php/jwsr/article/viewFile/528/540 Date of access: 26 May 2016.

Viljoen, C.D. & Marx, G.M. 2013. The implications for mandatory GM labelling under the Consumer Protection Act in South Africa. *Food control,* 31(2):387-391.

Viljoen, C.D., Dajee, B.K. & Botha, G.M. 2006. Detection of GMO in food products in South Africa: implication of GMO labelling. *African journal of biotechnology,* 5(2):73-82.

WHO (World Health Organisation). 2016. Food, genetically modified. http://www.who.int /topics/food_genetically_modified/en/ Date of access: 16 Mar. 2015.

Zhang, M. & Liu, G. 2015. The effects of consumer's subjective and objective knowledge on perceptions and attitude towards genetically modified foods: objective knowledge as a determinant. *International journal of food science and technology,* 50(5):1198-1205.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Genetic modification and genetically modified organisms (GMOs) were developed and implemented more than 20 years ago (Monsanto, 2015). A main aim of the development of GM food was to ensure food security in countries with rapidly growing populations (Brown, 2015:15), especially in developing countries, or countries with emerging economies and high poverty and malnutrition levels (Mondello, 2013:4589). GM food products are part of South African consumers' daily lives, as such biotechnology has been used to modify maize, soy and cottonseed (Viljoen & Marx, 2013:389). Maize, for instance, is the staple food of most South African consumers as it is affordable, easy to prepare and filling. As maize is the most-used food product in South Africa (James, 2011:130; Viljoen & Marx, 2013:389), it is inevitable that genetically modified ingredients will be consumed. White maize is also used to a large extent for animal feed (Botha & Viljoen, 2008:1060; Vermeulen *et al*., 2005:119; Viljoen *et al*., 2006:73), and soy is used in processed foods to act as a stabiliser and to enrich the product with protein.

Because GM technology differs among countries, not all GM and GM food labelling regulations are the same. In South African, the CPA states that any food product containing 5% or more GM ingredients should be labelled as containing GM. Food containing between 1% and 4.9% GM ingredients may be labelled (or not) at the relevant company's discretion (Viljoen & Marx, 2013:389). Although the CPA was implemented in 2008, it remains unknown whether South African consumers' knowledge of GM food have been influenced by this regulation. Previous research related to GM food in South Africa has focused on consumers' behaviour towards GM food (Peter & Karodia, 2014:265), without exploring consumers' knowledge of GM ingredients in food products. Yet without knowledge, consumers may not be able make informed decisions, making it necessary to explore consumers' knowledge of GM food (Gibson & Hull, 2013:4).

There are two important types of knowledge that will effectively determine consumers' knowledge: subjective and objective knowledge (House *et al.*, 2004:114). Subjective knowledge is a consumer's perception of his or her own knowledge, which may not be factually correct, while objective knowledge is based on factually correct information (Brucks, 1985:1; Flynn & Goldsmith, 1999:57; Dodd *et al.,* 2005:4). The combination of these two types of knowledge will affect that consumer's ability to make informed decisions (Flynn & Goldsmith, 1999:58) and efficiently act out his or her right to choose in South Africa. A third type of

knowledge namely consumption knowledge, is the practical knowledge of the usage of a specific item usually based on past experiences (Donoghue *et al.,* 2016:387).

In addition, as South Africa has a diverse population, consumer education and socialisation may not be consistent among all consumers (Barreiro-Hurlé *et al.,* 2008:178; Donoghue *et al.,* 2016:386), and certain demographic characteristics might be related to their knowledge of GM food (House *et al.,* 2004:118). It is thus necessary to explore consumers' demographic characteristics together with their subjective and objective knowledge, which will influence their ability to make informed decisions. Should results show a lack of knowledge, consumer education programmes can possibly be developed in order to empower South African consumers to take advantage of their right to informed decision making, which, in turn, will help build a stronger consumer base in South Africa.

2.2 Theoretical framework

A theoretical framework is presented to frame the exploration of consumers' knowledge of GM food and the associations between such knowledge and consumers' demographics. The basic concepts of consumers' subjective and objective knowledge of GM food, their demographic characteristics and the interrelationship between the concepts of this study are illustrated below (Figure 2.1). For this study, knowledge is categorised into subjective and objective knowledge (Carlson *et al.*, 2008:864), and as a part of objective knowledge, consumers' experience-based (consumption) knowledge will be explored to determine whether they are aware of their GM food consumption. Consumers' subjective and objective knowledge of the prevalence of GM ingredients in South African processed foods and the labelling regulations thereof will determine if they are equipped to make informed purchasing decisions. Continuously, the application of subjective and objective knowledge and consumers' ability to make informed purchasing decisions about GM food will determine if they are able to practice their consumer rights.

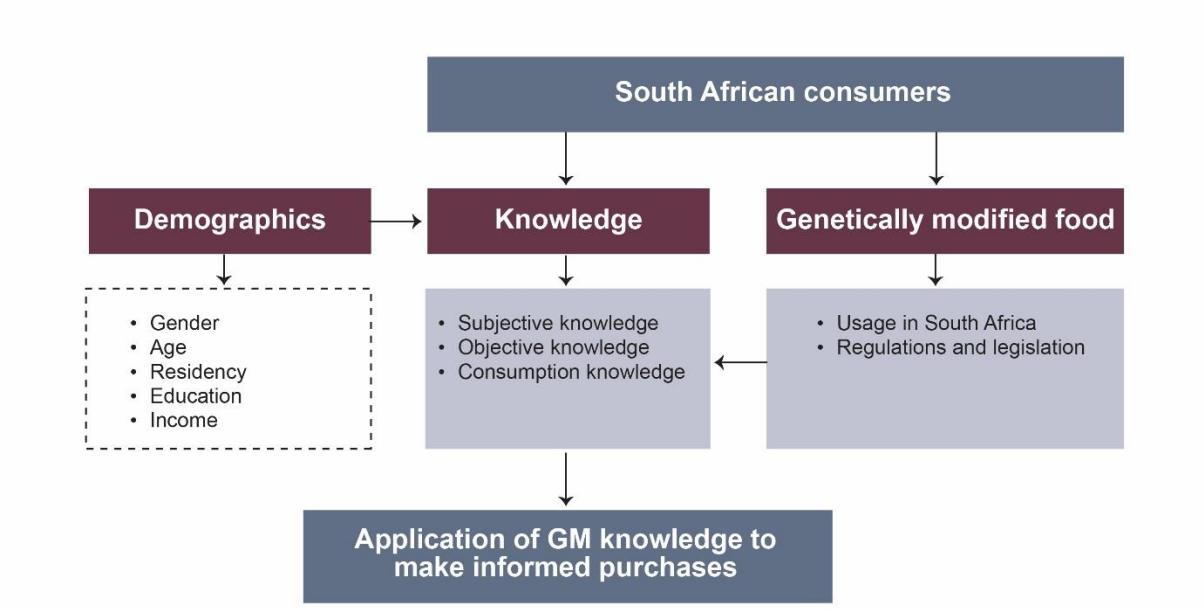


Figure 2.1 Theoretical framework for a study concerning consumers' subjective and objective knowledge of GM food (author's own compilation)

2.3 South African consumers

South African consumers, as demonstrated in Table 2.1, have diverse demographic characteristics. In 2016, there were approximately 55.6 million inhabitants in South Africa, of which 51% were females, with various levels of income and living standards among different groups (STATS SA, 2015:2). For instance, of the 79% of the consumer base that comprises black consumers (Schönfeldt *et al.,* 2010:256; STATS SA, 2011:7), 50% live below the poverty line (Anon, 2011). This figure is calculated in terms of the minimum wage in South Africa, which was R20 per hour in 2017, amounting to about R3 500 per month for a consumer working 40 hours per week (Business Tech, 2017). To contextualise, in 2017 the cost of a brown bread loaf averaged R11, a two-litre fresh milk was R26, and white sugar was R38 per 2.5kg pack. The low-income group in South Africa therefore spent about 59% of their monthly income on non-durable products such as food, beverages and tobacco (Ismail *et al.,* 2016:4). In addition, only 26.2% of consumers over the age of 20 had completed grade 12, and 11.2% of this population gained tertiary education (STATS SA, 2010:3). Considering these factors together with South Africa's history as a developing country and an emerging economy, South African consumers' knowledge frames can greatly vary, which may influence their ability to make informed decisions about GM food and the presence of this technology in their staple food.

Table 2.1 Demographic characteristics of South African consumers (STATS SA, 2015:2-9)

Characteristic	South Africa (%)
Gender	
Female	51.1
Male	48.9
Age	
0 – 14	30.2
15 – 24	19.0
25 – 34	17.4
35 – 44	12.7
44 – 55	0.9
55+	11.6
Ethnicity	
African	80.5
Coloured	8.8
White	8.3
Indian/Asian	2.5
Language	
isiZulu	22.7
isiXhosa	16
Afrikaans	13.5
English	9.6
Sepedi	9.1
Setswana	8
Sesotho	7.6
Xitsonga	4.5
siSwati	2.5
Tshivenda	2.4
isiNdebele	2.1
Education	
Lower than grade 12	79.1
Grade 12	16.6
Tertiary education	4.9
Residency	
Gauteng	24.0
KwaZulu Natal	19.9
Eastern Cape	12.6
Mpumalanga	7.8
Western Cape	11.3
Limpopo	10.4
North West	6.7
Free State	5.1
Northern Cape	2.2

2.3.1 South Africa as an emerging economy

South Africa became part of the BRICS economic block (Brazil, Russia, India, China and South Africa). BRICS countries are regarded as Third World countries with economies that are rapidly emerging (Rajagopal, 2010:96). A Third World country is described as a country experiencing barriers such as high levels of poverty, a lack of education, poor economic growth, political imbalances, rigid trade barriers, high inflation rates, sub-standard infrastructure and inadequate access to advanced services, electronics, banking services, telecommunication, basic retail and banking services (Appiah-Adu, 1998:120; Klemz *et al*., 2005:591). An emerging economy is defined as a country experiencing swift economic development, in a country with political or economic systems that have experienced change (Fan, 2008:354).

South Africa has overcome many of its Third World barriers, especially in urban and industrialised parts of the country (Molawa, 2009:3). Most urban parts of South Africa have modern infrastructure, banking and retail outlets, running water, electricity and telecommunication. Individuals in rural areas also have access to running water, electricity and basic household appliances (Klemz *et al.,* 2005:591). Therefore, South Africa can be characterised as a developing country with an emerging economy (Momberg *et al.*, 2012:409; Scheer *et al.,* 2008:5). Yet although most South African urban or rural consumers have access to necessities needed for survival, this does not necessarily imply that they receive proper education to efficiently act out their consumer rights in the marketplace.

2.3.2 Consumer education in South Africa

The progressive constitution and complementary legislation of South Africa aim to protect consumers' rights (NCPC, 2008). As indicated previously, the CPA of South Africa was developed to promote a fair and sustainable marketplace in which consumers can freely practice their consumer rights and behaviour. There are eight main consumer rights described by the CPA, including those focussed upon in this study: the right to consumer education (Rousseau, 2003:454), the right to disclosure of information and the right to choose (Cant *et al.,* 2006:46; Gibson & Hull, 2013:4).

Consumers have the right to choose to buy (or not to buy) food based on available information. Additionally, consumers have the right to be informed about the contents in a food product or product packaging in a language they understand (Gibson & Hull, 2013:8). The CPA has confirmed the need for government to prioritise consumer education to help consumers make

informed decisions (Erasmus, 2013:357). As such, consumers have the right to truthful and understandable information about a product to aid them in their pre-purchase information search (Mason *et al*., 2008:276).

In emerging economy countries such as South Africa, consumers are firstly protected by legislation (for example the CPA) and then they are educated and informed – for example, about the presence of GM ingredients in South African food products. In contrast, consumers in developed countries such as the USA and in the EU are informed then educated, and are therefore able to have a voice in how they are protected by legislation (Darley & Johnson, 1993:37; Donoghue *et al.*, 2016:385).

2.4 Consumerism

Consumerism has two distinct definitions. The first is the excessive use of consumer goods, also known as materialism (Erasmus, 2013:355; Kamndaya *et al.,* 2015:297). The second, which is relevant to this study, is the movement that developed and implemented consumer rights (Du Plessis, 2007:5). In this definition, consumerism is the set activities of various role players to protect the rights of consumers (Reddy & Rampersad, 2012:7403), as encouraged by a previous USA president, John F Kennedy, in the 1960s (Nwaizugbo & Ogbunankwor, 2013:14, Tower, 1994:192). The movement was developed to ensure that companies strive to improve consumer wellbeing by respecting the basic rights of consumers. Countries over the world have since implemented the consumerism movement in their organisation plans (Erasmus, 2013:355). This movement has helped several countries to conduct research on consumerism and consumer protection (Donoghue *et al.*, 2016:386, Nwaizugbo & Ogbunankwor, 2013:14).

2.4.1 Consumerism in South Africa

Consumerism in developing countries has become important owing to the increased competitiveness between these countries as well as the fact that consumers have become better informed about their rights (Donoghue *et al.*, 2016:385). Consumerism in these countries aims to protect consumers from organisations or practices that exploit them in their quest for profit. The Companies Act of South Africa (South Africa, 2010) states that companies have to protect the shareholders as well as consumers and the community's interests. Businesses should thus report their social and economic development activities as well as equality promotion and community development (Reddy & Rampersad, 2012:7403). While

consumers in developed countries such as the USA rely on market mechanisms to protect them against unfair trading, emerging economies rely on government interventions for protection (Nwaizugbo & Ogbunankwor, 2013:12). South Africa as a developing country also relies on such government interventions, but consumers are nevertheless often exploited owing to low levels of education, consumer socialisation and awareness concerning the implementation of their rights (Donoghue *et al.*, 2016:386, Erasmus, 2013:356).

Thus, while it is claimed that South African consumers should be among the best protected consumers in the world by the South African CPA (Donoghue & De Klerk, 2013:2), low literacy, consumer socialisation and a lack of funding for consumer education (Donoghue *et al.*, 2016:386) are some of the reasons why many consumers are not being able to utilise their rights. In other words, these consumers might not have the ability to act out their consumer rights in the marketplace and make informed purchasing decisions. As such, education about consumerism would empower consumers to use the CPA to their advantage (Donoghue & De Klerk, 2009:456).

2.4.2 Consumer socialisation in South Africa

Consumer socialisation is the process in which individuals acquire skills, attitudes and knowledge and become responsible consumers in the marketplace (Donoghue & De Klerk, 2009:457, Sharma, 2011:162). This process begins when consumers are born, and it is an on-going process, continuing while consumers live independently (Schiffman & Wisenblit, 2015:260). Children are socialised by their parents, who influence their behaviour so that it is acceptable to the family and consumer community. In adulthood, consumers are socialised by their peers and friends, and they will in turn influence their friends and children with their knowledge (Schiffman & Wisenblit, 2015:260; Sharma, 2011:163).

However, it is difficult to encourage consumerism in a country with an emerging economy characterised by previously disadvantaged consumers and low levels of consumer socialisation, as there are notions that adequate consumer protection is only for developed countries with sufficient financial resources. When consumers are not effectively socialised, they may not efficiently act as consumers, as they may not know how to use the CPA to their advantage. Indeed, consumers who are socialised tend to know their rights better than less socialised consumers (Donoghue *et al.,* 2016:386). For example, when individuals have the ability to differentiate between different types of food crops e.g. organic, conventional or GM, they are empowered to make informed decisions and enhance consumerism in South Africa.

However, consumers first need to have adequate and correct knowledge about the product in order to make informed purchasing decisions.

2.5 Consumers pre-purchase decision-making process

The decision-making process is influenced by internal and external factors at different stages of the process. Internal (psychological) factors are unique and inherent to an individual (Hoyer & MacInnis, 2010:10), and include learning and knowledge, motivation, perception and attitude (Ungerer, 2014:413). This study is specifically focussed on knowledge. Knowledge and information form the psychological core of consumer behaviour, as consumers cannot make informed purchasing decisions without information or knowledge of the product (Hoyer & MacInnis, 2010:10-11).

Consumers' subjective and objective knowledge of GM food may also be influenced by external factors such as labelling regulation of GM ingredients. External influencing factors are affected by internal factors, thus influence consumers' need recognition, pre-purchase information search, evaluation of alternatives and purchasing decisions. A social cognitive theory addresses the external influences as environmental influences that affect consumers' awareness and need recognition for a product, and their understanding and utilisation of a product. Such factors include the firm's marketing efforts and the consumer's subcultural environment, which includes family, informal sources, other non-commercial sources, social class, subculture and culture (Oppong, 2014:113; Ungerer, 2014:413-414). External factors can alter consumers' pre-purchase decision-making processes as well as their subjective and objective knowledge of GM food (House *et al.*, 2004:114; Rahbar, 2010:256). For the purpose of this literature study, the focus will be on the external factor product labelling as an information source. Labelling regulations and consumers' subjective and objective knowledge may influence or be influenced by their own utilisation practices of GM food.

2.6 The knowledge function

Knowledge is an important consumer behaviour construct that increases when consumers gain experience. Knowledge is guided by cognitive frameworks, which enables consumers to recognise a problem and act on a stimulus (Baron & Branscombe, 2012:44; Solomon, 2013:154). When acting on a stimulus, consumers start to collect information in order to fulfil the stimulus. If the decision is based on factual information (objective knowledge), an informed decision can be made (Dellaert & Häubl, 2012:277; Donoghue *et al.,* 2016:387; Lee & Lee,

2009:138), otherwise the decision might be based on their perception of their knowledge (subjective knowledge), which may not be based on facts.

When it comes to knowledge, consumers might be overconfident and think they know more than they actually do (Alba & Hutchinson, 2000:123). Many studies have been conducted about the impact of consumers' knowledge on their decision making (Alba & Hutchinson, 2000; Brucks, 1985; Dodd *et al.,* 2005; Donoghue *et al.,* 2016; Flynn & Goldsmith, 1999; House *et al.*, 2004; Lee & Lee, 2009). For instance, two major approaches to measure product familiarity are to test what consumers know (objective knowledge) and what they think they know (subjective knowledge) about the product (House *et al.*, 2004:114). An important factor that has to be kept in mind when researching consumer knowledge is the calibration of knowledge, which is the agreement between consumers' objective (including consumption knowledge) and subjective assessment of the validity of information used in decision making. An assessment of this calibration would show the difference between subjective and objective knowledge (Alba & Hutchinson, 2000:123). Although various disciplines use different terminology and distinguish between many types of knowledge, this specific study includes subjective, objective (also declarative) and procedural (consumption) knowledge (Figure 2.2).

It is not yet known if there are associations between consumers' subjective knowledge (what consumers think they know, or their perception of their knowledge) and objective knowledge (factual knowledge) of GM food and how it influences consumers purchasing behaviour. How consumers perceive new knowledge of a food products such as GM food will affect their purchasing decisions, as they can perceive the information positively or negatively. In addition, when consumers think they know much about GM food, and they have factual knowledge of GM food, it may affect how they perceive new information about GM food (House *et al.*, 2004:114). Consumers are also more likely to eliminate alternatives they believe to be inferior to what they already know (Brucks, 1985:3; House *et al.*, 2004:114).

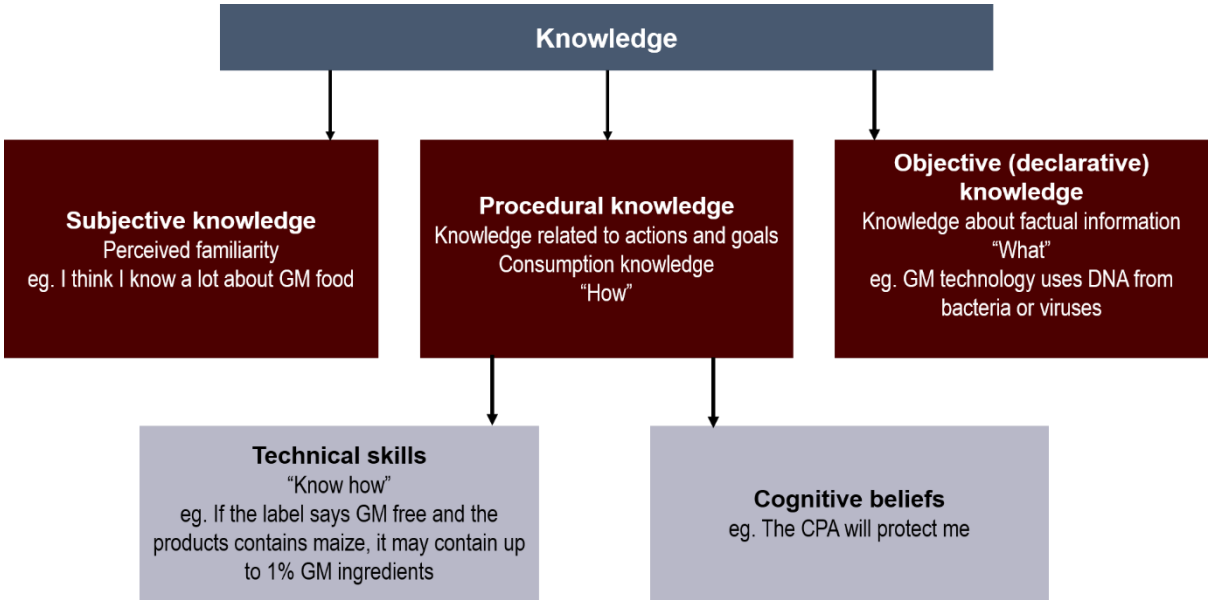


Figure 2.2 Schematic representation of knowledge in this study

Consumers' consumption knowledge depends on their past experiences, which influence their subjective and objective knowledge (Brucks, 1985:3) of GM food and can be explored alongside objective knowledge. Objective knowledge is based on expert information about a topic and should be investigated to understand what information consumers use to make purchasing decisions (Ladwig *et al*., 2012:2; Pouliot & Godbout, 2014:833).

Studies have shown that subjective and objective knowledge are two different constructs with their own unique measuring techniques and varying correlations (Brucks, 1985:2; House *et al.,* 2004:114; Lee & Lee, 2009:142), yet both types of knowledge should be explored in order to obtain a clear understanding of the role of knowledge in consumer behaviour (Flynn & Goldsmith, 1999:58). Consumers' subjective knowledge is usually measured through a self-evaluation scale, where a respondent assesses how much they know about a topic. A standardised objective knowledge scale cannot be formulated as it has to be developed according to the specific investigating domain (Flynn & Goldsmith, 1999:59). Researchers should also have expert knowledge about the researched topic when exploring consumers' objective knowledge, as factual questions should be asked (Donoghue *et al.,* 2016:388).

Consumption knowledge is related to consumers' actions and goals (e.g. knowledge of "how") (Melbye *et al.,* 2016:419; Su *et al.,* 2016:50). In this study the consumption knowledge would pertain to food items that contain GM ingredients. The technical skills influencing consumers' consumption knowledge is the "know how" skills, which indicate the consumers' ability to know and implement the GM ingredient labelling regulations to make an informed decision. The

cognitive beliefs influencing consumers' consumption knowledge include the belief that the CPA will protect them against unfair and misleading practices (Sternberg, 2006:229).

2.7 Food label information as an external factor of decision making

A main function of food labelling is to communicate product information to consumers to help them make informed decisions (Mackinson *et al.,* 2010:210). From a marketing perspective, providing the needed label information can also assist in selling the food product (Cheftel, 2005:531). Inaccurate label information can lead to confusion (Block & Peracchio, 2006:189; Gorton *et al.,* 2008:1364), and may prevent consumers from making informed choices (Hess *et al.,* 2011:413; Van der Merwe *et al.,* 2012:403). Consumers also need adequate, factual knowledge to be able to interpret food label information (Gorton *et al.,* 2008:1364; Van der Merwe *et al.,* 2012:403).

Food labels not only provide nutritional information, but offer information regarding, for example, ingredients, technologies used to produce ingredients (such as genetic modification) and best-before dates (Gavaravarapu *et al.,* 2009:344). Basic product information such as nutrition and quality, production processes and storage instructions are important to consumers, indicating that they use this information to make informed decisions (Van der Merwe *et al.,* 2012:403). It can be concluded that some information stated on the food label influences consumers' decision making (Ali & Kapoor, 2009:724); however, consumers may not always know when food label information is incorrect or misleading. Indeed, because the labelling of GM ingredients is self-regulating (Viljoen & Marx, 2013:388), consumers should know how to interpret the given information to make informed purchasing decisions of GM foods.

2.8 Genetic modification technology

Genetic modification is the alteration of a gene in an animal, bacterium or plant for the purpose of changing a specific characteristic (Okigbo *et al.*, 2011:30), also known as genetic engineering. A gene is a unit of heredity that encodes for expression of a specific protein in an organism. Proteins are the functional units of life that determine the cellular structure and functions (McWilliams, 2012:11). Gene modification is mainly used in plants, especially maize, soy beans and cotton. The first generation of GM foods were developed during the early 1990's to assist farmers during the crop production process, reduce the negative impact of pests, adverse weather conditions and weeds on crop yields, and reduce the need for

fertilisers and chemicals (Ison & Kontoleon, 2014:28; Klerck & Sweeney, 2007:172). Thus far, farmers and manufacturers has benefitted from scientifically improved gene modification technology, as these crops require lower production costs and less labour (Klerck & Sweeney, 2007:172).

Primary traits used in genetic modification in South Africa are herbicide tolerance and insect resistance. Approximately 100% of the commercially grown GM crops of cotton, 77% maize and 85% soybean is genetically modified (James, 2011:130). Herbicide-tolerant GM crops are, as the name suggests, tolerant of certain herbicides used for controlling weeds during the cropping season. GM insect resistant crops resist damage caused by various insects (Viljoen *et al.,* 2006:73). South Africa was the first African country to produce herbicide-tolerant Bt cotton and soybeans, and Bt cotton and maize (Shankar & Thirtle, 2005:99), which to date is still produced.

The use of herbicides and insecticides may differ among states, as not all countries have the same pests, leading to differences in GM food regulations. Countries such as the USA are supportive of GM food and technology because they help ensure food security, whereas some regions in the EU are opposed to the use of such technology in foods because they perceive that GM consumption has negative environmental effects (Boccaletti *et al.,* 2017:3; Eriksson *et al.,* 2017:52). BRICS countries such as South Africa are largely supportive of GM technology as it ensures food security (Brown, 2015:15; James, 2012:3; Mondello, 2013:4589) and helps to strengthen the economy.

2.8.1 Food security

Food security is a complex construct as it includes food availability, accessibility and utilisation throughout the year (UNDP, 2012:9). However, it can be defined as the availability of enough food, whether it is in a community, household, nationally or globally. It largely depends on the economic, social and physical access to safe, nutritious and sufficient food at all times to meet the food and dietary preferences of consumers to help them lead a healthy and active lifestyle (SADoA, 2002:15). National food authorities thus use food security to measure the extent to which a country has the capacity to produce food for its consumers on demand. The availability of food, whether self-production or at markets, enhances the accessibility to food, improving food security (Renzaho & Mellor, 2010:4). However, food availability does not ensure access to food, and enough calories do not ensure a healthy diet (Pinstrup-Anderson, 2009:5). Self-production of fresh produce enhances consumers' food security and accessibility, as the

availability of natural resources such as water, soil and land (FAO, 2011:15; UNDP, 2012:25; Botha & Viljoen, 2008:92) will not limit the availability of their own fresh produce.

As stated above, genetic modification of crops was originally developed to provide these crops with specific beneficial traits that resist certain biotic stresses, thereby ensuring high yields and, subsequently, some measure of food security. The cultivation of GM crops therefore allows countries to produce sufficient food to meet the need of growing populations (Godfray *et al.,* 2010:815). Maize, for instance, provides 30% of the food calories to 4.5 billion consumers in 94 countries with emerging economies. Of this percentage, 900 million consumers living in poverty prefer maize, rice and wheat as staple foods (Shiferaw *et al.,* 2011:307). The worldwide maize production is estimated to double between 2009 and 2050 – not because of a growing world population, but because of its demand as livestock feed (Botha & Viljoen, 2008:1060). The increased demand for maize has caused price increases, which will impose hardships in poor communities (Botha & Viljoen, 2008:1060), already seen in the price increase between 2008 and 2017. The domestic production of maize will therefore place a political burden on emerging economies (Shiferaw *et al.,* 2011:308).

2.8.2 GM crops used in South African food products

GM crops are currently the largest source of food in the world, and plants comprise the largest source of GM food (WHO, 2016). South Africa's legal commercially produced GM crops are soybeans, cotton and maize (Botha & Viljoen, 2008:1060; Vermeulen *et al*., 2005:119; Viljoen *et al*., 2006:73). In 2006, South Africa was ranked as the eighth highest country globally in terms of output of biotechnologically produced food (James, 2006:4). South Africa was the leader in GM food exports in Africa in 2013 (Lim Tung, 2013:2). White maize is consumed as a staple food by the majority of South African consumers, and soybean is used extensively in processed food. Many processed or packaged foods contains soy protein or maize flour (Botha & Viljoen, 2008:1060-1062), and therefore contains GM ingredients.

In South Africa, GM ingredients are labelled in the 'ingredient' section of the food label. If a food product contains GM maize or soy, it will be indicated by the use of (*) after the name of the GM ingredient. This indicator will be displayed at the end of the ingredients, together with the statement 'genetically modified'. Examples of GM-containing product labels in South Africa are presented in Figure 2.3. Figure 2.4 presents an example of a non-GM ingredient food product label. An example of a non-GMO and GMO-free food product label, which is placed in the front of the food packaging (FOP), is presented in Figure 2.5. The non-GMO label indicates that the food product may contain, for example, maize and/or soy ingredients that

have/has not been genetically modified. The GMO-free label indicates that the food product contains ingredients (for example, GM maize and/or soy) that comprise less than 1% of the food product.

Ingredients: Maize*, whole oat meal (gluten), sugar, pea protein, maize fibre*, salt, colourants.

*Contains genetically modified organisms (GMO).

Ingredients: Maize, whole oat meal (gluten), sugar, pea protein, maize fibre, salt, colourants.

THIS PRODUCT MAY CONTAIN GENETICALLY MODIFIED ORGANISMS (GMO).

Figure 2.3 Example labels of food products containing GM maize

Ingredients: Maize*, whole oat meal (gluten), sugar, pea protein, maize fibre*, salt, colourants.

*Not produced using genetically modified organisms (GMO).

Figure 2.4 Example label of a food product containing non-GM maize

Figure 2.5 Example of a non-GMO and GMO-free FOP food label

2.8.3 Other countries' GM food usage and regulations

Countries in the EU and other major agri-food importing countries such as Japan have restricted GMO regulations, while major agri-food exporters such as Argentina, Ukraine, Canada and Brazil have more lenient regulations, owing to the comparative advantage in agricultural product productions. Significant differences between GMO adopting and non-adopting countries are demonstrated by the USA and the EU respectively (Vigani & Olper, 2013:2). Table 2.2 provides data on the global area of biomechanically modified crops grown

in 2012 in each country. More recent studies still use this data (Brookes & Barfoot, 2016), indicating that such data has not changed, or that there has not yet been an update on this information.

Table 2.2 Global area of Biotech crops in 2012: by country (Million Hectares)* (James, 2012:3)

Rank	Country	Area (million hectares)	Biotech Crops
1	USA**	69.5	Maize, soybean, cotton, canola, sugar beet, alfalfa, papaya, squash
2	Brazil**	36.6	Soybean, maize, cotton
3	Argentina**	23.9	Soybean, maize, cotton
4	Canada**	11.6	Canola, maize, soybean, sugar beet
5	India**	10.8	Cotton
6	China**	4.0	Cotton, papaya, poplar, tomato, sweet pepper
7	Paraguay**	3.4	Soybean, maize, cotton
8	**South Africa****	**2.9**	**Maize, soybean, cotton**
9	Pakistan**	2.8	Cotton
10	Uruguay**	1.4	Soybean, maize
11	Bolivia**	1.0	Soybean
12	Philippines**	0.8	Maize
13	Australia**	0.7	Cotton, canola
14	Burkina Faso**	0.3	Cotton
15	Myanmar**	0.3	Cotton
16	Mexico**	0.2	Cotton, soybean
17	Spain**	0.1	Maize

* Rounded off to the nearest hundred thousand.

** 18 biotech mega-countries growing 50,000 hectares or more of biotech crops.

European Union

GMOs in the market are governed by EU legislation, and use of GM technology has to meet the national legislation requirements (Custers *et al.,* 2016:284). For example, GM maize cultivation has been approved, although only five countries in the EU (Czech Republic, Portugal, Spain, Slovakia and Romania) out of 27 produce GM maize (James 2012:3) (Table 2.2). Countries within the EU tend to be heterogeneous concerning GM food. Italy and Austria are part of the GMO-free Regions Network, while Spain and Germany are more receptive towards GMO products and have less restrictive GMO regulations (Vigani & Olper, 2013:9). EU legislations of GM technology aim to protect human health as well as the environment. Without clear indications of the long-term effects of GMOs in humans, the majority of EU countries oppose the use of GM ingredients (Boccaletti *et al.,* 2017:3; Eriksson *et al.,* 2017:52). In 2013, Monsanto suspended their quest for GM crop approval in the EU owing to consumers being anti-GM and campaigning against the use of GM crops. Consequently, EU farmers could

no longer address global food security, which had an impact on their economies as they could only plant conventional crops (Cressey, 2013:387).

United States of America

USA consumers tend to be more accepting towards GM food than EU consumers, and their objective knowledge of GM food is higher than that of UK consumers (Gaskell *et al.,* 1999:386). Indeed, the USA is the most GM-friendly country in the world at this time, with a 40% world rate of GM-crop production. GMOs are present in 80% of Americas' processed food (Lu *et al*., 2016:153). As indicated in Table 2.2, the USA is the frontrunner in biotechnologically modified crop production, with both the largest area of crop production and the largest amount of GM food products (James, 2012:3). The USA produces GM maize, soybean, cotton, canola, sugar beet, alfalfa, papaya and squash over an area of 69.5 million hectares. About 93% of USA soybean, sugar beets and cotton are genetically modified (Brown, 2015:15).

BRICS economies

Table 2.2 indicates that Brazil is the second-highest producer globally of biotechnologically modified crops, while Russia has implemented GM regulations, including mandatory labelling of GM ingredients (Sheldon, 2001:14). India is, as shown in Table 2.2, the fifth-highest ranked biotechnologically modified crop producer globally, specialising in GM cotton, and China is ranked sixth highest (James, 2012:3). Although China is one of the top countries in terms of rice consumption, GM rice is not currently commercially produced because of consumers' reluctance towards GM food (Delwaide *et al.,* 2015:2). Lastly, South Africa specialises in GM maize, soybean and cotton production (Table 2.2), and is still ranked eighth in the world.

2.8.4 Consumers' acceptance of GM technology

Consumers tend to be concerned about GM technology as they feel that scientists are treading on dangerous grounds when altering an organism's DNA as this phenomenon does not occur naturally (Brown, 2015:15). According to the Food and Drug Administration (FDA), however, all GM food are as safe as other products on the shelf. The FDA also blames consumers' fear of the unknown and the complexity of genetic modification technology for the lack of understanding of the purpose of GM technology among consumers (Parker & Pace,

2017:193). Indeed, the rejection of GM food products can be due to negative opinions and a lack of knowledge about GM food, and a food product containing GM carries the risk of being rejected by consumers (Domingo & Bordonaba, 2011:734) owing to a lack of factual knowledge. Although GM technology holds benefits for food safety and security, consumers tend to base their decisions on latent risks that are relevant to themselves. When consumers are not aware of the presence of GMOs in their everyday food products, it creates an element of shock when they do become aware of it (Lu *et al.,* 2016:153).

For instance, owing to the predominantly anti-GM attitude of consumers in the EU, only 27% of EU consumers supported the use of GM food in 2005. These consumers stated that GM food is risky, not morally accepted and not useful. Since 2005, this notion has gained popularity, and the majority of participants in one study undertaken in 2010 disagreed that GM food should be encouraged and developed (Eurobarometer, 2010:10). In contrast, however, other studies have shown that EU consumers are willing to support GM food if it was both environmentally friendly and cheaper than other crops (Knight *et al.,* 2007:508). In Switzerland, one study has shown that consumers treat GM food the same as any novel food (Aerni *et al.,* 2011:387).

In a study in the USA, it was found that consumers believe that GM ingredients should be labelled, although most of them do not search for GM ingredients on a food label (Hallman *et al.,* 2003:16). A follow-up study in 2013 found that consumers in the USA still do not know enough about GM food, and although they read food labels, they do not necessarily search for GM information. However, when they were asked if they would want GM information on food labels, they reported that they feel it is important to label GM ingredients, which may indicate that they want the option to make informed decisions by themselves. It was concluded that USA consumers are not conscious about GM labelling (Hallman *et al.,* 2013:4-5) even though they seem to be educated on GM food technology (Aleksejeva, 2014:500; Van der Werff, 2014:24) and are supportive thereof.

2.8.5 GM labelling regulations

In South Africa, mandatory GM ingredient labelling regulations have been implemented (Botha & Viljoen, 2008:1060), but in 2012, a study found that not all GM soy and maize ingredients used in processed foods were labelled according to standard CPA regulations (Viljoen & Marx, 2013:390). Currently, it is not known how much consumers know about GM food labelling requirements and how mandatory GM labelling functions in South Africa, as the food-industry is self-regulating (Viljoen & Marx, 2013:388). GM-containing food products are not

distinguishable from GM-free food and uninformed consumers may not be able to determine whether GM ingredients are labelled correctly, even though the labelling of GM ingredients could contribute to consumer awareness and knowledge of GM technology.

There have been arguments against mandatory GM labelling. Firstly, it has been thought that it would be negatively perceived as consumers do not have sufficient knowledge of GM food. This assumption was found to be incorrect, however, as it suggests that acceptance and ignorance are synonymous with one another (Botha & Viljoen, 2008:1060). Secondly, mandatory labelling was seen as not being feasible for less affluent consumers, as the industry thought that the costs of food would rise when GM food is labelled. However, additives, preservatives, allergens, health risks, Halal, Kosher, and so forth are labelled free of cost (Cheftel, 2005:531). Thirdly, voluntary labelling rather than mandatory labelling was argued to provide discerning consumers a choice without influencing non-discerning consumers with extra costs. However, voluntary labelling is not regulated and may result in consumers being misled with false or untrue information (Botha & Viljoen, 2008:1060) such as a GM-free label on products that do not contain soy or maize. In conclusion, consumers' knowledge and ability to implement information about mandatory GM ingredient labelling might influence their acceptance of GM food.

2.9 Knowledge of GM food

Since GM food has been present for more than 20 years (Monsanto, 2015) without appropriate and correct labelling regulations (Viljoen & Marx, 2013:390), consumers may have been eating GM food for a long time without knowing it. As consumers' subjective and objective knowledge of GM food might have an impact on their acceptance of the product, their knowledge might influence their perception of GM food, which would determine their behaviour towards GM food (Ison & Kontoleon, 2014:28). However, little research on consumers' knowledge of GM food has been done (Delwaide *et al.*, 2015:3), let alone any that distinguishes between subjective, objective and consumption knowledge of GM food.

One of the few sources of information is provided by the Council of Biotechnology Information (CBI), an American information organisation backed by several biotechnology companies whose mission is to improve consumers' knowledge, understanding and acceptance of biotechnology (especially GM food) by collecting credible and balanced scientific information about biotechnology and communicating it to consumers through a variety of channels (CBI, 2016). In 2009, it was found that South African consumers are not aware of GM food, despite prolific GM crop production and their use of GM food (Botha & Viljoen, 2008:1060; James,

2006; Peter & Karodia, 2014:265). Yet some food products are still labelled as GM-containing or not containing, despite the lack of knowledge among consumers (Viljoen *et al.,* 2006:75). It is not clear if South African consumers have become more aware of GM technology. The latest relevant study found that consumers in the Chris Hani District Municipality, Eastern Cape's tended to be unsupportive of GM food unless it was cheaper or better tasting (Peter & Karodia, 2014:290), thus confirming that choices are based on simplifying strategies rather than on GM knowledge. Furthermore, the CPA (68 of 2008) requires that GM ingredients in packaged food should be labelled, although it is not known if mandatory GM labelling has had any effect on South African consumers' awareness or knowledge of GM food (Botha & Viljoen, 2008:1060). Finally, it would be relevant to investigate if the demographics of South African consumers have associations with subjective and objective knowledge of GM food, owing to the diversity of the South African population.

2.10 Influence of consumers' demographic information on their knowledge of GM food

Consumers' subjective and objective knowledge of GM food may differ according to their demographic profiles (House *et al.,* 2004:118), which would indicate that different aspects of consumers' demographics may have an influence on their knowledge. Consumers' demographics refer to different characteristics that comprise a demographic profile. These aspects include, among others, gender, age, household size, education, income, culture, religion, ethnicity and marital status (McLean-Meyinsse, 2001:111). Previous studies have shown that consumers with higher levels of objective knowledge of GM food tend to be those with higher income and higher education levels (House *et al.,* 2004:118), indicating that socio-demographic aspects similar to those to be determined in this study need to be further analysed in a cross-sectional study (Costa-Font *et al.,* 2008:107), especially regarding consumers' knowledge of GM food. Thus in this study it was important to investigate South African consumers' demographic information in association with their knowledge of GM food, as this is an area that remains unexplored. As such, specific demographic characteristics studied in previous studies are discussed below.

Contradictory findings have been found in previous studies exploring associations between consumers' **gender** and their knowledge of GM food. For instance, while no associations for gender and GM food was found by House *et al.* (2004:118) and Lu *et al.* (2016:156), Chinese female consumers have been shown to have higher levels of objective knowledge of GM food according to De Steur *et al.* (2010:121). Moreover, USA and Chinese female consumers were

less likely to accept GM foods (De Steur *et al.,* 2010:121; Hallman *et al.,* 2003:16; Siegrist *et al.*, 2000:197). Other studies have found that middle-aged females are more concerned with GM technology than other categories (Siegrist *et al.*, 2000:197), and consumers over the age of 50 was pro-GM (De Steur *et al.,* 2010:121). However, USA consumers over 64 were less likely to approve of GM food (Hallman *et al.,* 2003:16). **Age** is thus one of the socio-demographic aspects that needs further research (Costa-Font *et al.,* 2008:107), especially to determine its associations on consumers' knowledge of GM food.

Consumers with lower education levels have shown to have a lower subjective and objective knowledge of GM food when compared to consumers with higher **education** levels (House *et al.,* 2004:118). In earlier studies, USA, EU and Chinese consumers with higher education had higher levels of objective knowledge of GM food and were more willing to accept GM food (De Steur *et al.,* 2010:121; Hallman *et al.,* 2003:16). Furthermore, Chinese consumers with a higher **income** had higher levels of objective knowledge of GM food than consumers in other income categories (De Steur *et al.,* 2010:121). Consumers with higher income also paid more attention to the product label (Cowburn & Stockley, 2005:24), while price-sensitive consumers were found to pay less attention to product label information during food purchases (Gracia *et al.,* 2007:171), implicating that price will have an important role in purchasing decisions. In addition, consumer knowledge was found to be a multi-dimensional construct among various **cultures** (Guo & Meng, 2008:261), while consumers who resided in **urban** areas in China showed to have higher levels of subjective knowledge about GM food, which might be due to raised levels of awareness of this technology in these areas (De Steur *et al.,* 2010:121).

2.11 Conclusion

Not all South African consumers are socialised regarding their rights as consumers, and there is a definite need for consumer education in order to enable them to make informed decisions based on objective knowledge, which in turn would give them better access to their right to choose in the marketplace. Consumers also need trustworthy and truthful information about the contents of the food they purchase. In order for them to make informed purchasing decisions, information such as 'genetically modified' should be labelled on all food products using more than 1% of genetic modification. As yet, because consumers' subjective and objective knowledge on a topic such as GM foods may differ and may not be factually correct, consumers may be deprived of their right to make informed decisions. Therefore, it is vital that such information be provided on food labels, assisting consumers in their attempts to obtain knowledge.

Genetic modification is currently used in BRICS economies, including South Africa, to ensure food security and increase food exports, which will enhance these countries' economies. South African consumers' knowledge of GM technology should thus be explored in order to investigate whether they know what the purpose of GM technology is, and if they are aware of the presence of GM ingredients in most of South Africa's food products. By exploring their knowledge of the presence of GM technology in food products, this study will be able to determine whether these consumers are capable of making informed decisions when purchasing food products. In addition, because South Africa is characterised by numerous cultures and varied demographics, it is necessary to explore if there are associations between consumers' demographic characteristics and their knowledge of GM food. Doing so will assist future studies to determine which consumers are in need of education about GM food and their consumer rights. An attempt should be made to improve not only consumers' subjective knowledge about GM food, but also their objective knowledge about GM food, specifically that which has an impact on their daily lives for the benefit of the consumer, the industry and consumer research.

2.12 References

Aerni, P., Scholderer, J. & Ermen, J. 2011. How would Swiss consumers decide if they had freedom of choice? Evidence from a field study with organic, conventional and GM corn bread. *Food policy*, 36(6):830-838.

Alba, J. & Hutchinson, J.W. 2000. Knowledge calibration: what consumers know and what they think they know. *Journal of consumer research*, 27(2):123-156.

Ali, J. & Kapoor, S. 2009. Understanding consumers' perspectives on food labelling in India. *International journal of consumer studies*, 33(6):724-734.

Anon. 2011. Poverty and inequality in South Africa. *Mail & guardian*, 16 Sep. http://mg.co.za/article/2011-09-16-poverty-and-inequality-in-south-africa/ Date of access: 12 Feb. 2017.

Appiah-Adu, K. 1998. Marketing in emerging countries: evidence from a liberalized economy. *Journal of marketing practice: applied marketing science*, 4(4):118-129.

Baron, R.A. & Branscombe, N.R. 2012. Social psychology. 13th ed. Upper Saddle River, NJ: Pearson.

Barreiro-Hurlé, J., Gracia, A. & De Magistris, T. 2008. Using latent classes to determine consumer heterogeneity in nutrition label valuation. *Food economics-acta agriculturae Scandinavica, Section C,* 5(3-4):178-193.

Block, L.G. & Peracchio, L.A. 2006. The calcium quandary: how consumers use nutrition labels. *Journal of public policy and marketing*, 25(2):188-196.

Boccaletti, S., Passuello, F. & Soregaroli, C. 2017. Segregation between GM and non-GM inputs in EU feed and food supply chains: future scenarios. *AgBioForum*, 20(1):1-13.

Botha, G.M. & Viljoen, C.D. 2008. South Africa: a case study for voluntary GM labelling. *Food chemistry,* 112(4):1060-1064.

Brookes, G. & Barfoot, P. 2016. Global income and production impacts of using GM crop technology 1996–2014. *GM crops and food,* 7(1):38-77.

Brown, A. 2015. Understanding food principles and preparations. 5th ed. Stamford, CT: Cengage Learning.

Brucks, M. 1985. The effects of product class knowledge on information search behavior. *Journal of consumer research*, 12(1):1-16.

Business Tech. 2017. It's official: national minimum wage set at R3,500 per month. https://businesstech.co.za/news/finance/1561/its-official-national-minimum-wage-set-at-r3500-per-month/ Date of access:8 Nov. 2017.

Cant, M.C., Brink, A. & Brijball, S. 2006. Consumer behaviour. Cape Town: Juta.

Carlson, J.P., Vincent, L.H., Hardesty, D.M. & Bearden, W.O. 2008. Objective and subjective knowledge relationships: a quantitative analysis of consumer research findings. *Journal of consumer research*, 35(5):864–876.

CBI (Council for Biotechnology Information). 2016. Council of Biotechnology. http://www.whybiotech.com Date of access: 28 Sep. 2016.

Cheftel, J.C. 2005. Food and nutrition labelling in the European Union. *Food chemistry*, 93(3):531–550.

Costa-Font, M., Gil, J.M. & Traill, W.B. 2008. Consumer acceptance, valuation of and attitudes towards genetically modified food: review and implications for food policy. *Food policy,* 33(2):99-111.

Cowburn, G. & Stockley, L. 2005. Consumer understanding and use of nutrition labelling: a systematic review. *Public health nutrition*, 8(1):21-28.

Cressey, D. 2013. Monsanto drops GM in Europe. *Nature,* 499(1):382-514.

Custers, R., Bartsch, D., Fladung, M., Nilsson, O., Pilate, G., Sweet, J. & Boerjan, W. 2016. EU regulations impede market introduction of GM forest trees. *Trends in plant science,* 21(4):283-285.

Darley, W.K. & Johnson, D.M. 1993. Cross-national comparison of consumer attitudes towards consumerism in four developing countries. *Journal of consumer affairs,* 27(1):37-54.

De Steur, H., Gellynck, X., Storozhenko, S., Liqun, G., Lambert, W., Van Der Straeten, D. & Viaene, J. 20010 Willingness-to-accept and purchase genetically modified rice with high folate content in Shanxi Province, China. *Appetite,* 54(1):118-125.

Dellaert, B.G.C. & Häubl, G. 2012. Searching in choice mode: consumer decision processes in product search with recommendations. *Journal of marketing research,* 49(2):277-288.

Delwaide, A., Nalley, L.L., Dixon, B.L., Danforth, D.M., Rodolfo, M.N.J., Van Loo, E.J. & Verbeke, W. 2015. Revisiting GMOs: are there differences in European consumers' acceptance and valuation for cisgenically vs transgenically bred rice? *PloS one*, 10(5):e0126060. http://journals.plos.org /plosone/article?id=10.1371/journal.pone.0126060 Date of access: 12 Feb. 2017.

Dodd, T.H., Laverie, D.A., Wilcox, J.F. & Duhan, D.F. 2005. Differential effects of experience, subjective knowledge and objective knowledge on sources of information used in consumer wine purchasing. *Journal of hospitality and tourism research*, 29(1):3-19.

Domingo, J.L. & Bordonaba, J.G. 2011. A literature review on the safety assessment of genetically modified plants. *Environmental international,* 37(4):734-742.

Donoghue, S. & De Klerk, H.M. 2009. The right to be heard and to be understood: a conceptual framework for consumer protection in emerging economies. *Journal of consumer studies,* 33(4):456-467.

Donoghue, S. & De Klerk, H.M. 2013. Consumers' anger and coping strategies following appraisals of appliance failure. http://www.repository.up.ac.za/dspace/bitstream/handle/2263/21996/Donoghue_Consumers(2013).pdf?sequence=1 Date of access: 21 Sep. 2016.

Donoghue, S., Van Oordt, C. & Strydom, N. 2016 Consumers' subjective and objective consumerism knowledge and subsequent complaint behaviour concerning consumer electronics: a South African perspective. *International journal of consumer studies,* 40(4):385-399.

Du Plessis, F. 2007. Introduction and overview. (*In* Du Plessis, P.J. & Rousseau, G.G., *eds.* Buyer behaviour: understanding consumer psychology and marketing. Cape Town: Oxford Southern Africa. p. 3-15).

Erasmus, A.C. 2013. Consumerism and consumers as citizens . (*In* Mpinganjira, M., Dos Santos, M.A.O., Botha, E., Du Toit, D., Erasmus, A.C., Maree, T. & Mugobo, V.V., *eds.* Consumer behaviour: South African psychology and marketing applications. Cape Town: Oxford University Press. p. 353-381).

Eriksson, M., Ghosh, R., Hansson, E., Basnet, S. & Lagerkvist, C. 2017. Environmental consequences of introducing genetically modified soy feed in Sweden. *Journal of cleaner production*, 176(2018):46-53.

Eurobarometer. 2010. Special Eurobarometer biotechnology report. http://ec.europa.eu /public_opinion/archives/ebs/ebs_341_en.pdf Date of access: 29 Aug. 2015.

Fan, Y. 2008. The rise of emerging market multi-dimensional and the impact on marketing. *Marketing intelligence & planning*, 26(4):353-358.

FAO (Food and Agriculture Organization of the United Nations). 2011. Module 8: processing and preservation, 2011. http://www.fao-ilo.org/fileadmin/user_upload/fao_ilo/pdf/ JFFLSmodule_8_L02.pdf Date of access: 24 Oct. 2017.

Flynn, L.R. & Goldsmith, R.E. 1999. A short, reliable measure of subjective knowledge. *Journal of business research*, 46(1):57-66.

Gaskell, G., Bauer, M.W., Durant, J. & Allum, C.A. 1999. Worlds apart? The reception of genetically modified foods in Europe and the U.S. *Science,* 285(5426):384-387.

Gavaravarapu, S.R.M., Vemula, S.R., Rao, P., Mendu, V.V.R. & Polasa, K. 2009. Focus group studies on food safety knowledge, perceptions, and practices of school-going adolescent girls in South India. *Journal of nutrition education and behavior*, 41(5):340-346.

Gibson, C. & Hull, G. 2013. Everyone's guide to the Consumer Protection Act. Cape Town: Zebra Press.

Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M. & Toulmin, C. 2010. Food security: the challenge of feeding 9 billion people. *Science,* 327(1):812:818.

Gorton, D., Mhurchu, C.N., Chen, M. & Dixon, R. 2008. Nutrition labels: a survey of use, understanding and preferences among ethnically diverse shoppers in New Zealand. *Public health nutrition*, 12(9):1359-1365.

Gracia, A., Loureiro, M. & Nayga, R.M. 2007. Do consumers perceive benefits from implementation of an EU mandatory nutrition labelling program? *Food policy*, 32(2):160-174.

Guo, L. & Meng, X. 2008. Consumer knowledge and its consequences: an international comparison. *International journal of consumer studies*, 32(3):260-268.

Hallman, W.K., Hebden, W.C., Aquino, H.L., Cuite, C.L. & Lang, J.T. 2003. Public perceptions of genetically modified foods: a national study of American knowledge and opinion. (Publication number RR1003-004). New Brunswick, NJ: Food Policy Institute, Cook College, Rutgers - The State University of New Jersey.

Hallman, W.L., Cuite, C.L. & Morin, X.K. 2013. Public perceptions of labeling genetically modified foods. http://s3.amazonaws.com/academia.edu.documents/39509254/Public_Perceptions_of_Labeling_Genetical20151028-15870-duwl33.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1492605841&Signature=dtkpCPPk0WjJDzmC1xh8V%2B2wWcY%3D&response-content-disposition=inline%3B%20filename%3DPublic_perceptions_of_labeling_genetical.pdf Date of access: 19 Apr. 2017.

Hess, R., Visschers, V.H.M. & Siegrist, M. 2011. The role of health-related, motivational and sociodemographic aspects in predicting food label use: a comprehensive study. *Public health and nutrition,* 15(3):407-414.

House, L., Lusk, J., Jaeger, S., Traill, W.B., Moore, M., Valli, C., Morrow, B. & Yee, W.M.S. 2004. Objective and subjective knowledge: impacts on consumer demand for genetically modified foods in the United States and the European Union. *The journal of agrobiotechnology management & economics*, 7(3):113-123.

Hoyer, W.D. & MacInnis, D.J. 2010. Consumer behavior. 5th ed. Mason, OH: South-Western Cengage Learning.

Ismail, Z., Mkhwanazi, S. & Silberman, K. 2017. Consumer expenditure trends. https://abrbuzz.co.za/publications/press-and-customers/stdbank/971-Standard%20Bank_Consumer%20Trends%20-%20ExpenditureTrends%20-%2019%20May%202016.pdf Date of access: 16 Nov. 2017.

Ison, J. & Kontoleon, A. 2014. Consumer preferences for functional GM foods in the UK: a choice experiment. *Journal of agrobiotechnology management and economics*, 17(1):28-36.

James, C. 2006. Global status of commercialized biotech/GM crops, 2006. (ISAAA Brief no. 35). Ithaca, NY: ISAAA.

James, C. 2011. Global status of commercialized biotech/GM Crops, 2011. (ISAAA Brief no. 43). Ithaca, NY: ISAAA.

James, C. 2012. Global status of commercialized biotech/GM Crops, 2012. (ISAAA Brief no. 44). Ithaca, NY: ISAAA.

Kamndaya, M., Vearey, J., Thomas, L., Kabiru, C.W. & Kazembe, L.N. 2015. The role of material deprivation and consumerism in the decisions to engage in transactional sex among young people in the urban slums of Blantyre, Malawi. *Global public health,* 11(3):295-308.

Klemz, B.R., Boshoff, C. & Mazibuko, N. 2005. Emerging markets in black South African townships. *European journal of marketing,* 40(5/6):590-610.

Klerck, D. & Sweeney, J.C. 2007. The effect of knowledge types on consumer perceived risk and adoption of genetically modified foods. *Psychology & marketing*, 24(2):171-193.

Knight, J.G., Mather, D.W., Holdsworth, D.K. & Ermen, D.F. 2007. Acceptance of GM food: an experiment in six countries. *Nature biotechnology*, 25(5):507-508.

Ladwig, P., Dalrymple, K.E., Brossard, D., Scheufele, D. & Corley, E.A. 2012. Perceived familiarity or factual knowledge? Comparing operationalizations of scientific understanding. *Science and public policy*, 39(6):761-774.

Lee, J.K. & Lee, W. 2009. Country-of-origin effects on consumer product evaluation and purchase intention: the role of objective versus subjective knowledge. *Journal of international consumer marketing*, 21(2):137-151.

Lim Tung, O.J. 2013. Labelling of genetically modified food products in South Africa. Paper presented at the Environmental Law Association Conference, Salt Rock, Kwa-Zulu Natal, 27 July 2013. http://www.elasa.co.za/uploads/1/1/8/2/11823994/odile_lim_tung.pdf Date of access: 12 Feb. 2017.

Lu, L., Rahman, I. & Chi, C.G. 2016. Can knowledge and product identity shift sensory perceptions and patronage intentions? The case of genetically modified wines. *International journal of hospitality management,* 53:152-160.

Mackinson, D., Wrieden, W.L. & Anderson, A.S. 2010. Validity and reliability testing of a short questionnaire developed to assess consumers' use, understanding and perception of food labels. *European journal of clinical nutrition*, 64(2):210-217.

Mason, A.M., De Klerk, H.M., Sommervile, J. & Ashdown, S.P. 2008. Consumers knowledge on sizing and fit issues: a solution to successful apparel selection in developing countries. *International journal of consumer studies*, 32(3):276-284.

McLean-Meyinsse, P.E. 2001. An analysis of nutritional label use in the southern United States. *Journal of food distribution research*, 32(1):110-114.

McWilliams, M. 2012. Foods: experimental perspectives. 7th ed. Upper Saddle River, NJ: Pearson.

Melbye, E.L., Onozka, Y. & Hansen, H. 2016. Throwing it all away: exploring affluent consumers' attitudes toward wasting edible food. *Journal of food products marketing,* 23(4):416-429.

Molawa, S. 2009. The first and third world in Africa: knowledge access, challenges and current technological innovations. (*In* 1st International Conference on African Digital Libraries and Archives (ICADLA-I) held in Addis Ababa, Ethiopia on 1-3 July 2009. Addis Ababa. p. 1-8).

Momberg, D., Jacobs, B. & Sonnenberg, N. 2012. The role of environmental knowledge in young female consumers' evaluation and selection of apparel in South Africa. *International journal of consumer studies,* 36(4):408-415.

Mondello, L. 2013. Nutraceuticals and separations. *Analytical and bioanalytical chemistry,* 405(13):4589-4590.

Monsanto. 2015. Glyphosate and Roundup brand herbicides. http://www.monsanto.com /glyphosate/pages/default.aspx Date of access: 30 Jan. 2017.

NCPC (National Cleaner Production Centre). 2008. Cleaner production overview. http://www.ncpc.co.za/media/cpsaoverview.html Date of access: 25 Aug. 2016.

Nwaizugbo, I.C. & Ogunankwor, C.E. 2013. Measuring consumer satisfaction with consumer protection agencies-insights from complaints to CPA offices in Anambah state. *International journal of small business and entrepreneurship research,* 1(3):12-88.

Okigbo, R.N., Iwube, J.C. & Putheti, R. 2011. An extensive review on genetically modified (GM) foods for sustainable development in Africa. *e-Journal of science and technology*, 21. http://e-jst.teiath.gr Date of access: 16 Mar. 2015.

Oppong, S. 2014. Between Bandura and Giddens: structuration theory in social psychological research? *Psychological thought,* 7(2):111-123.

Parker, R. & Pace, M. 2017. Introduction to food science and food systems. 2nd ed. Boston: Cengage Learning.

Peter, L. & Karodia, A.M. 2014. An investigation into the consumer acceptance of genetically modified foods at the Chris Hani district municipality, Eastern Cape, South Africa. *Kuwait chapter of Arabian journal of business management review,* 3(11):264-296.

Pinstrup-Andersen, P. 2009. Food security: definition and measurements. *Food security,* 1(1):5-7.

Pouliot, C. & Godbout, J. 2014. Thinking outside the 'knowledge deficit' box. *Science & society*, 15(8):833-835.

Rahbar, E. 2010. Ethno-cultural differences and consumer understanding of eco-labels: an empirical study in Malaysia. *Journal of sustainable development,* 3(3):255-262.

Rajagopal, P. 2010. Consumer behavior: global shifts and local effects. New York, NY: Nova Science.

Reddy, K. & Rampersad, R. 2012. Ethical business practices: the Consumer Protection Act and socio-economic transformation in South Africa. *African journal of business management*, 6(25):7403-7413.

Renzaho, A.M.N. & Mellor, D. 2010. Food security measurement in cultural pluralism: missing the point or conceptual misunderstanding. *Nutrition,* 26(1):1-9.

Rousseau, D. 2003. Consumerism and social responsibility. (*In* Du Plessis P.J. & Rousseau, G.G., *eds*. Buyers behaviour: a multi-cultural approach. 3rd ed. Cape Town: Oxford University Press. p. 446-470).

SADoA (South Africa. Department of Agriculture). 2002. The integrated food security strategy for South Africa. Pretoria.

Scheer, D., Rubik, D.R.F. & Gold, S. 2008. Enabling developing countries to seize EcoLabel opportunities: project background paper. Heidelberg Germany. Institute for Ecological Economy research. https://www.google.co.za/?gws_rd=ssl#q=Enabling+developing+countries+to+seize+ecolabel+opportunities:+project+background+paper. Date of access: 25 Aug. 2016.

Schiffman, L.G. & Wisenblit, J. 2015. Consumer behavior. 11th ed. Essex, England: Pearson Education Limited.

Schönfeldt, H.C., Gibson N. & Vermeulen, H. 2010. The possible impact of inflation on nutritionally vulnerable households in a developing country using South Africa as a case study. *British Nutrition Foundation nutrition bulletin*, 35:254-267.

Shankar, B. & Thirtle, C. 2005. Pesticide productivity and transgenic cotton technology: the South African smallholder case. *Journal of agricultural economics*, 56(1):97-116.

Sharma, A. 2011. Role of family in consumer socialization of children: literature review. *Journal of arts, science & commerce,* 2(3):161-167.

Sheldon, I.M. 2001. Regulation of biotechnology: will we ever "freely" trade GMOs? 77th EAAE Seminar / NJF Seminar No. 325, August 17-18, 2001, Helsinki.

Shiferaw, B., Prasanna, B.M., Hellin, J. & Bänziger, M. 2011. Crops that feed the world 6. Past successes and future challenges to the role played by maize in global food security. *Food security,* 3(3):307-327.

Siegrist, M., Cvetkovich, G. & Roth, C. 2000. Salient values similarity, social trust, and risk/benefit perceptions. *Risk analysis,* 20(3):195-203.

Solomon, M.R. 2013. Consumer behavior: buying, having, and being. 10th ed. Boston: Pearson.

South Africa Info. 2011. The languages of South Africa. http://www.southafrica.info/about/people/language.htm#distribution Date of access: 1 Nov 2016.

South Africa. 2010. Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972: regulations relating to the labelling and advertising of foodstuffs. (Notice 146). (Proclamation No. R. 642). *Government gazette*, 32975, 1 Mar.

STATS SA (Statistics South Africa). 2010. Mid-year population estimates 2010 statistical release P0302. http://www.statssa.gov.za/publications/P0302/P03022010.pdf Date of access: 1 Nov. 2016.

STATS SA (Statistics South Africa). 2011. Statistical release P0302: mid-year population estimates. http://www.statssa.gov.za/publications/P0302/P03022011.pdf Date of access: 3 Nov. 2016.

STATS SA (Statistics South Africa). 2016. Statistics South Africa. http://cs2016.statssa.gov.za Date of access: 3 Nov. 2016.

Sternberg, R. 2006. Cognitive psychology. 4th ed. Belmont, CA: Thomson.

Su, Y., Zhang, X., Moore, P., Chen, J., Ma, X. & Hu, B. 2016. Declarative and procedural knowledge modeling methodology for brain cognitive function analysis. (*In* Xiang, Y., *ed.* Brain-inspired intelligent robotics: the intersection of robotics and neuroscience. Science Robotics. p. 50-53).

Tower, K.D. 1994. Consumer-centered social work practice: restoring client self-determination. *Social work,* 39(2):191-196.

UNDP (United Nations Development Programme). 2012. Africa human development report 2012: towards a food secure future. New York: United Nations Development Programme.

Ungerer, L. 2014. Consumer decision making and beyond. (*In* Schiffman, L. & Kanuk, L., *eds*. Global and Southern African perspectives: consumer behaviour. Essex, England: Pearson Education Limited. p. 404-441).

Van der Merwe, D., Bosman, M., Ellis, S., De Beer, H. & Mielmann, A. 2012. Consumers' knowledge of food label information: an exploratory investigation in Potchefstroom, South Africa. *Public health nutrition,* 16(3):403-408.

Vermeulen, H., Kirsten, J.F., Doyer, T.O. & Schönfeldt, H.C. 2005. Attitudes and acceptance of South African urban consumers towards genetically modified white maize. *Agrekon,* 44(1):118-137.

Vigani, M. & Olper, A. 2013. GMO standards, endogenous policy and the market for information. *Food policy*, 43:32-43.

Viljoen, C.D. & Marx, G.M. 2013. The implications for mandatory GM labelling under the Consumer Protection Act in South Africa. *Food control,* 31(2):387-391.

Viljoen, C.D., Dajee, B.K. & Botha, G.M. 2006. Detection of GMO in food products in South Africa: implication of GMO labelling. *African journal of biotechnology,* 5(2):73-82.

WHO (World Health Organization). 2016. Joint FAO/WHO meeting on pesticide residues: summary report, Geneva, UN, 9-13 May. http://www.who.int/foodsafety/jmprsummary 2016.pdf Date of access: 30 Mar. 2017.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides an in-depth discussion of the methodology used in this study. The discussion starts with the research design, then addresses the study population, measuring instrument, sampling, data collection and data analysis. The reliability and validity of the measuring instrument used in the study are discussed, and an overview of the relevant ethical considerations are presented at the end of the chapter.

3.2 Research design

A quantitative research approach was followed in this study to explore South African consumers' subjective and objective knowledge of GM food (Fouché *et al.,* 2011:155; Fouché & De Vos, 2011:95). **Empirical data** was gathered by using online questionnaires as the survey instrument to collect **primary, numerical data** (Maree & Pietersen, 2016a:162) for the purpose of exploring and measuring social life aspects (Blaikie, 2010:205) – here, consumers' knowledge. Survey research with questionnaires is often used in health sciences (Babbie & Mouton, 2001:239) for exploratory research (Botma *et al.,* 2010:133). A cross-sectional survey was used, which enabled the researcher to measure several variables (Maree & Pietersen, 2016a:155; Malhotra & Birks, 2007:326) from a large population that could not have been directly observed (Botma *et al.,* 2010:133) at a single point in time (Botma *et al*., 2010:111; Neuman, 2006:254). Vast populations were reached in a convenient manner and comparisons were made between these populations (Corbetta, 2003:207) in South Africa.

3.3 Study population

The target population in this study was South African consumers (Maree & Pietersen, 2016a:162). South Africa consists of rural and urban areas, the latter ranging from large cities to small towns. To be included in this study, respondents had to be South African consumers 18 years and older who are aware of GM food and have made food purchases for their household. Since online questionnaires was used for data collection, respondents had to have internet access. An internet-based consumer consultancy agency site, AskAfrika, was used to conduct data collection in order for the study to reach a broad South African consumer base.

AskAfrika has access to databases of global and international practices, where individuals take part in marketing and business-related studies. The company specialises in both qualitative and quantitative consumer and marketing research. The demographic characteristics of AskAfrika's South African database used for this study are displayed in Table 3.1.

Table 3.1 Demographic attributes of AskAfrika's South African consumer database

Descriptive	**Percentage (%)**
Gender	
Female	54
Male	46
Residency	
Gauteng	48
Western Cape	22
KZN	14
Eastern Cape	4.9
Mpumalanga	3.9.
Free State	2.6
Limpopo	2.6
North West	2.6
Age groups	
15 – 19	8
20 – 24	22
25 – 34	35
35 – 44	20
45 – 54	10
55+	5
Marital status	
Married	50
Single	39
Divorced	10
Income (per annum)	
R 39,000 or less	4
R 40,000 – R 89,999	12
R 90,000 – R 149,999	26
R 150,000 – R 250,000	35
R 250,000 – R 500,000	22

To be included in the sample, the respondents had to fit the inclusion and exclusion criteria presented in Table 3.2.

Table 3.2 Inclusion and exclusion criteria of respondents participating in the study

Inclusion criteria	**Motivation**
AskAfrika subscribers.	The questionnaire was distributed through AskAfrika, thus the individual needed to be subscribed to the company in order to participate in the study.
Residents of South Africa.	The research aimed to explore South African consumers' knowledge of GM food.
Individuals 18 years and older.	Only individuals who could legally sign consent were included.
Individuals who are able to read, write and understand English.	The questionnaire was only available in English.
Individuals who are responsible for their household's food purchases.	The questionnaire consisted of food purchasing choices, thus only individuals with experience in food purchasing were able to participate in the study.
Exclusion criteria	**Motivation**
Individuals who are not aware of GM food.	The study aimed to explore consumers' knowledge. If they were not aware of GM technology, they would not have been able to complete knowledge questions.
Individuals who do not have internet access.	The questionnaire was an electronic, internet-based questionnaire.
Individuals who are not computer or mobile device literate.	The questionnaire could be accessed through a mobile smartphone or a computer with internet access, thus participants who were not able to use a mobile phone or computer could not participate in the study.

3.4 Conceptualisation and measurement

Objective and subjective knowledge are different constructs, each with its own unique measuring techniques with broadly varying correlations (Brucks, 1985:2; House *et al.,* 2004:114; Lee & Lee, 2009:142). Both objective and subjective knowledge should be explored in order to obtain a clear understanding of the role of knowledge in consumer behaviour (Flynn & Goldsmith, 1999:58). The conceptualisation and development of the scales used to explore consumers' subjective and objective knowledge of GM food will be discussed below.

Consumers' subjective knowledge is often measured by using a self-evaluation scale, where a respondent assesses how much he or she knows about a topic. Brucks (1985) developed one of the first subjective knowledge scales using a Likert scale. Thereafter, studies adapted the scale developed by Brucks (1985), using statements and Likert scales most applicable to their research topic and study population (Brucks, 1985:1; Dodd *et al.,* 2005; Flynn & Goldsmith, 1999; House *et al.,* 2004; Lee & Lee, 2009). As such, these scales can be adapted to suit consumer behavioural studies, where consumers' subjective knowledge is explored by

means that reflect their confidence in their perceived knowledge (Donoghue *et al.,* 2016:388). In this study, consumers' subjective knowledge of the use of genetic modification in food products was explored. Subjective knowledge questions aim at examining respondents' perceived knowledge compared to the average consumer.

Because previous studies have reported difficulties in developing a standardised scale to test objective knowledge – as the scale has to be developed according to the specific investigated domain (Flynn & Goldsmith, 1999:59) – to explore objective knowledge, true or false or multiple-choice questions should be used, guided by expert knowledge of the researched topic (Dodd *et al.,* 2005; House *et al.,* 2004; Lee and Lee, 2009). As such, the objective knowledge of respondents in this study was explored by using true or false factual statements of GM food. Consumers' consumption knowledge of their GM food intake was also investigated as experience-based knowledge. The measuring instrument's design and development will be discussed in the proceeding sections.

3.4.1 Instrument development

An operationalisation table for data collection and analysis is presented in in Table 3.3. The statistical methods used for data analysis will be discussed in the data analysis subsection, and the final questionnaire is presented in Annexure A.

Section A comprised questions regarding factors such as residential area, age, household food purchases and awareness of GM food, to ensure that respondents fitted the inclusion criteria. The first question regarding respondents' residential area was a multiple-choice question, which gave ten possible options, including the nine South African provinces and a tenth "other" option. Only one option could be selected. If a respondent chose the "other" option, they indicated that they did not reside in South Africa and the questionnaire was closed. The second question was a self-completion question where respondents had to indicate the year in which they were born. The questionnaire closed if any year >1999 was submitted, as this indicated that the respondent was not 18 years or older. The third and fourth questions were "yes" and "no" questions asking if the respondents have made food purchases for their household and if they were aware of GM food. In order to be able to participate, it was compulsory to answer "yes" to both these questions.

Section B included questions exploring consumers' subjective, objective and consumption knowledge of GM food and GM technology. For subjective knowledge, a five-point Likert scale as described by Brucks (1985) and adapted by House *et al.* (2004) was used to develop a scale to explore consumers' subjective knowledge of GM food. The scale consisted of ten

statements related to GM food and GM technology. Respondents had to rate their knowledge compared to other consumers' knowledge on specific GM food topics (subjective knowledge) (Donoghue *et al.*, 2016). Questions from the Eurobarometer questionnaire (2010) were adapted for statements concerning consumers' knowledge of GM food products. Other statements were derived from literature such as Eurobarometer (2010), House *et al.* (2004), Klerck and Sweeny (2007) and Tanius and Seng (2015).

Objective knowledge was explored by means of true or false questions based on literature (House *et al*., 2004; Klerck & Sweeny, 2007; Laux *et al.,* 2010; Pew Research Center, 2015; Tanius & Seng, 2015; Thomson Reuters, 2010; and Zinoti, 2010). Respondents were also provided with an "I do not know" ("IDK") option to each statement, which allowed respondents to state when they did not know the correct answer rather than randomly choosing between only two options. Stating that they do not know the correct option was regarded as an indication that respondents do not have objective knowledge.

Respondents' consumption knowledge regarding GM food was explored by first asking whether they consume GM food, with "yes", "no" or "IDK" options. In the following question, respondents had to indicate whether or not they consume ten food items from a list. Nine of these food products contain GM ingredients. Studies conducted by Botha and Viljoen (2008), Laux *et al.* (2010), Thomson Reuters (2010) and Zinoti (2010), which explored GM food products, were used to develop this question. In addition, food labels were scrutinised to search for products containing GM ingredients and to determine whether GM ingredients were labelled to confirm the findings of the literature.

Section C comprised of questions regarding demographic characteristics including gender, level of education, home language and household income in order to compile a demographic profile of the sample. Demographics included information such as home language and household income, since literature indicated correlations between these characteristics and consumers' knowledge (Costa-Font *et al*., 2008:107; Donoghue *et al*., 2016:393; House *et al*., 2004:118; McLean-Meyinsse, 2001:111). In addition, academic journals expect a demographic profile of the study population for the publication of articles on the researched topic (Neuman, 2011:323).

Table 3.3 Instrument development operationalisation

OBJECTIVES	CONSTRUCT	SECTION	QUESTIONS	SCALE	SCALE INCREMENTS	STATISTICAL METHODS*
Objective 1 **To explore and discuss consumers' subjective knowledge of GM food.**	Subjective GM knowledge	Section B	5.1.1 – 5.1.10 (V5.1.1 – V5.1.10)	Self-designed scale based on a similar scale used by Flynn and Goldsmith (1999) and House *et al.* (2004) and literature from: Eurobarometer (2010), House *et al.* (2004), Klerck and Sweeny (2007) and Tanius and Seng (2015).	5-point Likert scale: 1=Strongly disagree 3=Neutral 5=Strongly agree.	Descriptive statistics including frequencies, means, percentages and standard deviations.
Objective 2 **To explore and discuss consumers' objective knowledge of GM food.**	Objective GM knowledge	Section B	5.2.1 – 5.2.10 (V5.2.1 – V5.2.10)	Ten statements used was self-designed based on literature from: House *et al.* (2004), Klerck and Sweeny (2007), Laux *et al.* (2010), Pew Research Center (2015), Tanius and Seng (2015), Thomson Reuters (2010) and Zinoti (2010).	True, false or IDK.	Descriptive statistics including frequencies and percentages.
	Consumption knowledge	Section B	6.1 – 6.2.10 (V6.1 – V6.2.10)	Self-designed scale based on literature. Q6.1 Asking if they use GM food products. Q6.2 Listing GM containing and non-GM food products based on literature by: Botha & Viljoen (2008), Laux *et al.* (2010), Thomson Reuters (2010) and Zinoti (2010).	Q6.1 – Yes, no or IDK. Q6.2.1 – 6.2.10 – Yes, no or IDK.	Cross-tabulations and descriptive statistics including frequencies.
Objective 3 **To explore and describe the correlations between consumers' demographic characteristics and their knowledge of GM food.**	Demographic characteristics and inclusion criteria	Section A Section C	1 – 4 (V1.1 – V4.2) 7 – 10 (V7.1 – V10.5)	Demographic questions based on questionnaires from: Eurobarometer (2010), Donoghue (2008), Donoghue *et al.* (2016), House *et al.* (2004), McLean-Meyinsse (2001), Tanius and Seng (2015) and Thomson Reuters (2010).	Q1 – multiple choice. Q2 – self completion. Q3 & 4 – Yes and no.	Descriptive statistics including frequencies, and percentages.
	Correlations between consumers' subjective and objective GM knowledge and their demographic characteristics	Section A Section B Section C	1 – 4 (V1.1 – V4.2) 5.1 – 5.3. (V5.1.1 – V5.3.10) 6.1 – 6.2.10 (V6.1 – V6.2.10) 7 – 10 (7.1 – V10.5)			T-tests, one-ways, ANOVAs and effect sizes.

* Statistical analysis to be discussed in section 3.7

All questions exploring consumers' subjective knowledge were measured by a five-point Likert scale, and all objective knowledge questions were measured by "true", "false" or "IDK" options, which was done to ensure uniformity of the measuring instrument. A difficulty index item analysis was done by using Flesch and Kinkaid's grade level test to ensure that the questions were easy to understand. This test indicates the level of language used in the questionnaire, and the results are presented in Annexure B. The questionnaire was only available in English, as genetic modification includes subject-specific terminology (in English) that is not easily translated to other languages. However, most South African consumers understand English (STATS SA, 2014), it is the most used language on the internet worldwide (Internet World Stats, 2013) and it is the language of instruction for most consumers (Wyma *et al.,* 2012:435). In addition, it was not feasible to formulate the questionnaire in all eleven official languages of South Africa. However, as English is not necessarily all South Africans' first or even second language, only consumers who could read, write and understand English were able to participate in the study.

After the development of the questionnaire, it was reviewed by experts (Creswell & Plano Clark, 2011:189) in the field of Consumer Sciences (Professor A Erasmus, E. Botha and L. Wyma), Haematology and Cell Biology (Professor CD Viljoen), and Zoology (Professor J van den Berg). Adjustments were made according to these experts' inputs. Changes included the sequence of the questions and ensuring that the questions were based on facts, measured only relevant constructs and that the language level of the questionnaire could be comprehended by a person with a grade 8 level of education. In addition, willing individuals with different age groups and expertise were asked to take part in one of three cognitive interviews regarding the questionnaire. These individuals where asked about the clarity of statements and whether the scales are easily understood. This process also determined the time needed to complete the questionnaire, which was 15 minutes. When it was clear that respondents would understood the questions correctly, the questionnaire was finalised and submitted to and approved by the Health Research Ethics Committee (HREC) of the Faculty of Health Sciences at the North-West University Potchefstroom. The HREC approval letter is presented in Annexure C.

3.4.2 Electronic online questionnaires

An online questionnaire was used to collect data in this study as it provided accurate, reliable and valid data (Delport & Roestenburg, 2011:189), using SurveyMonkey and distributed by AskAfrika. Electronic questionnaires reduced the use of paper (Schobel *et al.,* 2014:1), and the data was directly available on a database after respondents completed the questionnaire,

minimising the chances of errors occurring during data transfer (McPeake *et al.,* 2014:25). The use of electronic questionnaires also reduced traveling and printing costs (Delport & Roestenburg, 2011:189; McPeake *et al.,* 2014:25), and more respondents could be reached as the questionnaire did not have to be printed and delivered to respondents, further saving on time and costs. Online questionnaires have proven to be successful and popular (Betlehem & Hundepool, 2002:3) in national (Donoghue, 2016; Havenga, 2014; Van der Merwe *et al.,* 2012; Van der Merwe *et al.,* 2014) and international studies (Ahmad & Nordin, 2014; Gámbaro *et al*., 2013; Robson *et al.,* 2014) quantitatively exploring consumers' knowledge and/or awareness.

Further advantages of online questionnaires included avoiding interviewer bias, which contributed to the objectivity of data. Online questionnaires are convenient for respondents as they completed it voluntarily and in their own time and venue of their choice. Pressure to participate in the study resulting from to direct contact with an interviewer was avoided (Delport & Roestenburg, 2011:189), since individuals could delete the email if they were not interested in participating in the study. Due to the anonymity of responses, respondents did not feel pressured to give the correct answers to the objective knowledge questions, as the answers could not be linked back to individuals. Only completed questionnaires could be submitted, as a "skip logic" option was used during the development of the questionnaire.

Disadvantages of online questionnaires included the presence of selection bias in the use of internet questionnaires, as only individuals with internet access could participate in the study (Delport & Roestenburg, 2011:190). Respondents could also possibly search for answers on the internet while completing the questionnaire, although respondents' honesty during the completion of the questionnaire was relied on. This fact was kept in mind when the study's findings were interpreted. As individuals from a consumer research database who voluntarily signed up to participate in consumer research were recruited, it was expected that respondents would comply with principles of honest data collection.

3.5 Sampling method and size

Sampling is one of the most vital elements in a research design (Malhotra & Birks, 2007:356). Since there was not a list of possible respondents who complied with the inclusion criteria from South Africa, a **non-probability** sampling method, including 300 respondents, was used for data collection. Since the sample is not representative, results could not be generalised to the South African population (Babbie & Mouton, 2001:166; Maree & Pietersen, 2016b:197; Neuman, 2006:222). In order to reach a large sample across South Africa, a **purposive**

sampling method was used for this study, since GM food is a relatively unfamiliar topic. This sampling method was used because the researcher had a specific purpose in mind – to explore South African consumers' knowledge of GM food – with set inclusion criteria (Maree & Pietersen, 2016b:198). The sample's characteristics were regulated (Botma *et al*, 2010:126), as only South African individuals 18 years and older (to legally sign consent), who could read and understand English and who purchased food could participate. Respondents who were not aware of GM food, who did not have internet access or were not internet literate were excluded from the study.

A minimum sample size of approximately 300 is required for a good factor analysis (Tabachnick & Fidell, 2001:613). A **power calculation** was not done as the sample was not random. Data from a vast population were collected (Wagoner & Besikof, 2010:79) from respondents who voluntarily participated in the survey, as they willingly subscribed to the database and indicated that they were aware of GM food (Maree & Pietersen, 2016b:197; Strydom, 2011:232). The questionnaire was distributed to 15 000 individuals in South Africa, and data gathering ended when 300 usable questionnaires were received. This was a cost-effective sampling method that was effectively executed.

3.6 Data collection process

SurveyFace was originally chosen to collect the data electronically. However, the "skip logic" option could not be used to close the questionnaire when a respondent did not comply with the inclusion criteria. Therefore, a subscription was made to SurveyMonkey, since it was affordable and provided the "skip logic" option in a consumer-friendly way. SurveyMonkey ensured that respondents were not able to proceed to the next question if they did not comply with the inclusion criteria. The "skip logic" options also ensured that all questions were answered before one could continue to the next question, making it compulsory to complete all questions. The program also had an exit option, which the respondent could use to withdraw from the survey if he or she did not want to continue.

Consumer insight consultancy online agencies in South Africa, namely AskAfrika, Consulta and Columinate, were contacted by the researcher to assist in data gathering, as a vast population had to be reached. AskAfrika was selected as the most suitable option. AskAfrika's consultants are trained professionals in conducting ethical data collection and had to adhere to the ethical requirements as indicated in the ethical approval document obtained from the North-West University. The contract between the researcher and AskAfrika is presented in Annexure E.

The study was advertised on AskAfrika's website prior to data collection (the advertisement is presented in Annexure F). AskAfrika sent out an e-mail with the consent form and access to the questionnaire, where it was stated that respondents could voluntarily participate, or ignore the email if they did not have an interest in the research topic. Respondents received the consent form explaining the purpose of the study, the inclusion criteria, why they were invited to take part and the risks and benefits of the study, and were assured of measures taken to ensure anonymity – neither the researcher nor AskAfrika would have been informed on who participated in the study. Annexure G presents the HREC approved consent form. After the respondents read the consent form, they had time to decide whether they wanted to participate in the study. When a respondent clicked on the link to the questionnaire, this was regarded as his or her consent to take part in the study.

Since fieldworker assistance was not available to respondents who struggled to complete the questionnaire, the principal investigator's e-mail address and contact number were available for respondents who were in need of assistance. When a respondent's internet data ran out or there was a power failure while they were busy with the questionnaire, the respondent could again follow the link and the database would recognise that the questionnaire was incomplete and the respondent could continue where he or she left off. Respondents who did not meet the inclusion criteria were thanked for their time and willingness to participate, and the questionnaire closed. Data was collected in an objective manner at a single point in time over a two-day period until a sufficient number of completed questionnaires was received.

After 300 completed questionnaires were submitted, the online questionnaire closed and only the researcher had access to the data. Respondents who were completing questionnaires while the survey closed could still submit their completed questionnaires, resulting in a total of 310 completed questionnaires. The data was automatically converted into an Excel spreadsheet, which is currently stored electronically in building F15, office number G05 on the North-West University's Potchefstroom campus. The data will be permanently deleted after five years.

3.7 Data analysis

The aim of data analysis was to draw conclusions regarding respondents' knowledge of GM food by using statistical interpretations (Pietersen & Maree, 2016a:207). The Statistical Consultation Services on the Potchefstroom Campus of the North-West University assisted in importing the database into SPSS and in analysing the data. The statistical data analysis program IBM SPSS Statistics Version 24, Release 24.0 was used (SPSS Inc., 2017). The data

analysis operationalisation is demonstrated in Table 3.3, and the statistical methods used to reach the objectives are discussed in the sections that follow.

For the first objective, respondents' subjective knowledge was analysed by using descriptive statistics including frequencies, means and standard deviations. The second objective explored respondents' objective knowledge, which was analysed using descriptive statistics such as frequencies. By using statements regarding GM technology and GM food, themes could be identified to determine respondents' knowledge. The statements with the highest scores indicated the most important information about GM food that has an impact on their daily lives. Consumption knowledge was analysed by means of a cross-tabulation, which is usually done when two quantitative independent variables are compared (Pietersen & Maree, 2016a:205). A cross-tabulation was used to determine whether respondents knew that the food items they consume contain GM or not. Phi-coefficients were used to indicate associations between respondents' knowledge of their GM food consumption and their actual GM food consumption. A practical significant effect is above 0.50 (Malhotra & Birks, 2007:523).

For the third objective, respondents' demographic profile was analysed by using descriptive statistics, including frequencies. This objective investigated correlations between respondents' demographic characteristics and their knowledge. The mean scores of subjective knowledge were determined from a minimum of 1 and a maximum of 5. Objective knowledge was marked and a score given out of 10. ANOVAs were used for demographical variables with more than two independent groups that needed to be compared with a single measure, as suggested by Pietersen and Maree (2016b:255). Here, tests for differences between the subjective and objective knowledge of respondents were conducted according to their age, education and monthly income groups. Respondents' knowledge according to their self-reported consumption of GM food was also analysed by means of ANOVAs.

A t-test is suitable for analysis comparing two independent groups in terms of a single quantitative variable (Pietersen & Maree, 2016b:250). T-tests were thus used to compare respondents' subjective and objective knowledge according to their gender, residency and language groups. Residency and home language were categorised into two distinct groups according to the largest cities (residency) and native South African languages, as well as Afrikaans and English (home language). Effect sizes were determined at t-tests and ANOVAs to indicate practical significances between demographic differences. Effect sizes over $d = 0.8$ were interpreted as having practically significant differences (Pietersen & Maree, 2016b:234). Data is presented in tables as well as discussed in written explanations (Fox & Bayat, 2011:77).

3.8 Enhancing the quality of the data

The validity of a measuring instrument refers to the accuracy and extent that concepts are measured in a question (Babbie, 2013:191; Delport & Roestenburg, 2011:173; Malhotra & Birks, 2007:314). The validity of the measuring instrument was determined by means of construct validity, as suggested by Delport and Roestenburg (2011:174-175). The validity of an instrument is important as it assists in ensuring the reliability of the instrument (Delport & Roestenburg, 2011:178). The reliability of a questionnaire refers to its stability and consistency to measure the problem of the study repeatedly on different samples (Babbie, 2013:188; Bernard, 2013:46; Delport & Roestenburg, 2011:177; Pietersen & Maree, 2016b:239). This reliability was determined by the internal consistency of constructs and Cronbach's alpha as suggested by various authors (Babbie, 2013:191; Pietersen & Maree, 2016b:238-239). The validity and reliability of the questionnaire will be discussed to determine the quality of the data.

3.8.1 Validity

Content (face) validity explored what the questionnaire actually measured and ensured that the measuring instrument covered all the objectives of the study (Babbie & Mouton, 2001:123). Experts in the field of Consumer Sciences (Professor A Erasmus, E. Botha and L. Wyma), Haematology and Cell Biology (Professor CD Viljoen) and Zoology (Professor J van den Berg) and the North-West University's Statistical Services evaluated the questionnaire to determine the face validity (Bernard, 2013:48; Delport & Roestenburg, 2011:174; Neuman, 2011:212; Pietersen & Maree, 2016b:240). Adaptations were made to the questionnaire according to the feedback from these experts

Construct validity of the questionnaire (Delport & Roestenburg, 2011:175) required that the questionnaire measured what it was supposed to measure – namely, subjective and objective knowledge of GM food (Delport & Roestenburg, 2011:175). The Keiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to determine the sample adequacy of the Likert scale questions. KMO values should be ≥0.5 (Field, 2009:647). Respondents' subjective knowledge based on the construct validity of the five-point Likert scale questions was determined by using a principal component analysis to measure underlying constructs between subjective knowledge statements (Field, 2009:628). Bartlett's test of sphericity was done to determine if high enough correlations are present between subjective knowledge statements.

3.8.2 Reliability

Internal consistency or reliability by means of Cronbach's alpha was used to determine the reliability of the subjective and objective knowledge scales. Inter-item correlation was determined by using Cronbach's alpha to ensure internal reliability. **Cronbach's alpha** measures the internal consistency and reliability of scales with multi-item data (Bless *et al*., 2013:226; Pietersen & Maree, 2016b:239; Shen *et al*., 2012:240). A value of >0.6 indicates internal consistency when measuring psychological constructs such as knowledge (Field, 2009:675; Malhotra & Birks, 2007:358; Tavakol & Dennick, 2011:53).

3.9 Ethical considerations

It was necessary to take ethical considerations into account to protect respondents taking part in this study. These ethical practices ensured that respondents and the researchers were not exploited when gathering scientific information (Neuman, 2011:143). During the development of the questionnaire, the potential risks and discomforts respondents may have experienced were taken into account and preventative measures were implemented beforehand. The questionnaire was kept short to be time efficient and included only relevant questions. Anonymity was ensured by not asking respondents' personal details, ensuring that they would not feel pressured when answering objective knowledge questions, and that they provide accurate answers to sensitive questions such as their monthly income without feeling exploited. Respondents were responsible for the minimal costs of the internet data used to access and complete the questionnaire on SurveyMonkey's database. However, care was taken not to use too much data by not using images or video clips.

After the development of the questionnaire, ethical clearance was obtained from the HREC for research with humans of the Faculty of Health Sciences of the North-West University before data collection was conducted (NWU-00067-16-A1). After ethical approval was granted by the HREC, the study was advertised for two weeks before data collection. The advertisement included the title and comprehensive information of the study, time period of data collection and the inclusion and exclusion criteria. This information gave individuals time to decide whether they wanted to participate in the study or not.

After the study was advertised, the consent form was e-mailed to potential respondents together with the link to the questionnaire. By clicking on the link, they gave consent to voluntarily participate in the study. The questionnaire had an exit option where respondents could terminate their participation at any moment (Creswell, 2014:97; Neuman, 2011:149;

Strydom, 2011:116). When a respondent withdrew, the database did not save the data. After all completed questionnaires were submitted, the data was automatically stored on an electronic database to which only the researchers and statistician had access.

There were no direct benefits for respondents, nor were incentives provided. This study yielded only indirect benefits to the larger consumer community. Results could contribute to academic research and future studies to develop intervention and educational programmes to inform consumers about GM food. Policy makers could also use the results of this study to alter the policies or to implement educational programmes if needed. The food industry can benefit from this study as the results can be used to supply consumers with trustworthy information about GM food. By supplying consumers with trustworthy information, it will equip them with factual knowledge to base their purchasing decisions upon.

3.10 Role of the researcher

The role of the researcher was to gather and analyse data in order to obtain a better understanding of South Africa's consumers' subjective and objective knowledge of GM ingredients in food products that they regularly consume. Other responsibilities of the researcher included the planning of the research project which involved:

- Conducting a thorough literature review regarding the investigated topic;
- Generating aims and objectives;
- Writing the protocol;
- Applying for HREC approval;
- Receiving HREC consent;
- Writing a research methodology and developing a relevant questionnaire for sufficient data collection with assistance from study leaders, experts in the field and statisticians;
- Coordinating data collection and data analysis processes;
- Conducting ethical research; and
- Reporting, disseminating and monitoring research.

3.11 Conclusion

For the purpose of this study, a quantitative research approach was used to conduct exploratory research using online questionnaires to explore consumers' subjective and objective knowledge of GM food. By using questionnaires, empirical research was conducted

and numerical data was gathered to measure social life aspects. Electronic questionnaires were used to gather information from a large South African population. The questionnaire was developed using scales from previous studies and adapting the content of the scales to suit the research topic of this study.

A non-probability, voluntary sampling method was used. Although only 300 completed questionnaires were required for statistical analysis, the electronic questionnaire was emailed to 15 000 potential participants, and a total of 310 were submitted. After data was collected, SPSS was used to convert numerical data into usable analytics to explore consumers' knowledge of GM food. Frequencies, means, standard deviations and Cronbach's alpha were used to describe consumers' knowledge. Correlations between respondents' demographic information and their knowledge were explored. For this analysis, one-way, t-tests and ANOVAs were used to determine and describe correlations. Ethical requirements as stated by HREC were met throughout the study. Analysed data will be discussed and illustrated by means of tables and graphs in the chapter to follow.

3.12 References

Ahmad, T.B.T. & Nordin, M.S. 2014. University students' subjective knowledge of green computing and pro-environmental behavior. *International education studies,* 7(2):64-74.

Babbie, E.R. 2013. The practice of social research. 13th ed. Belmont: Cengage Learning.

Babbie, E. & Mouton, J. 2001. The practice of social research. Cape Town: Oxford University Press.

Bernard, H.R. 2013. Social research methods: qualitative and quantitative approaches. 2nd ed. Los Angeles: Sage.

Betlehem, J. & Hundepool, A. 2002. On the documentation and analysis of electronic questionnaires. http://jpsm.umd.edu/qdet/final_pdf_papers/bethlehem.pdf Date of access: 25 Oct. 2016.

Blaikie, N. 2010. Designing social research. 2nd ed. Cambridge: Polity Press.

Bless, C., Higson-Smith, C. & Sithole, S.L. 2013. Fundamentals of social research methods: an African perspective. 5th ed. Cape Town: Juta.

Botha, G.M. & Viljoen, C.D. 2008. South Africa: a case study for voluntary GM labelling. *Food chemistry,* 112(4):1060-1064.

Botma, Y., Greeff, M., Mulaudzi, F.M. & Wright, S.C.D. 2010. Research in health sciences. Cape Town: Pearson.

Brucks, M. 1985. The effects of product class knowledge on information search behavior. *Journal of consumer research*, 12(1):1-16.

Corbetta, P. 2003. Social research: theory, methods and techniques. London: Sage.

Costa-Font, M., Gil, J.M. & Traill, W.B. 2008. Consumer acceptance, valuation of and attitudes towards genetically modified food: review and implications for food policy. *Food policy,* 33(2):99-111.

Creswell, J.W. 2014. Research design: qualitative, quantitative, and mixed methods approaches. 4th ed. Los Angeles, CA: Sage.

Creswell, J.W. & Plano Clark, V.L. 2011. Designing and conducting mixed methods research. 2nd ed. Los Angeles, CA: Sage.

Delport, C.S.L. & Roestenburg, W.J.H. 2011. Quantitative data collection methods: questionnaires, checklists, structured observation and structured interview schedules. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots: for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 171-205).

Dodd, T.H., Laverie, D.A., Wilcox, J.F. & Duhan, D.F. 2005. Differential effects of experience, subjective knowledge and objective knowledge on sources of information used in consumer wine purchasing. *Journal of hospitality and tourism research*, 29(1):3-19.

Donoghue, S. 2008. An explanation of consumer complaint behaviour concerning performance failure of major electrical household appliances. Pretoria: University of Pretoria. (Thesis – PhD).

Donoghue, S., Van Oordt, C. & Strydom, N. 2016. Consumers' subjective and objective consumerism knowledge and subsequent complaint behaviour concerning consumer electronics: a South African perspective. *International journal of consumer studies,* 40(4):385-399.

Eurobarometer. 2010. Special Eurobarometer biotechnology report. http://ec.europa.eu /public_opinion/archives/ebs/ebs_341_en.pdf Date of access: 29 Aug. 2015.

Field, A. 2009. Discovering statistics using SPSS. 3rd ed. London: Sage.

Flynn, L.R. & Goldsmith, R.E. 1999. A short, reliable measure of subjective knowledge. *Journal of business research*, 46(1):57-66.

Fouché, C.B. & De Vos, A.S. 2011. Formal formulations. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 89-100).

Fouché, C.B., Delport, C.S.L. & De Vos, A.S. 2011. Quantitative research designs. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 142-158).

Fox, W. & Bayat, M.S. 2011. A guide to managing research. Cape Town: Juta.

Gámbaro, A., Ellis, A.C. & Prieto, V. 2013. Influence of subjective knowledge, objective knowledge and health consciousness on olive oil consumption: a case study. *Food and nutrition sciences,* 4(04):445-453.

Havenga, S.C. 2014. Food label knowledge: a comparison between a developing and developed country context. Potchefstroom: NWU. (Dissertation – M Consumer Sciences).

House, L., Lusk, J., Jaeger, S., Traill, W.B., Moore, M., Valli, C., Morrow, B. & Yee, W.M.S. 2004. Objective and subjective knowledge: impacts on consumer demand for genetically modified foods in the United States and the European Union. *Journal of agrobiotechnology management & economics*, 7(3):113-123.

Internet World Stats. 2013. Internet world users by language. http://www.internet worldstats.com/stats7.htm Date of access: 1 Jul. 2015.

Klerck, D. & Sweeney, J.C. 2007. The effect of knowledge types on consumer perceived risk and adoption of genetically modified foods. *Psychology & marketing*, 24(2):171-193.

Laux, C.M., Mosher, G.A. & Freeman, S.A. 2010. Factors affecting college students' knowledge and opinions of genetically modified foods. *Journal of technology studies,* 36(2):2-9.

Lee, J.K. & Lee, W. 2009. Country-of-origin effects on consumer product evaluation and purchase intention: The role of objective versus subjective knowledge. *Journal of international consumer marketing*, 21(2):137-151.

Malhotra, N.K. & Birks, D.F. 2007. Marketing research: an applied approach. 3rd ed. Essex: Prentice Hall.

Maree, K. & Pietersen, K. 2016a. The quantitative research process. (*In* Maree, K., *ed.* First steps in research. 2nd ed. Pretoria: Van Schaik. p. 162-172).

Maree, K. & Pietersen, K. 2016b. Sampling. (*In* Maree, K., *ed.* First steps in research. 2nd ed. Pretoria: Van Schaik. p. 191-202).

McLean-Meyinsse, P.E. 2001. An analysis of nutritional label use in the southern United States. *Journal of food distribution research*, 32(1):110-114.

McPeake, J., Bateson, M. & O'Neill, A. 2014. Electronic surveys: how to maximise success. *Nurse researcher*, 21(3):24-26.

Neuman, W.L. 2006. Social research methods. 6th ed. Boston: Pearson.

Neuman, W.L. 2011. Social research methods: qualitative and quantitative approaches. 7th ed. London: Pearson.

Pew Research Center. 2015. Americans, politics and science issues. http://www.pewinternet.org/files/2015/07/2015-07-01_science-and-politics_FINAL.pdf Date of access: 15 Nov. 2017.

Pietersen, J. & Maree, K. 2016a. Statistical analysis I: descriptive statistics. (*In* Maree, K., *ed.* First steps in research. 2nd ed. Pretoria: Van Schaik. p. 203-217).

Pietersen, J. & Maree, K. 2016b. Standardisation of a questionnaire. (*In* Maree, K., *ed*. First steps in research. 2nd ed. Pretoria: Van Schaik Publishers. p. 237-247).

Robson, K., Plangger, K., Campbell, C. & Pitt, L. 2014. Objective and subjective wine knowledge: evidence from an online study. http://academyofwinebusiness.com/wp-content/uploads/2014/07/CB02_Robson_Karen2.pdf Date of access: 11 Apr. 2016.

Schobel, J., Schickler, M., Pryss, R., Maier, F. & Reichert, M. 2014. Towards process-driven mobile data collection applications: requirements, challenges, lessons learned. http://dbis.eprints.uni-ulm.de/1036/1/Schobel2014.pdf Date of access: 25 Aug. 2015.

Shen, B., Wang, Y., Lo, C K.Y. & Shum, M. 2012. The impact of ethical fashion on consumer purchase behaviour. *Journal of fashion marketing and management*, 16(2):234-245.

SPSS Inc. 2017. IBM SPSS Statistics Version 24, Release 24.0.0 http://www-01.ibm.com/software/analytics/spss/ Date of access: 12 Oct. 2017.

STATS SA (Statistics South Africa). 2014. Mid-year population estimates. http://www.statssa.gov.za/ publications/P0302/P03022014.pdf Date of access: 30 Jun. 2015.

Strydom, H. 2011. Sampling in the quantitative paradigm. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 222-235).

Tabachnick, B.G. & Fidell, L.S. 2001. Using multivariate statistics. 4th ed. Boston: Allyn & Bacon.

Tanius, E. & Seng, S.W. 2015. Consumer awareness towards genetically modified (GM) foods. *International journal of business, economics and law,* 6(2):17-26.

Tavakol, M., & Dennick, R. 2011. Making sense of Cronbach's alpha. *International journal of medical education*, 2:53-55.

Thomson Reuters. 2010. National survey of healthcare consumers: genetically engineered food. http://www.justlabelit.org/wp-content/uploads/2011/09/NPR_report_GeneticEngineered Food-1.pdf Date of access: 11 Apr. 2016.

Van der Merwe, D., Bosman, M., Ellis, S., De Beer, H. & Mielmann, A. 2012. Consumers' knowledge of food label information: an exploratory investigation in Potchefstroom, South Africa. *Public health nutrition,* 16(3):403-408.

Van der Merwe, D., Bosman, M., Ellis, S., Van der Colff, N. & Warnock, M. 2014. Consumers' knowledge of textile label information: an exploratory investigation. *International journal of consumer sciences,* 38(1):18-24.

Wagoner, R.L. & Besikof, R.J. 2010. Community college fundraising: the voluntary support of education survey as a sampling tool for research. *Community college journal of research and practice,* 35(1-2):74-87.

Wyma, L., Van der Merwe, D., Bosman, M.J.C., Erasmus, A.C., Strydom, H. & Steyn, F. 2012. Consumers' preferences for private and national brand food products. *International journal of consumer studies,* 36(4):432-439.

Zinoti, B. 2010. Public opinion survey on GMO in Lithuania. https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=582 Date of access: 11 Apr. 2016.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter provides the results of the study and a discussion of the findings in the context of existing literature. Results are presented according to the objectives of the study, which are to explore consumers' subjective and objective knowledge of GM food and the differences between their knowledge according to demographic groups. The demographic characteristics of the respondents are described, followed by a description of respondents' subjective and objective knowledge regarding GM food. Respondents' knowledge of GM food is described as a part of objective knowledge to explore whether they know that they consume GM ingredients in everyday food products. It was also tested whether or not there are differences among demographical groups with regards to subjective and objective knowledge. Associations between self-acknowledged consumption of GM food and the actual usage of different GM and non-GM products were tested. Finally, the correlation between subjective and objective knowledge of GM food is explored.

Subjective knowledge and objective knowledge are two different concepts regarding consumers' knowledge (Lee & Lee, 2009:142). Subjective knowledge is based on consumers' personal perception of their knowledge whereas objective knowledge is considered factual information (Alba & Hutchinson, 2000:124; Donoghue *et al.,* 2016:387). These two concepts have their own unique measuring techniques (Brucks, 1985:2; House *et al.,* 2004:114). In exploring consumers' objective knowledge, it can be determined which themes have an impact on consumers' daily lives and purchasing behaviour. Subjective and objective knowledge can be directly linked to experiences (Donoghue *et al.,* 2016:387) and consumer behaviour (Brucks, 1985:2), thus these concepts should be investigated alongside consumers' experience-based (consumption) behaviour, which influences purchasing behaviour.

4.2 Demographic characteristics of the sample

A total of 310 (N) questionnaires were collected, and all respondents complied with the inclusion criteria. The demographic characteristics of the sample are presented in Table 4.1. The sample comprised of 58.7% females, and the majority (84.5%) were between the ages of 18 and 45 years old. The remaining 15.5% were older than 45 years. The majority of respondents resided in Gauteng (42.6%), the Western Cape (20%) or in Kwa-Zulu Natal (19.4%). Gauteng is the province with two of the larger metropolitan areas in South Africa, and

together, Gauteng, Western Cape and Kwa-Zulu Natal represent the largest segment of the population of South Africa (STATS SA, 2016).

Table 4.1 Demographic characteristics of the study sample (N=310)

Category	Frequency (n)	Percent (%)
Gender		
Female	182	58.7
Male	128	41.3
Age		
18 – 25	69	22.3
26 – 35	125	40.3
36 – 45	68	21.9
46 – 55	26	8.4
>55	22	7.1
Residency		
Gauteng	132	42.6
Western Cape	62	20.0
Kwa-Zulu Natal	60	19.4
Eastern Cape	21	6.8
Limpopo	11	3.5
Free State	10	3.2
North West	8	2.6
Mpumalanga	5	1.6
Northern Cape	1	0.3
Language		
English	145	46.8
isiZulu	38	12.3
Afrikaans	35	11.3
isiXhosa	26	8.4
Northern Sotho	16	5.2
Setswana	11	3.5
Sesotho	11	3.5
Xitsonga	10	3.2
Tshivenda	9	2.9
siSwati	7	2.3
isiNdebele	2	0.6
Education		
Lower than grade 12	12	3.9
Grade 12	71	22.9
Grade 12 + a degree or diploma	150	48.4
Postgraduate degree or diploma	77	24.8
Monthly income		
Less than R5,000	39	12.6
R5,000 or more but less than R10,000	57	18.4
R10,000 or more but less than R15,000	66	21.3
R15,000 or more but less than R25,000	67	21.6
R25,000 or more	81	26.1

English is the most common home language, spoken by 46.8% of the respondents, followed by isiZulu (12.3%), Afrikaans (11.3%) and isiXhosa (8.4%). English is also the home language of the majority of the respondents on the respondent database. In addition, Gauteng has the largest English-speaking population in South Africa (STATS SA, 2010:4), which is where the majority of respondents reside. Most of the respondents have a tertiary education (73.2% in total), and only 3.9% do not have a grade 12. This level of education among respondents could be owing to the inclusion criteria, which required that respondents know about GM food and be able to use the internet. This finding corresponds with similar studies conducted in USA and EU exploring consumers' subjective and objective knowledge and demand for GM food, where the majority of respondents had a tertiary education (degree or diploma, or postgraduate degree or diploma) (House *et al.,* 2004:116). In this study, the majority of respondents (69%) earn more than R10,000 per month. The minimum wage in 2017 for South Africans is R20 per hour, amounting to R3,500 per month for a 40-hour work week (Business Tech, 2017). Thus, the respondents were comparatively affluent consumers as they earn more than the South African minimum wage.

4.3 Consumers' subjective knowledge of GM food

The first objective was to explore consumers' subjective knowledge of GM food. This section of the questionnaire required respondents to rate their own knowledge with regards to ten statements about GM food compared to that of an average person by means of a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Descriptive statistics of respondents' answers to the subjective knowledge statements, which includes the frequencies, means and standard deviations, are presented in Table 4.2. The results of the mean scores of respondents' subjective knowledge are presented in descending order. The mean scores for the different statements were between ($\overline{x}$ = 3.80 to 3.24), indicating that respondents felt neutral about their knowledgeable about GM products. Respondents also indicated that they felt neutral about their knowledge of GM food to make informed purchasing decisions ($\overline{x}$ = 3.30).

Principal component analysis was used in this particular study to explore the structure of a set of variables in terms of underlying constructs by means of a questionnaire, and to reduce the data set while keeping the original data intact (Field, 2009:628). The KMO measure was used to determine sample adequacy. The KMO of the subjective knowledge statements was 0.938, indicating that the sample was large enough. Bartlett's test of sphericity was done to determine if the correlations between statements are high enough. The reported p-value <0.001 indicated

sufficient correlations amongst the statements. Based on the pattern matrix, it can be concluded that the exploratory factor analysis yielded only one scale. The Cronbach's alpha of the scale had a score of α = 0.920, indicating reliability, and also indicating internal consistency among the ten given statements, as a Cronbach's alpha >0.6 indicates good internal consistency (Malhotra & Birks, 2007:358). The overall mean score of the respondents' feedback was $\bar{x}$ = 3.53, indicating that they tend to agree that they know a lot about GM foods when compared to other consumers.

Table 4.2 Frequencies of respondents' subjective knowledge of GM food

			Frequency distribution (%)				
Compared to an average person, I know a lot about...	**Mean**	**SD**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
how GM food differ from organic food	3.80	0.850	1.0	6.5	22.6	51.3	18.7
the purpose of genetic modification of foods.	3.67	0.856	1.3	7.1	29.4	47.7	14.5
the advantages and or disadvantages of GM food compared to regular/conventional food.	3.62	0.912	2.3	8.4	28.7	46.1	14.5
how food is genetically modified.	3.58	0.877	2.3	8.4	29.7	48.7	11.0
various GM fresh produce that is available in South Africa.	3.56	0.893	1.3	8.7	37.1	38.1	14.8
the difference in the production of GM food versus the production of organic food.	3.56	0.903	2.6	9.4	28.4	48.4	11.3
the characteristics of genetically modified (GM) food.	3.52	0.930	3.5	7.4	34.8	41.6	12.6
the difference in the labelling of GM and non-GM food.	3.43	0.975	3.5	12.3	34.2	37.7	12.3
GM technology and feel confident when I make a purchase.	3.30	0.937	3.9	12.9	41.0	33.5	8.7
how to tell the difference between GM and non-GM food.	3.24	0.998	4.8	16.8	37.7	31.3	9.4
KMO[1]	0.938						
Bartlett's test (*p-value)	0.000						
Cronbach's alpha	0.920						
Mean	3.53						

[1]KMO = Kaiser-Mayer-Olkin

4.4 Consumers' objective knowledge of GM food

The majority of respondents knew the correct answers for eight of the ten statements (percentage of the correct answers varies between 61.6% and 86.8%). However, for the two remaining questions, more respondents answered incorrectly (36%) or indicated that they do not know the answer (28.6%). The "IDK" option proved to be necessary when exploring objective knowledge as it provided respondents with an option of not guessing. The eight statements with the highest scores indicate that the statements may have an impact on respondents' daily lives, and can possibly be used to make informed purchasing decisions, as indicated in the literature study. The production processes of GM crops may not affect the respondents' daily lives, which could be owing to the complicated scientific nature of the GM processes.

Respondents' objective knowledge about organic food and organic meat scored the lowest. Many South Africans do not have the opportunity to purchase organic food, as a large variety organic food is not available in all supermarkets, or is expensive when it is available. More expensive food products such as organic food and meat are considered as luxury consumer goods in South Africa (Cawthorn *et al*., 2013:1; Van der Veen, 2003:407), making such products less accessible for consumers. Thus, it can be concluded that respondents' lower levels of objective knowledge of organic food might be because of low exposure to organic food.

Respondents' objective knowledge of GM food was explored in ten statements, where respondents had to indicate whether the statement is "true", "false" or "I don't know". The "IDK" option was provided to give respondents the opportunity to indicate when they do not know the correct answer to the statement. However, when calculating the mean, this option was analysed together with the incorrect option. Nine of these statements were true and one was false. The answers were marked, and each respondent was given a score out of ten for their objective knowledge. When calculating the average of all respondents' scores, they received an average score of $\bar{x} = 5.97$. The Cronbach's alpha of the scale was $\alpha = 0.646$, indicating reliability and internal constancy among the statements. This average score indicates that respondents had above average objective knowledge, as they had an overall score of 59.7%. Figure 4.1 presents respondents' frequency distribution of the different options per objective knowledge question.

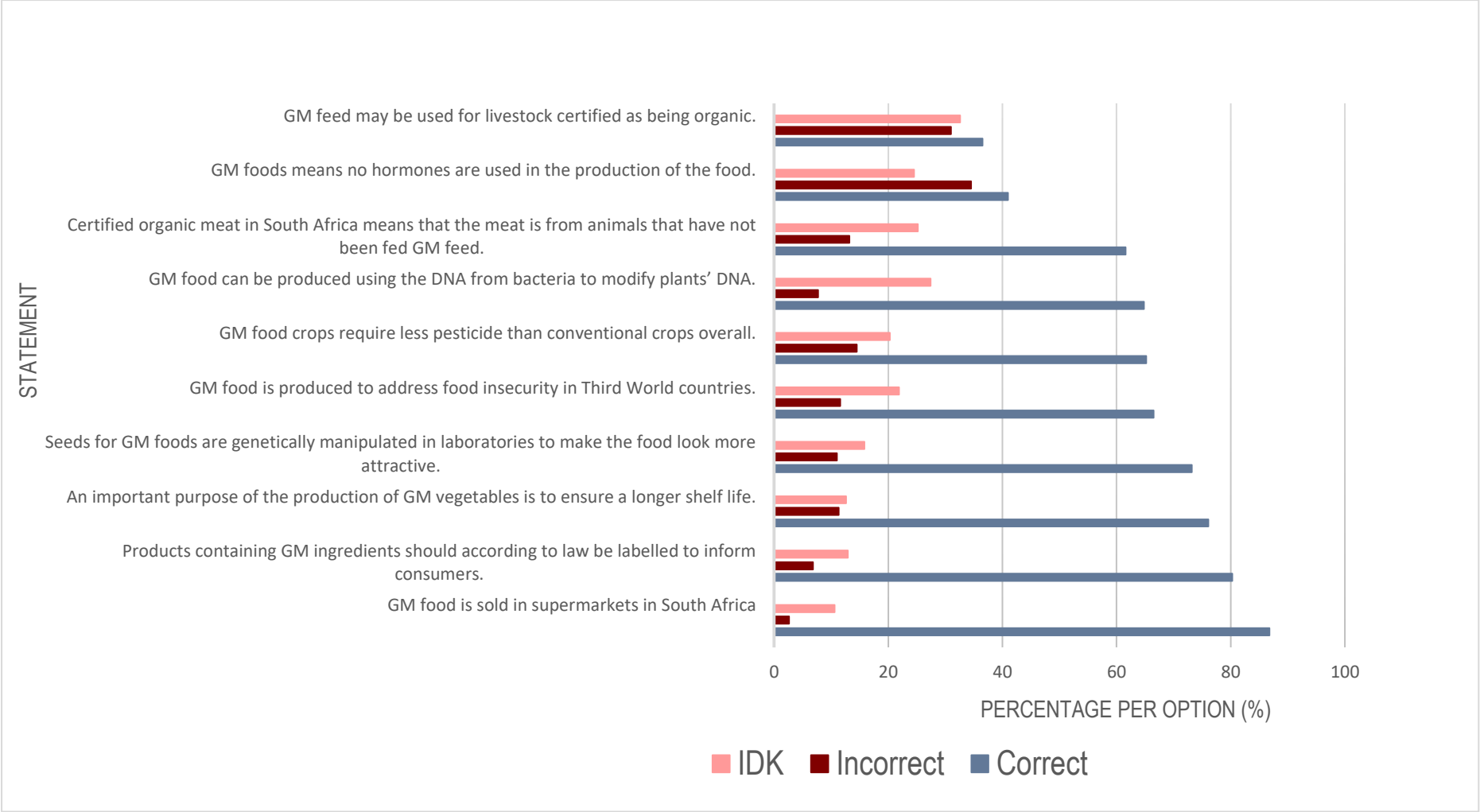


Figure 4.1 Percentages regarding respondents' objective knowledge

As part of objective knowledge, respondents' perceived consumption knowledge of GM food was explored to determine whether they knew that they consume GM ingredients in the form of everyday food items. Respondents' knowledge of their consumption of GM food is summarised in Table 4.3. Consumers were asked whether they consume GM food, and they had the option to indicate "yes", "no" or "I don't know". Thereafter, respondents were asked whether they consume a list of ten food items, of which eight contained GM ingredients, and two items (potatoes and tomatoes) were not GM foods. Multi-ingredient products often contain GM ingredients from maize or soybean. Given the level of GM production for these commodities in South Africa, it is indeed likely that they may contain GM ingredients unless otherwise indicated on the packaging.

Table 4.3 Cross-tabulation of respondents' consumption of GM food

	Yes		No		I do not know		Effect sizes from cross tabulations	
	N	%	N	%	n	%	Phi	Sig.
Do you consume GM food?	210	100	34	100	66	100	-	-
Potatoes	204	97.1	31	91.2	65	98.5	0.115	0.127
Bread	205	97.6	30	88.2	65	98.5	0.171	0.011
Tomatoes	200	95.2	32	94.1	62	93.2	0.026	0.899
Chocolate	194	92.4	31	91.2	64	97.0	0.079	0.381
Vegetable oil	187	89.0	23	67.6	51	77.3	0.205	0.001
Low-fat yogurt	184	87.6	24	70.6	51	77.3	0.166	0.014
Soup powder	179	85.2	25	73.5	55	83.3	0.097	0.232
Corn Flakes	179	85.2	25	73.5	50	75.8	0.125	0.087
Maize Meal	180	85.7	26	76.5	44	66.7	0.198	0.002
Soy Milk	81	38.6	9	26.5	11	16.7	0.194	0.003

Small effect was phi = 0.10; medium effect was phi = 0.30; and large effect was phi = 0.50.
* The p-values are reported for completeness but will not be interpreted since a random sample was not used.

A cross tabulation was done to compare respondents' responses when asked if they consume GM food and their reported consumption of GM food. Table 4.3 indicates the frequencies of respondents' reported GM consumption and their reported consumption of food items. The cross tabulations indicate that all respondents do consume GM food, including those who indicated that they do not consume GM food and those who are unaware of their GM consumption, with results showing that 32.3% of respondents are not aware that they consume GM food ingredients. This approach was taken to determine whether respondents who thought they do not consume GM food only consume potatoes and tomatoes, which would confirm that they do not consume GM food. However, results indicated that GM

containing food was consumed by all respondents, even those who said that they do not consume GM food.

Cross tabulations were done to determine the association between self-acknowledged GM usage and actual usage of the different products. The phi-coefficients was used to measure the size of the effect between respondents' perceived consumption and their actual consumption (Table 4.3). Only small effects were found between respondents' perceived consumption (subjective knowledge) and actual consumption (phi <0.30), indicating that what they think they do and what they actually do is not associated. This result indicates that many consumers do not really know what they consume in terms of GM food, and it was found that they base their purchasing decisions on their subjective knowledge of GM food. This finding is consistent with studies exploring consumers' subjective and objective knowledge (Donoghue *et al.,* 2016:397).

Effect sizes were determined as ANOVAs to explore if there are correlations between consumers' subjective and objective knowledge and GM consumption. Large effects of practical significant differences were found between respondents who indicated that they do not know if they consume GM food, and respondents who indicated that they do consume and do not consume GM food with regards to **subjective knowledge** (Table 4.4). This finding serves as an indication that respondents who do not know if they consume GM food felt less confident in their subjective knowledge, since their reported mean indicates an average neutral answer opposed to the other respondents (both those who answered yes and no) .

A large effect or practical significant difference can be seen between the average **objective knowledge** scores of respondents who do not know if they consume GM food and those who said that they do consume GM food. Respondents who said they do not know had lower average objective knowledge scores ($\bar{x}$ = 4.59) than respondents who do consume GM food ($\bar{x}$ = 6.47).

Table 4.4 ANOVA between GM consumption groups with regards to respondents' subjective and objective knowledge

	n	%	Mean	SD	ANOVA p-value	Welch p-value
Subjective knowledge						
I do not know	66	21.3	3.00[a]	0.61	0.000	0.000
No	34	11.0	3.55[b]	0.67		
Yes	210	67.7	3.69[b]	0.65		
Objective knowledge						
I do not know	66	21.3	4.59[a]	2.16	0.000	0.000
No	34	11.0	5.56[ab]	2.19		
Yes	210	67.7	6.47[b]	1.91		

Small effects ≤0.2, medium effects ≤0.5, large effects ≤0.8.
* The p-values are reported for completeness but will not be interpreted since a random sample was not used.
** The means with different superscripts have large practical significant differences (≥0.8).
*** subjective knowledge mean score max = 5, objective knowledge mean score max = 10

4.5 Correlation between subjective and objective knowledge

A non-parametric correlation coefficient was calculated to determine whether respondents' subjective knowledge correlates with their objective knowledge. Based on each respondent's subjective knowledge and objective knowledge scores, the correlation is between medium and large (Spearman's rho = 0.401). This result serves as an indication that respondents who felt that they knew a lot (subjective knowledge) also tended to have high levels of objective knowledge of GM food for this specific sample. Interestingly, this correlation contradicts previous findings that show no correlations between consumers' subjective and objective knowledge in South African (Donoghue *et al.,* 2016:397; Van der Merwe *et al.,* 2011:407). In Figure 4.2, a scatterplot visually illustrates the relationship between subjective and objective knowledge.

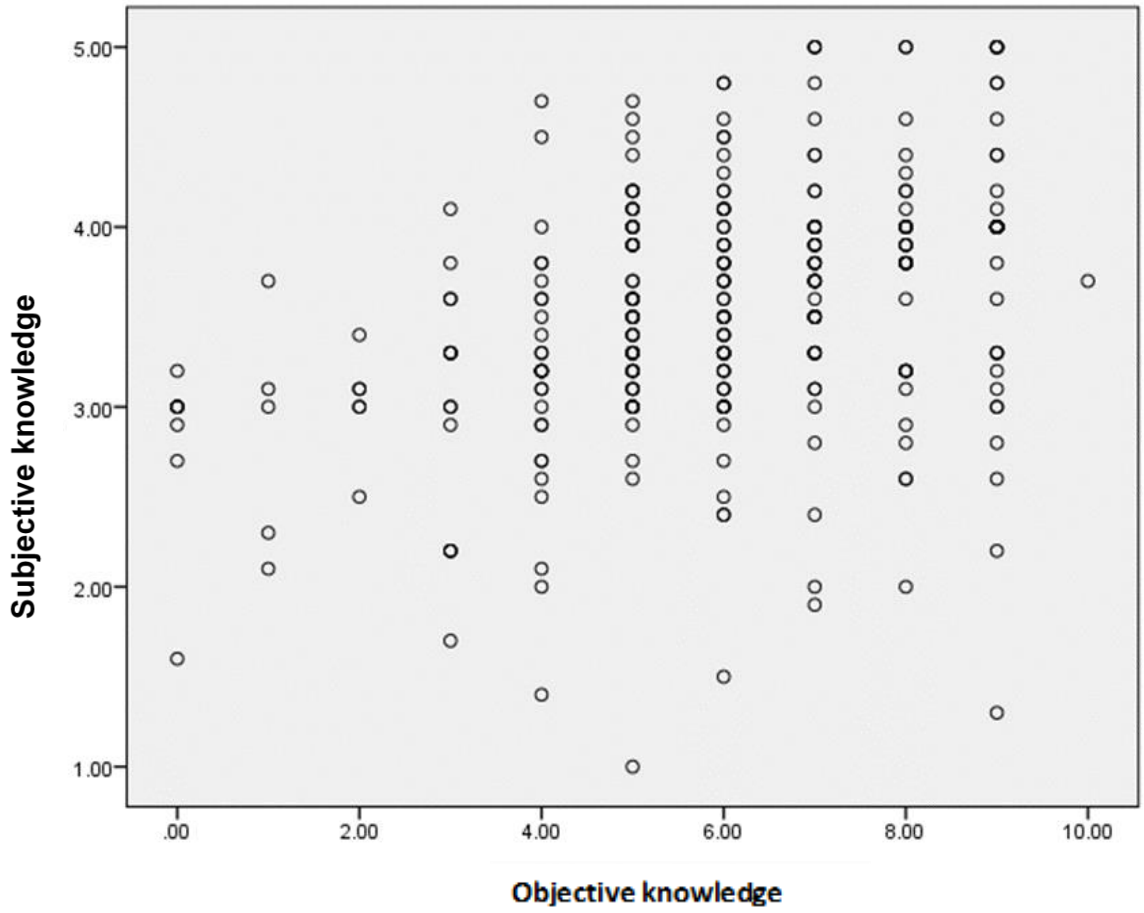


Figure 4.2 Scatterplot of the relationship between respondents' subjective and objective knowledge of GM food

4.6 Differences between consumers' demographic groups and their knowledge of GM food

The differences between demographical groups' subjective and objective knowledge of GM food was determined using the t-tests and ANOVAs. Effect sizes were used to determine if there were any practical significant differences between the demographical groups and their subjective and objective knowledge (Pietersen & Maree, 2016:234). The results of the tests with regards to subjective knowledge will be discussed first, and followed by those pertaining to objective knowledge.

For the purpose of t-tests, respondents' residency and home languages were both divided into two groups. The provinces in which respondents resided were categorised into Residency 1: Gauteng, Kwa-Zulu Natal and Western Cape, and Residency 2: Eastern Cape, Limpopo, Free State, North West, Mpumalanga and Northern Cape. Gauteng, Western Cape and Kwa-Zulu Natal were grouped together as these three provinces are home to the largest populations in

South Africa (STATS SA, 2016). The eleven official languages of South Africa were divided into two groups, namely Language group 1: English and Afrikaans, and Language group 2: African languages (isiZulu, isiXhosa, Northern Sotho, Setswana, Sesotho, Xitsonga, Tshivenda, siSwati and isiNdebele). T-tests were also used for the analysis of respondents' gender. ANOVAs were used for demographic characteristics with more than two groups, namely age, education and income.

4.6.1 Subjective knowledge

No large effects or practical significant differences (≥0.80) were found between respondents' demographic characteristics (age, gender, residency, language, education and income) and their subjective knowledge, indicating that respondents' demographic characteristics did not affect their subjective knowledge (Table 4.5). This finding corresponds with those of previous studies that also could not find correlations between respondents' subjective knowledge with regards to demographical groups (Donoghue *et al.,* 2016:397; House *et al.,* 2004:121). Table 4.5 presents the results of the t-tests and ANOVAs between respondents' subjective knowledge and their demographic characteristics.

Table 4.5 Results of the t-tests and ANOVAs regarding subjective knowledge

	n	%	Mean	SD	t-tests	ANOVA p-value	Welch p-value
Gender							
Male	128	41.3	3.61[a]	0.77	0.098		
Female	182	58.7	3.47[a]	0.63			
Residency							
Residency 1[1]	254	81.9	3.51[a]	0.71	0.313		
Residency 2[2]	56	18.1	3.61[a]	0.63			
Language							
Language 1[1]	180	58.1	3.42[a]	0.68	0.001		
Language 2[2]	130	41.9	3.68[a]	0.70			
Age							
18 – 25	69	22.3	3.67[a]	0.62		0.061	0.053
26 – 35	125	40.3	3.45[a]	0.69			
36 – 45	68	21.9	3.62[a]	0.78			
45 – 55	26	8.4	3.53[a]	0.65			
>55	22	7.1	3.25[a]	0.66			
Education							
Grade 12 and lower	39	12.6	3.68[a]	0.77		0.190	0.249
Grade 12 + degree or diploma	123	39.7	3.45[a]	0.68			
Postgraduate degree or diploma	67	21.6	3.46[a]	0.70			
Income							
<R10,000	83	26.8	3.45[a]	0.68		0.038	0.020
R10,000 – R15,000	150	48.4	3.48[a]	0.74			
>R15,000	77	24.8	3.70[a]	0.60			

Small effects ≤0.2, medium effects ≤0.5, large effects ≤0.8.
* The p-values are reported for completeness but will not be interpreted since a random sample was not used.
** The means with different superscripts have large practical significant differences (≥ 0.8).
[1]Residency 1: Gauteng, Western Cape, Kwa-Zulu Natal
[2]Residency 2: Mpumalanga, Limpopo, Free State, Eastern Cape, Northern Cape, North West.
[1]Language 1: English, Afrikaans
[2]Language 2: African (isiXhosa, isiZulu, Setswana, Sesotho, Xitsonga, siSwati, Tshivenda, isiNdebele, Northern Sotho).

4.6.2 Objective knowledge

No large effects or practical significant differences (≥0.80) were found between respondents' objective knowledge of GM food with regard to their demographic characteristics, indicating that their demographic characteristics (age, gender, residency, language, education and income) do not affect their objective knowledge of GM food. More specifically, no practical significant differences could be found between respondents' objective knowledge when compared across different education levels, which confirms findings of previous South African knowledge studies (Donoghue *et al.,* 2016:397; Van der Merwe *et al.,* 2011:407). However,

previous studies have found that consumers in the USA and EU who had a higher level of education also had a higher level objective knowledge of GM food (House *et al.,* 2004:121) however USA consumers were not as conscious of GM ingredient labelling (Hallman *et al.,* 2013:4-5). Table 4.6 represents the t-tests and ANOVAs for respondents' objective knowledge of GM food and their demographic characteristics.

Table 4.6 Results of the t-tests and ANOVAs regarding objective knowledge

	n	%	Mean	SD	t-test	ANOVA p-value	Welch p-value
Gender							
Male	128	41.3	6.15 [a]	2.21	0.225		
Female	182	58.7	5.85 [a]	2.08			
Residency							
Residency 1[1]	254	81.9	5.98 [a]	2.19	0.857		
Residency 2[2]	56	18.1	5.93 [a]	1.88			
Language							
Language 1[1]	180	58.1	5.76 [a]	2.22	0.033		
Language 2[2]	130	41.9	6.27 [a]	1.97			
Age							
18 – 25	69	22.3	5.96[a]	2.28		0.341	0.422
26 – 35	125	40.3	5.98[a]	2.10			
36 – 45	68	21.9	6.28[a]	2.01			
45 – 55	26	8.4	5.85[a]	1.89			
>55	22	7.1	5.18[a]	2.42			
Education							
Grade 12 and lower	39	12.6	6.15[a]	2.15		0.633	0.537
Grade 12 + degree or diploma	123	39.7	5.76[a]	2.25			
Postgraduate degree or diploma	67	21.6	6.02[a]	2.01			
Income							
<R10,000	83	26.8	5.52[a]	2.28		0.004	0.005
R10,000 – R15,000	150	48.4	5.89[a]	2.02			
>R15,000	77	24.8	6.61[a]	2.05			

Small effects ≤0.2, medium effects ≤0.5, large effects ≤0.8.

* The p-values are reported for completeness but will not be interpreted since a random sample was not used.

** The means with different superscripts have large practical significant differences (≥0.8).

[1]Residency 1: Gauteng, Western Cape, Kwa-Zulu Natal

[2]Residency 2: Mpumalanga, Limpopo, Free State, Eastern Cape, Northern Cape, North West.

[1]Language 1: English, Afrikaans

[2]Language 2: African (isiXhosa, isiZulu, Setswana, Sesotho, Xitsonga, siSwati, Tshivenda, isiNdebele, Northern Sotho).

4.7 Conclusion

A total sample of 310 South African residents who complied with the inclusion criteria submitted completed questionnaires. The demographic profile of the respondents indicated that the majority of respondents were aged between 18 and 45 years. The answers to the questions regarding education levels and monthly income indicated that more affluent consumers took part in the study as the majority had a tertiary education and income levels above minimum wage in South Africa, which might have been owing to the requirements of the inclusion criteria.

Overall, respondents felt neutral about their subjective knowledge of GM food even if they had higher levels of education. However, they did not indicate that they feel confident about their knowledge to make informed purchasing decisions. Subsequently, when their objective knowledge was explored, it was found that they have average levels of objective knowledge. Nevertheless, respondents' objective knowledge of GM food may depend upon the relevance thereof in their daily lives, i.e. technical scientific facts are less important than utilisation practices. However, respondents cannot be singled out, because lower levels of factual knowledge of GM food that does not apply to their daily lives, such as expert knowledge, was used to develop objective knowledge statements, which not all consumers may know.

Although results indicate that respondents' perception was that they know more than other consumers about GM food (subjective knowledge), and they have above average factual knowledge of GM food (objective knowledge), many respondents are unaware of their consumption of GM ingredients, or of the presence of GM ingredients in everyday food items (experience-based knowledge). When respondents' consumption of GM food was explored, it was found that a large percentage of respondents are not aware of the presence of GM ingredients in everyday food items which they may consume on a daily basis. This finding is an indication that many of the respondents do not have consumption knowledge of GM food. Consumption knowledge was explored as part of objective knowledge, indicating that even if respondents had factual knowledge of GM food, many of them may not utilise that knowledge. It was found that many respondents base their purchasing decisions on their subjective knowledge that may be factually incorrect.

This study found no significant differences between respondents' demographic group and subjective or objective knowledge of GM food. However literature indicates that the demographic groups of other consumers outside of South Africa had an influence on their subjective and objective knowledge of GM food, it was not the case in this study. Taking this finding into account, this study concludes that even affluent South African consumers do not

have high levels of objective knowledge, and many of these respondents are unaware of the presence and their daily consumption of GM ingredients in food items. A more detailed description of the study's findings is presented in the final chapter.

4.8 References

Alba, J. & Hutchinson, J.W. 2000. Knowledge calibration: what consumers know and what they think they know. *Journal of consumer research*, 27(2):123-156.

Brucks, M. 1985. The effects of product class knowledge on information search behavior. *Journal of consumer research*, 12(1):1-16.

Business Tech. 2017. It's official: national minimum wage set at R3,500 per month. https://businesstech.co.za/news/finance/1561/its-official-national-minimum-wage-set-at-r3500-per-month/ Date of access:8 Nov. 2017.

Cawthorn, D., Steinman, H.A. & Hoffman, L.C. 2013. A high incidence of species substitution and mislabelling detected in meat products sold in South Africa. *Food control*: 32(2):1-14.

Donoghue, S., Van Oordt, C. & Strydom, N. 2016. Consumers' subjective and objective consumerism knowledge and subsequent complaint behaviour concerning consumer electronics: a South African perspective. *International journal of consumer studies,* 40(4):385-399.

Field, A. 2009. Discovering statistics using SPSS. 3rd ed. London: Sage.

Hallman, W.L., Cuite, C.L. & Morin, X.K. 2013. Public perceptions of labeling genetically modified foods. http://s3.amazonaws.com/academia.edu.documents/39509254/Public_Perceptions_of_Labeling_Genetical20151028-15870-duwl33.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1492605841&Signature=dtkpCPPk0WjJDzmC1xh8V%2B2wWcY%3D&response-content-disposition=inline%3B%20filename%3DPublic_perceptions_of_labeling_genetical.pdf Date of access: 19 Apr. 2017.

House, L., Lusk, J., Jaeger, S., Traill, W.B., Moore, M., Valli, C., Morrow, B. & Yee, W.M.S. 2004. Objective and subjective knowledge: impacts on consumer demand for genetically modified foods in the United States and the European Union. *The journal of agro biotechnology management & economics*, 7(3):113-123.

Lee, J.K. & Lee, W. 2009. Country-of-origin effects on consumer product evaluation and purchase intention: The role of objective versus subjective knowledge. *Journal of international consumer marketing*, 21(2):137-151.

Malhotra, N.K. & Birks, D.F. 2007. Marketing research: an applied approach. 3rd ed. Essex: Prentice Hall.

Pietersen, J. & Maree, K. 2016. Standardisation of a questionnaire. (*In* Maree, K., *ed*. First steps in research. 2nd ed. Pretoria: Van Schaik Publishers. p. 237-247).

STATS SA (Statistics South Africa). 2010. Mid-year population estimates 2010 statistical release P0302. http://www.statssa.gov.za/publications/P0302/P03022010.pdf Date of access: 1 Nov. 2016.

STATS SA (Statistics South Africa). 2016. Statistics South Africa. http://cs2016.statssa.gov.za Date of access: 3 Nov. 2016.

Van der Merwe, D., Bosman, M., Ellis, S., De Beer, H. & Mielmann, A. 2012. Consumers' knowledge of food label information: an exploratory investigation in Potchefstroom, South Africa. *Public health nutrition,* 16(3):403-408.

Van der Veen, M. 2003. When is food a luxury? *World archaeology*, 34(3):405-427.

CHAPTER 5: CONCLUDING CHAPTER

5.1 Introduction

This chapter provides a comprehensive conclusion to this research project. The findings according to the study's objectives are discussed, followed by possible implications for future research and limitations of this research project. Finally, recommendations are made for further research projects based on the findings of this study.

5.2 Conclusion

According to the CPA of South Africa implemented in 2008, it is mandatory that GM ingredients in food products be labelled. However, it is not known how much consumers know about GM food and the presence of GM ingredients in food products that are consumed daily. For instance, maize is a staple food product for many South Africans, and in 2011, 77% of South African maize was produced by means of genetic modification. In addition, soy beans are used to fortify food products with protein, and 85% of South African soy is produced by means of genetic modification. With the presence of maize and soy in most processed food products, it is inevitable that South Africans will consume GM food at some point – whether it is through food items such as maize meal, corn flakes, protein bars, chocolates or low-fat yogurt. If consumers do not know that they consume GM-containing food items, they are deprived of their right to choose.

Consumers base their choices on their knowledge. The three categories of knowledge focused on in this study are subjective, objective and consumption knowledge, which are two different constructs with their own unique measurements. While subjective knowledge can be described as consumers' perceived knowledge, objective knowledge is knowledge based on factually correct information. When consumers base their choices on what they think is correct (subjective knowledge), they might be misled by their incorrect interpretation or understanding of information, and are thus deprived from making informed purchasing decisions.

However, objective knowledge is based on expert knowledge of a subject, and not all consumers may have high levels of objective knowledge, as some information does not affect their daily lives. Consumption knowledge was then explored as part of objective knowledge, where consumers had to indicate if they consume GM food as part of their experience-based knowledge, contributing to subjective and objective knowledge. Consumers' subjective and objective knowledge of GM food serve as an indication as to whether consumers are equipped to exercise their right to choose by making informed decisions regarding purchase and

consumption in the marketplace. Furthermore, the study aimed to explore whether there are associations between consumers' demographic characteristics and their knowledge.

To explore subjective knowledge, respondents had to rate their knowledge of GM food compared to other consumers on a five-point Likert scale. Results indicated that the majority of respondents rated their subjective knowledge of GM food as average. They indicated that they felt knowledgeable of GM food in most statements, yet when asked if they think they had sufficient knowledge about GM food to make informed purchasing decisions, many respondents did not indicate that they felt confident about their knowledge. Thus indicating that even if consumers think they are knowledgeable, they still feel uncertain in the marketplace.

Objective knowledge was explored by using a true or false scale containing ten factual statements of GM food, compiled through analysis of the literature and verified by GM food experts. Most respondents answered correctly on statements regarding GM food availability, labelling, purpose and production processes. When their objective knowledge scores were calculated, it was evident that the respondents had average levels of objective knowledge. Additionally, respondents with high levels of subjective knowledge tended to have high levels of objective knowledge. Those that thought they know more about GM food actually knew more. However, objective knowledge statements were based on expert scientific information and did not necessarily indicate that consumers are equipped to make informed purchasing decisions. Consumers also do not necessarily need expert GM food information to make informed food purchases, as such information does not influence their daily lives. However most respondents had higher levels of education, it did not play a role in their levels of objective knowledge, indicating that practical utilisation is more important to make informed consumption decisions.

Respondents had lower scores for objective knowledge about technical aspects of GM food, crop production processes and GM grain used for livestock. They also had lower scores for objective knowledge about organic food, which may be due to the fact that they do not have much exposure to such luxury food products. A need for education about the differences between GM food and organic food was identified. Even though the findings show above-average levels of subjective knowledge and average levels of objective knowledge, it can be concluded that consumers are not fully aware of their GM food consumption.

Although it was expected that consumers with higher levels of education and income would have higher objective knowledge, results did not support this assumption as no practical significant associations between respondents' demographic characteristics and their subjective and objective knowledge could be drawn. Previous research found little

associations between consumers' gender and age and their subjective and objective knowledge of GM food. No literature could be found with regards to previous studies exploring associations between South African consumers' subjective and objective knowledge of GM food and their home language and place of residency.

The demographic characteristics of the respondents indicated that they are comparatively more affluent consumers, since they earn considerably more than the minimum wage in South Africa, and many respondents had a tertiary education. If more affluent South African consumers do not feel confident in their subjective knowledge of GM food to make informed purchases, have average levels of objective knowledge and lack knowledge of their GM food consumption, it can be assumed that the less affluent and less educated consumers in South Africa are even more disadvantaged in making informed GM food purchase decisions. The question thus arises whether less affluent consumers who may be dependent on staple food processed with GM maize and soy ingredients are able to utilise their right to choose according to the CPA about their GM food intake.

There is a need for consumer education about GM food and GM ingredients in consumers' daily diets. This is necessary because consumers have a right to choose, but need objective knowledge to make informed decisions. Therefore it is necessary to educate consumers on factual knowledge impacting their consumption and daily lives. South African consumers need to know about GM technology and how it impacts food products, since they have a basic consumer right to the disclosure of information and the right to choose. Consumers also need to be educated on utilisation practices with regards to searching for GM information on food packaging and to enable them to identify GM ingredients in food products, thus empowering them to make informed food purchase decisions and thereby enhancing their wellbeing.

5.3 Practical implications of this study

5.3.1 Implications for future research and for consumers

Future research, both locally and internationally, can be conducted based on the results of this study. It is recommended that qualitative methods be implemented in future research to gain a deeper understanding of consumers' objective knowledge, which influences their daily lives. Future studies can also explore which information sources consumers use and trust to search for information about GM food. This information can be used to optimise educational programmes. These educational programmes will educate consumers on the presence of GM ingredients in their diet, which will aim to improve the wellbeing of the South African consumers by empowering them to make informed decisions.

5.3.2 Implications for the food industry

Companies can use these results to provide consumers with trustworthy information about the presence of GM ingredients in food products. The food industry should aim to improve the disclosure of information with regards to GM content on packaging material and their compliance with legislation. The food industry could earn consumers' trust by providing truthful information and making an honest attempt to explain the implications of such information. More knowledgeable consumers would then be able to make informed decisions and be less fearful of change and development of new food products. By investing in educational programmes to provide correct information to consumers about GM food, the food industry could gain consumer trust.

5.4 Limitations and recommendations

5.4.1 Sample

Owing to the non-probability, non-representative sample of the study, the results are not representative of the larger South African population. A similar study could be conducted that focuses on less affluent populations of South Africa for the purpose of developing and implementing educational programmes that will empower these consumers to make informed purchasing decisions. For future research projects, it is recommended that researchers target specific locations within South Africa and make use of random sampling to target a more diverse population. By situating the study in specific locations or municipality regions, those results can be generalised to that specific population. In turn, expert information about GM food that influences consumers' daily lives can be identified according to different demographic characteristics. Similar studies can be conducted at more than one location and the results can be compared with those from other regions. Future research can also focus on specific age groups and compare their knowledge and knowledge influences.

5.4.2 Nature of the study

Owing to the exploratory nature of the study and the use of a purposive sampling method, the results could not be generalised to the South African population. However, these results can be used as a baseline for future studies exploring South African consumers' knowledge of GM food.

BIBLIOGRAPHY

Aerni, P., Scholderer, J. & Ermen, J. 2011. How would Swiss consumers decide if they had freedom of choice? Evidence from a field study with organic, conventional and GM corn bread. *Food policy*, 36(6):830-838.

Agarwal, B. 2011. Food crises and gender inequality. http://www.un.org/esa/desa/papers /2011/wp107_2011.pdf Date of access: 24 Oct. 2017.

Ahmad, T.B.T. & Nordin, M.S. 2014. University students' subjective knowledge of green computing and pro-environmental behavior. *International education studies,* 7(2):64-74.

Alba, J. & Hutchinson, J.W. 2000. Knowledge calibration: what consumers know and what they think they know. *Journal of consumer research*, 27(2):123-156.

Aleksejeva, I. 2014. EU experts' attitude towards use of GMO in food and feed and other industries. *Procedia-social and behavioral sciences*, 110:494-501.

Ali, J. & Kapoor, S. 2009. Understanding consumers' perspectives on food labelling in India. *International journal of consumer studies*, 33(6):724-734.

Anon. 2011. Poverty and inequality in South Africa. *Mail & guardian*, 16 Sep. http://mg.co.za/article/2011-09-16-poverty-and-inequality-in-south-africa/ Date of access: 12 Feb. 2017.

Appiah-Adu, K. 1998. Marketing in emerging countries: evidence from a liberalized economy. *Journal of marketing practice: applied marketing science*, 4(4):118-129.

Babbie, E. & Mouton, J. 2001. The practice of social research. Cape Town: Oxford University Press.

Babbie, E.R. 2013. The practice of social research. 13th ed. Belmont: Cengage Learning.

Baron, R.A. & Branscombe, N.R. 2012. Social psychology. 13th ed. Upper Saddle River, NJ: Pearson.

Barreiro-Hurlé, J., Gracia, A. & De Magistris, T. 2008. Using latent classes to determine consumer heterogeneity in nutrition label valuation. *Food economics-acta agriculturae Scandinavica, Section C,* 5(3-4):178-193.

Barreiro-Hurlé, J., Gracia, A. & De-Magistris, T. 2010. The effects of multiple health and nutrition labels on consumer food choices. *Journal of agricultural economics*, 61(2):426-443.

Bernard, H.R. 2013. Social research methods: qualitative and quantitative approaches. 2nd ed. Los Angeles: Sage.

Betlehem, J. & Hundepool, A. 2002. On the documentation and analysis of electronic questionnaires. http://jpsm.umd.edu/qdet/final_pdf_papers/bethlehem.pdf Date of access: 25 Oct. 2016.

Blaikie, N. 2010. Designing social research. 2nd ed. Cambridge: Polity Press.

Bless, C., Higson-Smith, C. & Sithole, S.L. 2013. Fundamentals of social research methods: an African perspective. 5th ed. Cape Town: Juta.

Block, L.G. & Peracchio, L.A. 2006. The calcium quandary: how consumers use nutrition labels. *Journal of public policy and marketing*, 25(2):188-196.

Boccaletti, S., Passuello, F. & Soregaroli, C. 2017. Segregation between GM and non-GM inputs in EU feed and food supply chains: future scenarios. *AgBioForum*, 20(1):1-13.

Botha, G.M. & Viljoen, C.D. 2008. South Africa: a case study for voluntary GM labelling. *Food chemistry,* 112(4):1060-1064.

Botma, Y., Greeff, M., Mulaudzi, F.M. & Wright, S.C.D. 2010. Research in health sciences. Cape Town: Pearson.

Bredahl, L. 1999. Consumers' cognitions with regard to genetically modified foods - results of a qualitative study in four countries. *Appetite,* 33(3):343-360.

Brookes, G. & Barfoot, P. 2016. Global income and production impacts of using GM crop technology 1996–2014. *GM crops and food,* 7(1):38-77.

Brown, A. 2015. Understanding food principles and preparations. 5th ed. Stamford, CT: Cengage Learning.

Brucks, M. 1985. The effects of product class knowledge on information search behavior. *Journal of consumer research*, 12(1):1-16.

Business Tech. 2017. It's official: national minimum wage set at R3,500 per month. https://businesstech.co.za/news/finance/1561/its-official-national-minimum-wage-set-at-r3500-per-month/ Date of access:8 Nov. 2017.

Cant, M.C., Brink, A. & Brijball, S. 2006. Consumer behaviour. Cape Town: Juta.

Carlson, J.P., Vincent, L.H., Hardesty, D.M. & Bearden, W.O. 2008. Objective and subjective knowledge relationships: a quantitative analysis of consumer research findings. *Journal of consumer research*, 35(5):864-876.

CBI (Council for Biotechnology Information). 2016. Council of Biotechnology. http://www. whybiotech.com Date of access: 28 Sep. 2016.

Cheftel, J.C. 2005. Food and nutrition labelling in the European Union. *Food chemistry*, 93(3):531–550.

Corbetta, P. 2003. Social research: theory, methods and techniques. London: Sage.

Costa-Font, M., Gil, J.M. & Traill, W.B. 2008. Consumer acceptance, valuation of and attitudes towards genetically modified food: review and implications for food policy. *Food policy,* 33(2):99-111.

Cowburn, G. & Stockley, L. 2005. Consumer understanding and use of nutrition labelling: a systematic review. *Public health nutrition*, 8(1):21-28.

Cressey, D. 2013. Monsanto drops GM in Europe. *Nature,* 499(1):382-514.

Creswell, J.W. 2014. Research design: qualitative, quantitative, and mixed methods approaches. 4th ed. Los Angeles, CA: Sage.

Creswell, J.W. & Plano Clark, V.L. 2011. Designing and conducting mixed methods research. 2nd ed. Los Angeles, CA: Sage.

Custers, R., Bartsch, D., Fladung, M., Nilsson, O., Pilate, G., Sweet, J. & Boerjan, W. 2016. EU regulations impede market introduction of GM forest trees. *Trends in plant science,* 21(4):283-285.

Darley, W.K. & Johnson, D.M. 1993. Cross-national comparison of consumer attitudes towards consumerism in four developing countries. *Journal of consumer affairs,* 27(1):37-54.

De Steur, H., Gellynck, X., Storozhenko, S., Liqun, G., Lambert, W., Van Der Straeten, D. & Viaene, J. 2010. Willingness-to-accept and purchase genetically modified rice with high folate content in Shanxi Province, China. *Appetite,* 54(1):118-125.

Dellaert, B.G.C. & Häubl, G. 2012. Searching in choice mode: consumer decision processes in product search with recommendations. *Journal of marketing research,* 49(2):277-288.

Delport, C.S.L. & Roestenburg, W.J.H. 2011. Quantitative data collection methods: questionnaires, checklists, structured observation and structured interview schedules. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots: for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 171-205).

Delwaide, A., Nalley, L.L., Dixon, B.L., Danforth, D.M., Rodolfo, M.N.J., Van Loo, E.J. & Verbeke, W. 2015. Revisiting GMOs: are there differences in European consumers' acceptance and valuation for cisgenically vs transgenically bred rice? *PloS one*, 10(5):e0126060. http://journals.plos.org /plosone/article?id=10.1371/journal.pone.0126060 Date of access: 12 Feb. 2017.

Dodd, T.H., Laverie, D.A., Wilcox, J.F. & Duhan, D.F. 2005. Differential effects of experience, subjective knowledge and objective knowledge on sources of information used in consumer wine purchasing. *Journal of hospitality and tourism research*, 29(1):3-19.

Domingo, J.L. & Bordonaba, J.G. 2011. A literature review on the safety assessment of genetically modified plants. *Environmental international,* 37(4):734-742.

Donoghue, S. 2008. An explanation of consumer complaint behaviour concerning performance failure of major electrical household appliances. Pretoria: University of Pretoria. (Thesis – PhD).

Donoghue, S. & De Klerk, H.M. 2009. The right to be heard and to be understood: a conceptual framework for consumer protection in emerging economies. *Journal of consumer studies,* 33(4):456-467.

Donoghue, S. & De Klerk, H.M. 2013. Consumers' anger and coping strategies following appraisals of appliance failure. http://www.repository.up.ac.za/dspace/bitstream/handle/2263/21996/Donoghue_Consumers(2013).pdf?sequence=1 Date of access: 21 Sep. 2016.

Donoghue, S., Van Oordt, C. & Strydom, N. 2016. Consumers' subjective and objective consumerism knowledge and subsequent complaint behaviour concerning consumer electronics: a South African perspective. *International journal of consumer studies*, 40(4):385-399.

Du Plessis, F. 2007. Introduction and overview. (*In* Du Plessis, P.J. & Rousseau, G.G., *eds.* Buyer behaviour: understanding consumer psychology and marketing. Cape Town: Oxford Southern Africa. p. 3-15).

Erasmus, A.C. 2013. Consumerism and consumers as citizens . (*In* Mpinganjira, M., Dos Santos, M.A.O., Botha, E., Du Toit, D., Erasmus, A.C., Maree, T. & Mugobo, V.V., *eds.* Consumer behaviour: South African psychology and marketing applications. Cape Town: Oxford University Press. p. 353-381).

Eriksson, M., Ghosh, R., Hansson, E., Basnet, S. & Lagerkvist, C. 2017. Environmental consequences of introducing genetically modified soy feed in Sweden. *Journal of cleaner production*, 176(2018):46-53.

Eurobarometer. 2010. Special Eurobarometer biotechnology report. http://ec.europa.eu/public_opinion/archives/ebs/ebs_341_en.pdf Date of access: 29 Aug. 2015.

Evans, E.A. & Ballen, F.H. 2013. A synopsis of US consumer perception of genetically modified (Biotech) crops. http://edis.ifas.ufl.edu/pdffiles/FE/FE93400.pdf Date of access: 23 Aug. 2015.

Fan, Y. 2008. The rise of emerging market multi-dimensional and the impact on marketing. *Marketing intelligence & planning*, 26(4):353-358.

FAO (Food and Agriculture Organization of the United Nations). 2011. Module 8: processing and preservation, 2011. http://www.fao-ilo.org/fileadmin/user_upload/fao_ilo/pdf/JFFLSmodule_8_L02.pdf Date of access: 24 Oct. 2017.

FAO (Food and Agriculture Organization of the United Nations). 2013. The state of food and agriculture: food systems for better nutrition. Rome: FAO.

Field, A. 2009. Discovering statistics using SPSS. 3rd ed. London: Sage.

Flynn, L.R. & Goldsmith, R.E. 1999. A short, reliable measure of subjective knowledge. *Journal of business research*, 46(1):57-66.

Fouché, C.B. & De Vos, A.S. 2011. Formal formulations. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 89-100).

Fouché, C.B., Delport, C.S.L. & De Vos, A.S. 2011. Quantitative research designs. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 142-158).

Fox, W. & Bayat, M.S. 2011. A guide to managing research. Cape Town: Juta.

Gámbaro, A., Ellis, A.C. & Prieto, V. 2013. Influence of subjective knowledge, objective knowledge and health consciousness on olive oil consumption: a case study. *Food and nutrition sciences,* 4(04):445-453.

Gaskell, G., Bauer, M.W., Durant, J. & Allum, C.A. 1999. Worlds apart? The reception of genetically modified foods in Europe and the U.S. *Science,* 285(5426):384-387.

Gavaravarapu, S.R.M., Vemula, S.R., Rao, P., Mendu, V.V.R. & Polasa, K. 2009. Focus group studies on food safety knowledge, perceptions, and practices of school-going adolescent girls in South India. *Journal of nutrition education and behavior*, 41(5):340-346.

Gibson, C. & Hull, G. 2013. Everyone's guide to the Consumer Protection Act. Cape Town: Zebra Press.

Gorton, D., Mhurchu, C.N., Chen, M. & Dixon, R. 2008. Nutrition labels: a survey of use, understanding and preferences among ethnically diverse shoppers in New Zealand. *Public health nutrition*, 12(9):1359-1365.

Gracia, A., Loureiro, M. & Nayga, R.M. 2007. Do consumers perceive benefits from implementation of an EU mandatory nutrition labelling program? *Food policy*, 32(2):160-174.

Guo, L. & Meng, X. 2008. Consumer knowledge and its consequences: an international comparison. *International journal of consumer studies*, 32(3):260-268.

Hallman, W.K., Hebden, W.C., Aquino, H.L., Cuite, C.L. & Lang, J.T. 2003. Public perceptions of genetically modified foods: a national study of American knowledge and opinion. (Publication number RR1003-004). New Brunswick, NJ: Food Policy Institute, Cook College, Rutgers - The State University of New Jersey.

Hallman, W.L., Cuite, C.L. & Morin, X.K. 2013. Public perceptions of labeling genetically modified foods. http://s3.amazonaws.com/academia.edu.documents/39509254/Public_Perceptions_of_Labeling_Genetical20151028-15870-duwl33.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1492605841&Signature=dtkpCPPk0WjJDzmC1xh8V%2B2wWcY%3D&response-content-disposition=inline%3B%20filename%3DPublic_perceptions_of_labeling_genetical.pdf Date of access: 19 Apr. 2017.

Havenga, S.C. 2014. Food label knowledge: a comparison between a developing and developed country context. Potchefstroom: NWU. (Dissertation – M Consumer Sciences).

Hemphill, T.A. & Banerjee, S. 2015. Genetically modified organisms and the U.S. retail food labeling controversy: consumer perceptions, regulation, and public policy. *Business and society review*, 120(3):435-464.

Hess, R., Visschers, V.H.M. & Siegrist, M. 2011. The role of health-related, motivational and sociodemographic aspects in predicting food label use: a comprehensive study. *Public health and nutrition,* 15(3):407-414.

House, L., Lusk, J., Jaeger, S., Traill, W.B., Moore, M., Valli, C., Morrow, B. & Yee, W.M.S. 2004. Objective and subjective knowledge: impacts on consumer demand for genetically modified foods in the United States and the European Union. *The journal of agrobiotechnology management & economics*, 7(3):113-123.

Hoyer, W.D. & MacInnis, D.J. 2010. Consumer behavior. 5th ed. Mason, OH: South-Western Cengage Learning.

Internet World Stats. 2013. Internet world users by language. http://www.internet worldstats.com/stats7.htm Date of access: 1 Jul. 2015.

Ison, J. & Kontoleon, A. 2014. Consumer preferences for functional GM foods in the UK: a choice experiment. *Journal of agrobiotechnology management and economics*, 17(1):28-36.

James, C. 2006. Global status of commercialized biotech/GM crops, 2006. (ISAAA Brief no. 35). Ithaca, NY: ISAAA.

James, C. 2011. Global status of commercialized biotech/GM crops, 2011. (ISAAA Brief no. 43). http://www.isaaa.org/resources/publications/briefs/43/download/isaaa-brief-432011.pdf Date of access: 25 Aug. 2015.

James, C. 2012. Global status of commercialized biotech/GM Crops, 2012. (ISAAA Brief no. 44). Ithaca, NY: ISAAA.

Kamndaya, M., Vearey, J., Thomas, L., Kabiru, C.W. & Kazembe, L.N. 2015. The role of material deprivation and consumerism in the decisions to engage in transactional sex among young people in the urban slums of Blantyre, Malawi. *Global public health,* 11(3):295-308.

Klemz, B.R., Boshoff, C. & Mazibuko, N. 2005. Emerging markets in black South African townships. *European journal of marketing,* 40(5/6):590-610.

Klerck, D. & Sweeney, J.C. 2007. The effect of knowledge types on consumer perceived risk and adoption of genetically modified foods. *Psychology & marketing*, 24(2):171-193.

Knight, J.G., Mather, D.W., Holdsworth, D.K. & Ermen, D.F. 2007. Acceptance of GM food: an experiment in six countries. *Nature biotechnology*, 25(5):507-508.

Ladwig, P., Dalrymple, K.E., Brossard, D., Scheufele, D. & Corley, E.A. 2012. Perceived familiarity or factual knowledge? Comparing operationalizations of scientific understanding. *Science and public policy*, 39(6):761-774.

Laux, C.M., Mosher, G.A. & Freeman, S.A. 2010. Factors affecting college students' knowledge and opinions of genetically modified foods. *Journal of technology studies,* 36(2):2-9.

Lee, J.K. & Lee, W. 2009. Country-of-origin effects on consumer product evaluation and purchase intention: the role of objective versus subjective knowledge. *Journal of international consumer marketing*, 21(2):137-151.

Leedy, P.D. & Ormrod, J.E. 2005. Practical research: planning and design. 8th ed. Upper Saddle River, NJ: Merrill Prentice-Hall.

Lim Tung, O.J. 2013. Labelling of genetically modified food products in South Africa. Paper presented at the Environmental Law Association Conference, Salt Rock, Kwa-Zulu Natal, 27 July 2013. http://www.elasa.co.za/uploads/1/1/8/2/11823994/odile_lim_tung.pdf Date of access: 12 Feb. 2017.

Linnhoff, S., Volovich, E., Martin, H.M., Smiths, L.M. 2017. An examination of millennials' attitudes toward genetically modified organism (GMO) foods: is it Franken-food or super-food? *International journal of agricultural resources, governance and ecology*, 13(4):371-390.

Lu, L., Rahman, I. & Chi, C.G. 2016. Can knowledge and product identity shift sensory perceptions and patronage intentions? The case of genetically modified wines. *International journal of hospitality management,* 53:152-160.

Mackinson, D., Wrieden, W.L. & Anderson, A.S. 2010. Validity and reliability testing of a short questionnaire developed to assess consumers' use, understanding and perception of food labels. *European journal of clinical nutrition*, 64(2):210-217.

Malhotra, N.K. & Birks, D.F. 2007. Marketing research: an applied approach. 3rd ed. Essex: Prentice Hall.

Maree, K. & Pietersen, K. 2016a. The quantitative research process. (*In* Maree, K., *ed.* First steps in research. 2nd ed. Pretoria: Van Schaik. p. 162-172).

Maree, K. & Pietersen, K. 2016b. Sampling. (*In* Maree, K., *ed.* First steps in research. 2nd ed. Pretoria: Van Schaik. p. 191-202).

Mason, A.M., De Klerk, H.M., Sommervile, J. & Ashdown, S.P. 2008. Consumers knowledge on sizing and fit issues: a solution to successful apparel selection in developing countries. *International journal of consumer studies*, 32(3):276-284.

McLean-Meyinsse, P.E. 2001. An analysis of nutritional label use in the southern United States. *Journal of food distribution research*, 32(1):110-114.

McPeake, J., Bateson, M. & O'Neill, A. 2014. Electronic surveys: how to maximise success. *Nurse researcher*, 21(3):24-26.

McWilliams, M. 2012. Foods: experimental perspectives. 7th ed. Upper Saddle River, NJ: Pearson.

Meyer, K.E., Estrin, S., Bhaumik, S. & Peng, M.W. 2008. Institutions, resources, and entry strategies in emerging economies. *Strategic management journal,* 3(1): 61-80.

Miller, J.A., Topel, D.G. & Rust, R.E. 1976. USDA beef grading: a failure in consumer information? *Journal of marketing,* 40(1):25-31.

Molawa, S. 2009. The first and third world in Africa: knowledge access, challenges and current technological innovations. (*In* 1st International Conference on African Digital Libraries and Archives (ICADLA-I) held in Addis Ababa, Ethiopia on 1-3 July 2009. Addis Ababa. p. 1-8).

Momberg, D., Jacobs, B. & Sonnenberg, N. 2012. The role of environmental knowledge in young female consumers' evaluation and selection of apparel in South Africa*. International journal of consumer studies,* 36(4):408-415.

Mondello, L. 2013. Nutraceuticals and separations. *Analytical and bioanalytical chemistry,* 405(13):4589-4590.

Monsanto. 2015. Glyphosate and roundup brand herbicides. http://www.monsanto.com /glyphosate/pages/default.aspx Date of access: 30 Jan. 2017.

Murano, P.S. 2003. Understanding food science and technology. Wadsworth: Cengage Learning.

NCPC (National Cleaner Production Centre). 2008. Cleaner production overview. http://www.ncpc.co.za/media/cpsaoverview.html Date of access: 25 Aug. 2016.

Neuman, W.L. 2006. Social research methods. 6th ed. Boston: Pearson.

Neuman, W.L. 2011. Social research methods: qualitative and quantitative approaches. 7th ed. London: Pearson.

Nwaizugbo, I.C. & Ogunankwor, C.E. 2013. Measuring consumer satisfaction with consumer protection agencies-insights from complaints to CPA offices in Anambah state. *International journal of small business and entrepreneurship research,* 1(3):12-88.

O'Fallon, M.J., Gursoy, D. & Swanger, N. 2007. To buy or not to buy: impact of labelling on purchasing intentions of genetically modified foods. *Hospitality management,* 26(1):117-130.

Okigbo, R.N., Iwube, J.C. & Putheti, R. 2011. An extensive review on genetically modified (GM) foods for sustainable development in Africa. *e-Journal of science and technology*, 21. http://e-jst.teiath.gr Date of access: 16 Mar. 2015.

Oppong, S. 2014. Between Bandura and Giddens: structuration theory in social psychological research? *Psychological thought,* 7(2):111-123.

Parker, R. & Pace, M. 2017. Introduction to food science and food systems. 2nd ed. Boston: Cengage Learning.

Peter, L. & Karodia, A.M. 2014. An investigation into the consumer acceptance of genetically modified foods at the Chris Hani district municipality, Eastern Cape, South Africa. *Kuwait chapter of Arabian journal of business management review,* 3(11):264-296.

Pew Research Center. 2015. Americans, politics and science issues. http://www.pewinternet.org/files/2015/07/2015-07-01_science-and-politics_FINAL.pdf Date of access: 15 Nov. 2017.

Pieniak, Z., Verbeke, W. & Scholderer, J. 2010. Health-related beliefs and consumer knowledge as determinants of fish consumption. *Journal of human nutrition and dietetics,* 23(5):480-488.

Pietersen, J. & Maree, K. 2016a. Statistical analysis I: descriptive statistics. (*In* Maree, K., *ed.* First steps in research. 2nd ed. Pretoria: Van Schaik. p. 203-217).

Pietersen, J. & Maree, K. 2016b. Standardisation of a questionnaire. (*In* Maree, K., *ed*. First steps in research. 2nd ed. Pretoria: Van Schaik Publishers. p. 237-247).

Pinstrup-Andersen, P. 2009. Food security: definition and measurements. *Food security,* 1(1):5-7.

Polonsky, M.J., Vocino, A., Grau, S.L., Garma, R. & Ferdous, A.S. 2012. The impact of general and carbon-related environmental knowledge on attitudes and behaviour of US consumers. *Journal of marketing management,* 28(3-4):238-263.

Pouliot, C. & Godbout, J. 2014. Thinking outside the 'knowledge deficit' box. *Science & society*, 15(8):833-835.

Rahbar, E. 2010. Ethno-cultural differences and consumer understanding of eco-labels: an empirical study in Malaysia. *Journal of sustainable development,* 3(3):255-262.

Rajagopal, P. 2010. Consumer behavior: global shifts and local effects. New York, NY: Nova Science.

Reddy, K. & Rampersad, R. 2012. Ethical business practices: the Consumer Protection Act and socio-economic transformation in South Africa. *African journal of business management*, 6(25):7403-7413.

Renzaho, A.M.N. & Mellor, D. 2010. Food security measurement in cultural pluralism: missing the point or conceptual misunderstanding. *Nutrition,* 26(1),1-9.

Robson, K., Plangger, K., Campbell, C. & Pitt, L. 2014. Objective and subjective wine knowledge: evidence from an online study. http://academyofwinebusiness.com/wp-content/uploads/2014/07/CB02_Robson_Karen2.pdf Date of access: 11 Apr. 2016.

Rousseau, D. 2003. Consumerism and social responsibility. (*In* Du Plessis P.J. & Rousseau, G.G., *eds*. Buyers behaviour: a multi-cultural approach. 3rd ed. Cape Town: Oxford University Press. p.446-470).

Scheer, D., Rubik, D.R.F. & Gold, S. 2008. Enabling developing countries to seize EcoLabel opportunities: project background paper. Heidelberg Germany. Institute for Ecological Economy research. https://www.google.co.za/?gws_rd=ssl#q=Enabling+developing+countries+to+seize+ecolabel+opportunities:+project+background+paper Date of access: 25 Aug. 2016.

Schiffman, L.G. & Wisenblit, J. 2015. Consumer behavior. 11th ed. Essex, England: Pearson Education Limited.

Schobel, J., Schickler, M., Pryss, R., Maier, F. & Reichert, M. 2014. Towards process-driven mobile data collection applications: requirements, challenges, lessons learned. http://dbis.eprints.uni-ulm.de/1036/1/Schobel2014.pdf Date of access: 25 Aug. 2015.

Schönfeldt, H.C., Gibson N. & Vermeulen, H. 2010. The possible impact of inflation on nutritionally vulnerable households in a developing country using South Africa as a case study. *British Nutrition Foundation nutrition bulletin*, 35:254-267.

Shankar, B. & Thirtle, C. 2005. Pesticide productivity and transgenic cotton technology: the South African smallholder case. *Journal of agricultural economics*, 56(1):97-116.

Sharma, A. 2011. Role of family in consumer socialization of children: literature review. *Journal of arts, science & commerce,* 2(3):161-167.

Sheldon, I.M. 2001. Regulation of biotechnology: will we ever “freely” trade GMOs? 77th EAAE Seminar / NJF Seminar No. 325, August 17-18, 2001, Helsinki.

Shen, B., Wang, Y., Lo, C K.Y. & Shum, M. 2012. The impact of ethical fashion on consumer purchase behaviour. *Journal of fashion marketing and management*, 16(2):234-245.

Shiferaw, B., Prasanna, B.M., Hellin, J. & Bänziger, M. 2011. Crops that feed the world 6. Past successes and future challenges to the role played by maize in global food security. *Food security,* 3(3):307-327.

Siegrist, M., Cvetkovich, G. & Roth, C. 2000. Salient values similarity, social trust, and risk/benefit perceptions. *Risk analysis,* 20(3):195-203.

Solomon, M.R. 2013. Consumer behavior: buying, having, and being. 10th ed. Boston: Pearson.

South Africa Info. 2011. The languages of South Africa. http://www.southafrica.info/about/people/language.htm#distribution Date of access: 1 Nov 2016.

South Africa. 2011. Consumer Protection Act 68 of 2008 regulations. (Notice 293). *Government gazette*, 34180, 1 Apr.

SPSS Inc. 2017. IBM SPSS Statistics Version 24, Release 24.0.0 http://www-01.ibm.com/software/analytics/spss/ Date of access: 12 Oct. 2017.

STATS SA (Statistics South Africa). 2010. Mid-year population estimates 2010 statistical release P0302. http://www.statssa.gov.za/publications/P0302/P03022010.pdf Date of access: 1 Nov. 2016.

STATS SA (Statistics South Africa). 2011. Statistical release P0302: mid-year population estimates. http://www.statssa.gov.za/publications/P0302/P03022011.pdf Date of access: 3 Nov. 2016.

STATS SA (Statistics South Africa). 2014. Mid-year population estimates. http://www.statssa.gov.za/ publications/P0302/P03022014.pdf Date of access: 30 Jun. 2015.

STATS SA (Statistics South Africa). 2016. Statistics South Africa. http://cs2016.statssa.gov.za Date of access: 3 Nov. 2016.

Sternberg, R. 2006. Cognitive psychology. 4th ed. Belmont, CA: Thomson.

Strydom, H. 2011. Sampling in the quantitative paradigm. (*In* De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L., *eds*. Research at grass roots for the social sciences and human services professions. 4th ed. Pretoria: Van Schaik. p. 222-235).

Tabachnick, B.G. & Fidell, L.S. 2001. Using multivariate statistics. 4th ed. Boston: Allyn & Bacon.

Tanius, E. & Seng, S.W. 2015. Consumer awareness towards genetically modified (GM) foods. *International journal of business, economics and law,* 6(2):17-26.

Tavakol, M., & Dennick, R. 2011. Making sense of Cronbach's alpha. *International journal of medical education*, 2:53-55.

Thomson Reuters. 2010. National survey of healthcare consumers: genetically engineered food. http://www.justlabelit.org/wp-content/uploads/2011/09/NPR_report_GeneticEngineered Food-1.pdf Date of access: 11 Apr. 2016.

Tower, K.D. 1994. Consumer-centered social work practice: restoring client self-determination. *Social work,* 39(2):191-196.

UNDP (United Nations Development Programme). 2012. Africa human development report 2012: towards a food secure future. New York: United Nations Development Programme.

Ungerer, L. 2014. Consumer decision making and beyond. (*In* Schiffman, L. & Kanuk, L., *eds*. Global and Southern African perspectives: consumer behaviour. Essex, England: Pearson Education Limited. p. 404-441).

Van der Merwe, D., Bosman, M., Ellis, S., De Beer, H. & Mielmann, A. 2012. Consumers' knowledge of food label information: an exploratory investigation in Potchefstroom, South Africa. *Public health nutrition,* 16(3):403-408.

Van der Merwe, D., Bosman, M., Ellis, S., Van der Colff, N. & Warnock, M. 2014. Consumers' knowledge of textile label information: an exploratory investigation. *International journal of consumer sciences,* 38(1):18-24.

Van der Werff, M. 2014. Institutions of the societal acceptance of genetically modified crops in emerging economies: the case of Brazil, India and China. *Journal of world systems research*, 21(1):88-105. http://jwsr.pitt.edu/ojs/index.php/jwsr/article/viewFile/528/540 Date of access: 26 May 2016.

Vermeulen, H., Kirsten, J.F., Doyer, T.O. & Schönfeldt, H.C. 2005. Attitudes and acceptance of South African urban consumers towards genetically modified white maize. *Agrekon,* 44(1):118-137.

Vigani, M. & Olper, A. 2013. GMO standards, endogenous policy and the market for information. *Food policy*, 43:32-43.

Viljoen, C.D. & Marx, G.M. 2013. The implications for mandatory GM labelling under the Consumer Protection Act in South Africa. *Food control,* 31(2):387-391.

Viljoen, C.D., Dajee, B.K. & Botha, G.M. 2006. Detection of GMO in food products in South Africa: implication of GMO labelling. *African journal of biotechnology,* 5(2):73-82.

Wagoner, R.L. & Besikof, R.J. 2010. Community college fundraising: the voluntary support of education survey as a sampling tool for research. *Community college journal of research and practice,* 35(1-2):74-87.

WHO (World Health Organisation). 2015. Food, genetically modified. http://www.who.int /topics/food_genetically_modified/en/ Date of access: 16 Mar. 2015.

WHO (World Health Organization). 2016. Joint FAO/WHO meeting on pesticide residues: summary report, Geneva, UN, 9-13 May. http://www.who.int/foodsafety/jmprsummary 2016.pdf Date of access: 30 Mar. 2017.

Wyma, L., Van der Merwe, D., Bosman, M.J.C., Erasmus, A.C., Strydom, H. & Steyn, F. 2012. Consumers' preferences for private and national brand food products. *International journal of consumer studies,* 36(4):432-439.

Zhang, M. & Liu, G. 2015. The effects of consumer's subjective and objective knowledge on perceptions and attitude towards genetically modified foods: objective knowledge as a determinant. *International journal of food science and technology,* 50(5):1198-1205.

Zinoti, B. 2010. Public opinion survey on GMO in Lithuania. https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=582 Date of access: 11 Apr. 2016.

ANNEXURE A – QUESTIONNAIRE

QUESTIONNAIRE					
SECTION A: INCLUSION CRITERIA					
1. Please specify the province you live in.	Gauteng	1		V1.1	
	North West	2		V1.2	
	Free State	3		V1.3	
	Mpumalanga	4		V1.4	
	Limpopo	5		V1.5	
	Kwa-Zulu Natal	6		V1.6	
	Northern Cape	7		V1.7	
	Western Cape	8		V1.8	
	Eastern Cape	9		V1.9	
	Other	10		V1.10	
2. In what year were you born?				V2	
3. Have you ever purchased food for you/your family?	Yes	1		V3.1	
	No	2		V3.2	
4. Are you aware of genetically modified or GM food / GM technology / GMO's?	Yes	1		V4.1	
	No	2		V4.2	

SECTION B: CONSUMER KNOWLEDGE OF GM FOOD								
5.1. To which extent do you agree with the following statements about yourself: **Compared to an average person, I know a lot about...**	Strongly disagree	Disagree	Neither agree, nor disagree	Agree	Strongly agree			
1. the characteristics of genetically modified (GM) food.	1	2	3	4	5		V5.1.1	
2. various GM fresh produce that is available in South Africa.	1	2	3	4	5		V5.1.2	
3. how food is genetically modified.	1	2	3	4	5		V5.1.3	
4. the purpose of genetic modification of foods.	1	2	3	4	5		V5.1.4	
5. how GM food differ from organic food	1	2	3	4	5		V5.1.5	
6. the advantages and or disadvantages of GM food compared to regular/conventional food.	1	2	3	4	5		V5.1.6	
7. the difference in the production of GM food versus the production of organic food.	1	2	3	4	5		V5.1.7	
8. how to tell the difference between GM and non-GM food.	1	2	3	4	5		V5.1.8	
9. the difference in the labelling of GM and non-GM food.	1	2	3	4	5		V5.1.9	
10. GM food to feel confident when I make a purchase.	1	2	3	4	5		V5.1.10	

5.2. Please state whether the following statements on GM food are TRUE or FALSE.	True	False	I do not know			
1. GM food is sold in supermarkets in South Africa.	1	2	0		V5.2.1	
2. GM food can be produced using the DNA from bacteria to modify plants' DNA.	1	2	0		V5.2.2	
3. GM food crops require less pesticide than conventional crops overall.	1	2	0		V5.2.3	
4. An important purpose of the production of GM vegetables is to ensure a longer shelf life.	1	2	0		V5.2.4	
5. Seeds for GM foods are genetically manipulated in laboratories to make the food look more attractive.	1	2	0		V5.2.5	
6. Products containing GM ingredients should according to law be labelled to inform consumers.	1	2	0		V5.2.6	
7. Certified organic meat in South Africa means that the meat is from animals that have not been fed GM feed.	1	2	0		V5.2.7	
8. GM foods means no hormones are used in the production of the food.	1	2	0		V5.2.8	
9. GM feed may be used for livestock certified as being organic.	1	2	0		V5.2.9	
10. GM food is produced to address food insecurity in Third World countries.	1	2	0		V5.2.10	

6. Please answer the following questions regarding your food consumption	Yes	No	I do not know			
6.1 Do you consume any GM food?	1	2	0		V6.1	
6.2 Do you use any of the following products?						
1. Maize meal	1	2	0		V6.2.1	
2. Tomatoes	1	2	0		V6.2.2	
3. Soy milk	1	2	0		V6..2.3.	
4. Vegetable oil	1	2	0		V6.2.4	
5. Corn flakes	1	2	0		V6.2.5	
6. Low fat yogurt	1	2	0		V6.2.6	
7. Bread	1	2	0		V6.2.7	
8. Soup powders	1	2	0		V6.2.8	
9. Chocolate	1	2	0		V6.2.9	
10. Potatoes	1	2	0		V6.2.10	

SECTION C: DEMOGRAPHIC INFORMATION					
7. What is your gender?	Male	1		V7.1	
	Female	2		V7.2	
8. What is your highest level of education?	Lower than grade 12	1		V8.1	
	Grade 12	2		V8.2	
	Grade 12 + a degree or diploma	3		V8.3	
	Postgraduate degree or diploma	4		V8.4	
9. What is your home language?	English	1		V9.1	
	Afrikaans	2		V9.2	
	Setswana	3		V9.3	
	isiXhosa	4		V9.4	
	isiZulu	5		V9.5	
	Sesotho	6		V9.6	
	Xitsonga	7		V9.7	
	siSwati	8		V9.8	
	Tshivenda	9		V9.9	
	isiNdebele	10		V9.10	
	Northern Sotho	11		V9.11	
10. What is your monthly household income before tax?	Less than R5,000	1		V10.1	
	R5,000 or more but less than R10,000	2		V10.2	
	R10,000 or more but less than R15,000	3		V10.3	
	R15,000 or more but less than R25,000	4		V10.4	
	R25,000 or more	5		V10.5	

ANNEXURE B – READABILITY SCORESHEET

Purpose: Our Text Readability Consensus Calculator uses 7 popular readability formulas to calculate the average grade level, reading age, and text difficult of your sample text.

Your Results:

Your text: QUESTIONNAIRE Please answer the following questio ...(show all text)

Flesch Reading Ease score: 82 (text scale)
Flesch Reading Ease scored your text: easy to read.
[f] | [a] | [r]

Gunning Fog: 4.1 (text scale)
Gunning Fog scored your text: easy to read.
[f] | [a] | [r]

Flesch-Kincaid Grade Level: 2.6
Grade level: Third Grade.
[f] | [a] | [r]

The Coleman-Liau Index: 3
Grade level: Third Grade
[f] | [a] | [r]

The SMOG Index: 4
Grade level: Fourth Grade
[f] | [a] | [r]

Automated Readability Index: -3.4
Grade level: 3-5 yrs. old (Preschool)
[f] | [a] | [r]

Linsear Write Formula : 1
Grade level: First Grade.
[f] | [a] | [r]

Readability Consensus

Based on 8 readability formulas, we have scored your text:
Grade Level: 2

ANNEXURE C – HREC APPROVAL LETTER

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom,
South Africa, 2520

Tel: (018) 299-4900
Faks: (018) 299-4910
Web: http://www.nwu.ac.za

Institutional Research Ethics Regulatory Committee
Tel: +27 18 299 4849
Email : Ethics@nwu.ac.za

ETHICS APPROVAL CERTIFICATE OF STUDY

Based on approval by **Health Research Ethics Committee (HREC)** on **07/12/2016** after being reviewed at the meeting held on **11/08/2016**, the North-West University Institutional Research Ethics Regulatory Committee (NWU-IRERC) hereby **approves** your study as indicated below. This implies that the NWU-IRERC grants its permission that provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Consumers' subjective and objective knowledge of genetically modified food in a South African context.

Study Leader/Supervisor: **Ms L Wyma**
Student: **I Marx**

Ethics number: N W U - 0 0 0 6 7 - 1 6 - A 1
(Institution – Study Number – Year – Status)
Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type: Single Study
Commencement date: 2016-12-07 **Risk:** Minimal

Continuation of the study is dependent on receipt of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation up to a maximum period of three years.

Special conditions of the approval (if applicable):

- Translation of the informed consent document to the languages applicable to the study participants should be submitted to the HREC (if applicable).
- Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the HREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:

- *The study leader (principle investigator) must report in the prescribed format to the NWU-IRERC via HREC:*
  - *annually (or as otherwise requested) on the monitoring of the study, and upon completion of the study*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *Annually a number of studies may be randomly selected for an external audit.*
- *The approval applies strictly to the proposal as stipulated in the application form. Would any changes to the proposal be deemed necessary during the course of the study, the study leader must apply for approval of these amendments at the HREC, prior to implementation. Would there be deviated from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *The date of approval indicates the first date that the study may be started.*
- *In the interest of ethical responsibility the NWU-IRERC and HREC retains the right to:*
  - *request access to any information or data at any time during the course or after completion of the study;*
  - *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process.*
  - *withdraw or postpone approval if:*
    - *any unethical principles or practices of the study are revealed or suspected,*
    - *it becomes apparent that any relevant information was withheld from the HREC or that information has been false or misrepresented,*
    - *the required amendments, annual (or otherwise stipulated) report and reporting of adverse events or incidents was not done in a timely manner and accurately,*
    - *new institutional rules, national legislation or international conventions deem it necessary.*
- *HREC can be contacted for further information or any report templates via Ethics-HRECApply@nwu.ac.za or 018 299 1206.*

The IRERC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the IRERC or HREC for any further enquiries or requests for assistance.

Yours sincerely

Prof LA Du Plessis
Digitally signed by Prof LA Du Plessis
Date: 2017.01.11 09:18:10 +02'00'

Prof Linda du Plessis
Chair NWU Institutional Research Ethics Regulatory Committee (IRERC)

ANNEXURE D – STATISTICAL SERVICES CONFIRMATION LETTER

SKD SCS

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

Statistical Consultation Services
Tel: +27 18 299 2652
Fax: +27 0 87 231 5294
Email: marelize.pretorius@nwu.ac.za

7 June 2016

For attention: Ethics Committee

Faculty of Health Sciences

Re: South African consumers' subjective and objective knowledge of genetically modified food, Ms Izelri Marx 22855246

I hereby confirm that I have reviewed the project's research design in terms of sample size and sampling method. Due to funding and the sampling technique used, a random sample will not be feasible in this case. I therefore recommend that a voluntary sample should be used instead and that the researcher should aim for at least 300 responses. Therefore, the results will not be interpreted by generalising the findings to the broader South African community. I would also recommend that the title is changed to *Consumers' subjective and objective knowledge of genetically modified food in a South African context*.

I have also reviewed the questionnaire in terms of face validity and basic statistical justifiability.

The translation and content validity of the questionnaire as well as ensuring that the study fulfils the academic requirements remains the responsibility of the student and supervisors.

Kind regards

Pretorius

Me M Pretorius

Statistical Consultation Services

ANNEXURE E – ASKAFRIKA CONTRACT

Head Office – South Africa
Lakeview Office Park, 137 Mucklenauk Street,
Nieuw Muckleneuk, Pretoria 0181, South Africa
P.O. Box 2088, Brooklyn Square 0075, South Africa

Tel: +27 12 428 7400 • Fax: +27 12 346 5366

www.askafrika.co.za

23 May 2016

GMO Foods Survey – Izelri Marx

Good day Izelri

As discussed I can confirm:

1. Ask Afrika will assist with the operational aspects of your research study on GMO foods
2. Ask Afrika will send a survey to approximately 15 000 respondents across South Africa
    a. The required inclusion and excludsion criteria will be programmed into the survey as provided by Izelri Marx
3. The NWU consent form will be completed digitally by all respondents before the survey is attempted
4. Ask Afrika will comply with SAMRA, ESOMAR regulation as well as NWU ethical regulations as communicated

Kind regards

Jean-Jacques Moolman

Associate Accounts Director

Ask Afrika (Pty) Ltd

Head Office: ***+27 (0)12 428 7400***

Mobile Phone: +27 (0)71 356 0829

Web Portal: ***www.askafrika.co.za***

ANNEXURE F – ADVERTISEMENT

GENETICALLY MODIFIED FOOD

WHAT DO YOU KNOW?

CONSUMER KNOWLEDGE

SOUTH AFRICA

FROM 24 APRIL 2017

CONSUMER SCIENCES

YOU MAY PARTICIPATE IF:

- You are subscribed to a database of AskAfrika
- You live in South Africa
- You are 18 years or older
- You can read, write and understand English
- You have purchased food products.

YOU MAY NOT PARTICIPATE IF:

- You are not aware of GM food,
- You do not have access to the Internet
- You do not know how to work with computers or mobile devices.

WE NEED YOUR PARTICIPATION!

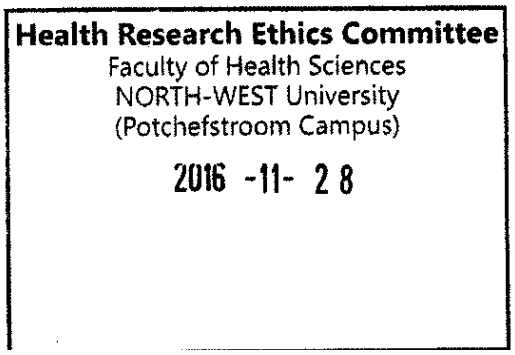
For more information please contact:
Mrs. Louise Wyma
louise.wyma@nwu.ac.za

ASK AFRIKA
DARE TO KNOW

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

ANNEXURE G – CONSENT FORM

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS



HREC Stamp

RESPONDENT INFORMATION LEAFLET AND CONSENT FORM FOR SOUTH AFRICAN CONSUMERS PARTICIPATING IN THE STUDY OF CONSUMERS' KNOWLEDGE OF GENETICALLY MODIFIED (GM) FOOD

TITLE OF THE RESEARCH PROJECT: CONSUMERS' SUBJECTIVE AND OBJECTIVE KNOWLEDGE OF GENETICALLY MODIFIED FOOD WITHIN A SOUTH AFRICAN CONTEXT

REFERENCE NUMBERS: NWU-00067-16-A1

PRINCIPAL INVESTIGATOR: Louise Wyma

ADDRESS: Hoffman Street, NWU Potchefstroom Campus, Potchefstroom, 2520.

CONTACT DETAILS: louise.wyma@nwu.ac.za

You are being invited to take part in a research project that forms part of my master's degree. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Furthermore, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee of the Faculty of Health Sciences of the North-West University (NWU-00067-16-S1)** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki and the ethical guidelines of the National Health Research Ethics Council. It might be necessary for the research ethics committee members or relevant authorities to inspect the research records.

What is this research study all about?

- *This study will be done in South Africa and will involve electronic questionnaires on AskAfrika and will be conducted by researchers in the field of consumer sciences. 300 questionnaires are needed for this study.*
- *We want to explore:*
    - *what people think they know about GM food,*
    - *what people really know about GM food, and*
    - *how demographic information influences people's knowledge.*

Why have you been invited to participate?

- *You are subscribed to a database of AskAfrika*
- *You live in South Africa,*
- *You are 18 years or older,*
- *You can read, write and understand English,*
- *You have purchased food products for your household before.*

You may not participate when:

- *you do not know about GM food,*
- *you do not have internet access,*
- *you are not able to use a computer or mobile phone.*

What will your responsibilities be?

- *You can sign the consent and immediately continue to the questionnaire, or you can take your time to think about the consent and come back to it at a time that suits you.*
- *You will be expected to fill in this questionnaire once, at a time that best suits you.*
- *Only 300 completed questionnaires can be used, so the study can close at any time without warning.*
- *It will take you 15 minutes to complete the questionnaire.*

What will the researcher's responsibilities be?

- *To conduct ethical research and keep the participants' information confidential and anonymous.*

Will you benefit from taking part in this research?

- *There are no direct benefits, but your answers will help to determine South African consumers' knowledge about GM foods.*
- *The indirect benefit will be that educational programmes can become available in the future to teach people about GM foods.*

Are there risks involved in your taking part in this research?

- *This study will need your time and effort, but the questionnaire is short and easy. When you cannot complete the questionnaire due to technical problems, you can proceed with the questionnaire when the problem is sorted out. Please answer all the questions as true as you can. Be assured that your contact information will not be shared with others or in the results of this study. You will be anonymous.*

What will happen in the unlikely event of some harm/form of discomfort occurring as a direct result of your taking part in this research study?

- *In the case of technical problems, you can go to the questionnaire again by giving the same contact number you gave at the beginning. The questionnaire cannot be accessed again if you have submitted your answers.*

Who will have access to the data?

- *Partial anonymity will be ensured by not asking you to provide your identity; only a contact number will be asked to track your questionnaire if you want to withdraw after your answers were submitted. Your number will not be used for anything else. Only the researchers will have access to the contact details, which will only be used to track the questionnaire if you wish to withdraw. The statistician will receive a copy of the data* ***without*** *the contact details to keep the questionnaires anonymous. Data will be kept safe and secure by password protecting electronic data. Data will be stored for five years after which it will be destroyed permanently.*

What will happen with the data?

- *This is a once-off collection and the data will be analysed in South Africa on the Potchefstroom Campus of the North-West University by the researcher and a statistician of the North-West University's Statistical Consultation Services.*
- *The ethics research committee of The North-West University (Potchefstroom Campus) may inspect research records.*

Will you be paid to take part in this study and are there any costs involved?

- *No, you will not be paid to take part in the study and there are no costs involved to participate.*

Is there anything else that you should know or do?

- *You can contact my study leader, Louise Wyma, at louise.wyma@nwu.ac.za, if you have any further queries or encounter any problems.*

- *You can contact the Health Research Ethics Committee via Mrs Carolien van Zyl at 018 299 2016 or carolien.vanzyl@nwu.ac.za if you have any concerns or complaints that have not been adequately addressed by the researcher.*

How will you know about the findings?

- *The findings will be sent to AskAfrika where it will be posted on their website.*

- **Declaration by respondent**

The http link at the end of this document will take you to the online questionnaire on SurveyFace. By clicking on the link you will declare:

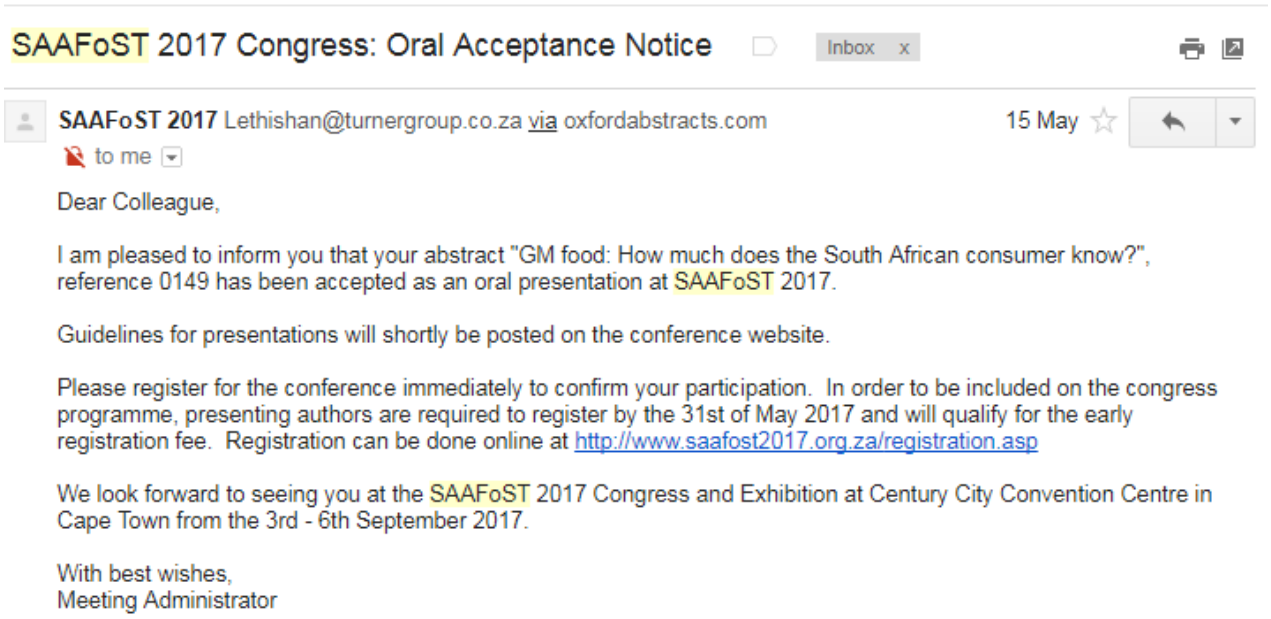
- I have read this information and consent form and it is written in a language in which I am comfortable.
- I was given the opportunity to ask questions and all my questions have been adequately answered (if applicable).
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed upon.
- I understand that my contact information will be handled confidentially and that the number I give will only be used to trace the questionnaire if I wish to withdraw after I have submitted my answers.

I have read, agree and understand the purpose, procedure, inclusion criteria, exclusion criteria and motivation for this study. I understand that my participation is voluntary and anonymous and that I can withdraw at any time.

URL LINK TO QUESTIONNAIRE (will appear when the respondent ticked the 'agree' option)

ANNEXURE H – CONGRESS INVITATION LETTERS

SAAFoST 2017



SAAFoST 2017 Congress: Oral Acceptance Notice

Inbox x

SAAFoST 2017 Lethishan@turnergroup.co.za via oxfordabstracts.com 15 May

to me

Dear Colleague,

I am pleased to inform you that your abstract "GM food: How much does the South African consumer know?", reference 0149 has been accepted as an oral presentation at SAAFoST 2017.

Guidelines for presentations will shortly be posted on the conference website.

Please register for the conference immediately to confirm your participation. In order to be included on the congress programme, presenting authors are required to register by the 31st of May 2017 and will qualify for the early registration fee. Registration can be done online at http://www.saafost2017.org.za/registration.asp

We look forward to seeing you at the SAAFoST 2017 Congress and Exhibition at Century City Convention Centre in Cape Town from the 3rd - 6th September 2017.

With best wishes,
Meeting Administrator

SAAFECS 2018

SAAFECS

South Africa Association of Family Ecology and Consumer Science

17 October 2017

Dear Miss I Marx, Mrs L Wyma, Mrs E Botha and Prof CD Viljoen

Thank you for submitting your abstract, SAAFECS2018020 (Subjective and objective consumer knowledge of GM food in South Africa) for consideration and inclusion in the programme for the 13th International SAAFECS Conference to be held at St. George Hotel and Conference Centre, Centurion, South Africa from 5 – 9 March 2018.

This is to confirm that your abstract has been approved for presentation at the SAAFECS Conference. I congratulate you and invite you to register and attend the conference and present the student paper.

Reviewer remarks:
Exciting paper. Looking forward to this student presentation. Hope the data will then have been analysed.

Important dates:
Final closing date for registration: 13 November 2017
Final closing date for proof of payment: 8 January 2018
If you have not provided the proof of payment by the due date, your presentation will be removed from the programme.

Please find attached a Delegate Registration Form.

Regards

PLawson

Ms Petra Lawson
Conference Administrator (SAAFECS 2018)
E-mail: conferencepl@gmail.com
Phone: (27) 83 231 6538

ANNEXURE I – TURNITIN REPORT

IMarx_Dissertation_for_Turnitin_30Nov.docx

by IZELRI MARX

Submission date: 01-Dec-2017 11:50AM (UTC+0200)
Submission ID: 888232806
File name: IMarx_Dissertation_for_Turnitin_30Nov.docx (65.32K)
Word count: 18958
Character count: 106838

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ANNEXURE J – LETTER FROM THE LANGUAGE EDITOR

04/12/2017

To whom it may concern,

This letter serves to confirm that the attached dissertation by Izelri Marx with the title "Consumers' subjective and objective knowledge of GM food in a South African context" has been edited by a qualified language practitioner. For further verification, I may be contacted by email: kellygilbertson@gmail.com or by cellphone: 0616150292/+447984529866.

Kind regards,

Kelly-Anne Gilbertson

ANNEXURE K – SOLEMN DECLARATION

NWU®

Higher Degrees Administration

SOLEMN DECLARATION AND PERMISSION TO SUBMIT

1. Solemn declaration by student

I, **Izelri Marx**

declare herewith that the thesis/dissertation/mini-dissertation/article entitled (**exactly as registered/approved title**).

Consumers' subjective and objective knowledge of genetically modified food in a South African context

which I herewith submit to the North-West University, Potchefstroom Campus, is in compliance/partial compliance with the requirements set for the degree:

Master of Science in Consumer Sciences

is my own work, has been text-edited in accordance with the requirements and has not already been submitted to any other university.

LATE SUBMISSION: If a thesis/dissertation/mini-dissertation/article of a student is submitted after the deadline for submission, the period available for examination is limited. No guarantee can therefore be given that (should the examiner reports be positive) the degree will be conferred at the next applicable graduation ceremony. It may also imply that the student would have to re-register for the following academic year.

Signature of Student: Izelri Marx — Digitally signed by Izelri Marx Date: 2017.12.02 09:26:52 +02'00'

University Number: 22855246

Signed on this 2 day of December of 20 17

2. Permission to submit and solemn declaration by supervisor/promoter

The undersigned declares that the thesis/dissertation/mini-dissertation complies with the specifications set out by the NWU and that:

- the student is hereby granted permission to submit his/her mini-dissertation/ dissertation/thesis:
  (•) Yes ( ) No
- that the student's work has been checked by me for plagiarism (by making use of TurnItIn software for example) and a satisfactory report has been obtained:
  (•) Yes ( ) No

Signature of Supervisor/Promoter: Louise Wyma — Digitally signed by Louise Wyma DN: cn=Louise Wyma, o=NWU, ou=Consumer Science, email=louise.wyma@nwu.ac.za, c=ZA Date: 2017.12.04 12:30:20 +02'00'

Date: 4/12/2017

Original details: Marietjie Ackermann(10512187) R/SSupport doc's\SOLEMN DECLARATION AND PERMISSION TO SUBMIT.docm 28 July 2017

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