Exploring household food security and the acceptance of an amaranth enriched food product

Lizelle Coetzee

21189536

Dissertation submitted in fulfilment of the requirements for the degree *Magister Scientiae* in Consumer Sciences at the Potchefstroom Campus of the North-West University

Supervisor: Dr H de Beer

Co-supervisor: Dr A Mielmann

October 2015

ACKNOWLEDGEMENTS

I would like to express sincere gratitude towards the following:

- My supervisor, Dr H de Beer, for her advice, motivation and guidance throughout the past years
- My co-supervisor, Dr A Mielmann, for her critical eye to achieve perfection and constant encouragement
- Dr S Ellis for assistance with the statistical analysis
- AUTHeR for their financial support which made this study possible
- Anna Nqongolo for her assistance during the product development and sensory evaluation stages and her kind words of encouragement
- All colleagues of the Consumer Sciences subject group for their willingness to contribute wherever they could
- All respondents that took part in the study for willingly offering their time to participate
- My family and friends for their love, support and encouragement throughout the course of the study and especially during difficult times when the end seemed out of sight
- Most importantly, our Heavenly Father for providing me with this remarkable opportunity and for giving me the perseverance to complete this dissertation.

SUMMARY

Food insecurity affects a large part of the South African population's households, even though the country is classified as being food secure. Several poor households experience insufficient food security. In general, agricultural means of addressing food insecurity have been explored with a measure of success. For this study amaranth, a widely grown traditional leafy vegetable, the lesser known grain-producing species, the grain amaranth, has been selected, because it can further contribute to households' food supply. This research study aimed to propose a different approach of dealing with food insecurity, altering commonly consumed wheat bread by enriching it with grain amaranth flour. The study was conducted in two phases. During the first phase a quantitative household survey obtained data from two different income groups: Group A's respondents were recruited among cleaners, and represented mainly the lower income group, while respondents from Group B were recruited among staff at the NWU and represented the middle to higher income group. The questionnaire acquired demographic information, food consumption patterns and food security situation. The food consumption patterns from Phase I revealed that bread was the most consumed food item among all respondents, thus the most appropriate food item to be enriched with grain amaranth. During Phase II enriched bread was developed and sensorially evaluated. A quantitative questionnaire with a seven-point hedonic scale measured the acceptance of the amaranth enriched bread samples. An untrained consumer sensory evaluation panel evaluated the acceptance, preference and purchase intent for the bread samples. The three samples consisted of the control brown wheat bread made from wheat flour, while 15% and 25% grain amaranth flour respectively replaced the wheat flour in the second and third samples. Results from the household survey revealed that none of the lower -income households was food secure, while 66.7% of the higher income group was. Approximately a quarter of the households presented in this study were identified as being at risk of becoming food insecure, revealing 27% of the lower -income group and 24.7% of the middle to higher income groups. Reason for concern were the 73% of lower income households experiencing food insecurity on a regular basis compared to 8.6% of the middle to higher income households who also experienced food insecurity on a regular basis. Results from sensory evaluation panels revealed that both amaranth enriched amaranth enriched breads were acceptable. Respondents indicated they either "slightly like" or "like" the samples. Thus this study revealed that the nutritional intake of households could be improved by enriching bread up to 25% of grain amaranth flour. The exceptional nutritional value of grain amaranth and acceptable sensory characteristics of the enriched bread could enhance the food security situation of households.

KEY WORDS

Food consumption, household food security, grain amaranth, amaranth enriched bread, sensory evaluation, acceptability

OPSOMMING

Voedselonsekerheid affekteer ‘n groot deel van die Suid-Afrikaanse bevolking, alhoewel Suid-Afrika as ‘n voedselsekerland beskou word. Verskeie huishoudings ervaar onvoldoende voedselsekerheid. Deur die gebruik van landboukundig-verwante aspekte is voedselsekerheid deels aangespreek. Die doel van hierdie studie was om ‘n alternatiewe benadering om huishoudelike voedselonsekerheid te verbeter voor te stel deur ‘n gewone koringbrood met graanamarantmeel te verryk. Amarant, ’n bekende tradisionele blaargroente wat wild groei, het ook saadproduserende spesies (bekend as graanamarant) wat verder tot voedselvoorsiening kan bydra. Die studie het in twee fases plaasgevind. Tydens die eerste fase is ‘n kwantitatiewe huishoudelike vraelys gebruik om inligting by twee verskillende inkomstegroepe in te samel: Groep A se respondente is onder skoonmakers gewerf en verteenwoordig hoofsaaklik die laer inkomstegroep, terwyl respondente van Groep B gewerf is onder NWU personeel en die gemiddelde tot hoër inkomstegroep verteenwoordig. Die vraelys het demografiese inligting, voedselverbruikpatrone en voedselsekerheidstatus bepaal. Na data-analise van die voedselpatrone tydens Fase I is brood geïdentifiseer as die mees geskikte voedselitem om te verryk omdat dit deur die meeste respondente verbruik word. Gedurende Fase II is die verrykte brood ontwikkel en sensories geëvalueer. ‘n Kwantitatiewe vraelys met ‘n sewe-punt hedoniese skaal is gebruik om die aanvaarbaarheid van die amarant-verrykte broodmonsters te meet. Vervolgens is die aanvaarbaarheid van die broodmonsters en die voorkeur en aankoopvoorneme van die verbruikers, deur ‘n onopgeleide verbruikerspanele geëvalueer. Die eerste broodmonsters het uit die kontrole-bruinbrood van koringmeel bestaan, terwyl 15% en 25% graanamarantmeel onderskeidelik die bruinbroodmeel by die twee ander brode vervang het. Verwerking van die huishoudelike vraelys het aangedui dat geen lae-inkomste huishouding in hierdie studie voedselseker was nie, teenoor die 66.7% van die hoër inkomstegroep wat was. By beide die laer (27%) en gemiddeld tot hoër (24.7%) inkomstegroepe het ongeveer ’n kwart van die verteenwoordigende huishoudings aangetoon dat die huishoudings ‘n risiko met betrekking tot voedselsekerheid ondervind het. Dit is kommerwekkend dat 73% van die lae-inkomste huishoudings aangetoon het dat daar op ‘n gereelde basis onvoldoende voedsel in die huis was. Verder het 8.6% van die huishoudings uit die hoër inkomstegroep voedselonsekerheid ervaar. Resultate van die sensoriese evaluering het bewys dat beide die amarantverrykte broodmonsters aanvaarbaar was. Oor die algemeen het deelnemers aangedui dat die amarantverrykte broodmonsters “*effens van gehou”* tot *“van gehou”* word*.* Hierdie studie onthul dus dat die voedingsinname van huishoudings verbeter kan word deur broodmeel met tot 25% amarantmeel te vervang. Die uitstekende voedingswaarde van graanamarant en die aanvaarbare sensoriese eienskappe van die verrykte brood kan deur huishoudings gebruik word om die voedselsekerheidsituasie van die huishouding te verbeter.

SLEUTELTERME

Voedselverbruik; huishoudelike voedselsekerheid; graanamarant; amarantverrykte brood; sensoriese evaluering; aanvaarbaarheid

ABBREVIATIONS

ANOVA	Analysis of Variance
Ca	Calcium
DoA	Department of Agriculture
DoAFF	Department of Agriculture, Forestry and Fisheries
FACT	Food Action Rating scale
FAO	Food and Agriculture Organisation
FBDG	Food-Based Dietary Guidelines
Fe	Iron
HHS	United States Department of Health and Human Sciences
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Virus
HREC	Health Research Ethical Committee
IBM	International Business Machine
IFSS	Integrated Food Security Strategy
JAR	Just About Right scale
Lys	Lysine
MDG	Millennium Developmental Goals
Mg	Magnesium
Mn	Manganese
Na	Sodium
NWU	North West University
P	Phosphorus
SA	South Africa
SANHANES	South African National Health and Nutrition Examination Survey

SE	Sensory Evaluation
StatsSA	Statistics South Africa
SPSS	Statistical Package for Social Sciences
TB	Tuberculosis
TLV	Traditional Leafy Vegetables
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNMP	United Nations Millennium Project
US	United States
WFP	World Food Programme
Zn	Zinc

CONCEPT CLARIFICATION:

Food security	When individuals have material, communal and financial access to adequate amounts of safe and wholesome food complying with their dietary needs and food preferences to accommodate an active and healthy lifestyle (DoA, 2002). Thus food insecurity would be the abscense of these factors.
Grain amaranth	Grain amaranth is considered a pseudocereal and belongs to the genus *Amaranthus* typically cultivated for its grains, but the leaves can also be consumed (Mlakar *et al.,* 2010).
Higher income group	Refers to Group B in this study, and includes respondents employed at the NWU, earning middle to high income.
Household food security	The capability of a household to secure sufficient amounts of food required for all members of a household (Pinstrup-Andersen, 2009).
Lower income group	Refers to Group A in this study and includes respondents from the cleaning service provider at the NWU who earn a basic to low income.

[1]

*References included with Chapter 1 references [1]

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.1 Background and motivation

Global pressure to fulfil food requirements exists largely because of diminishing resources, climate changes and financial challenges (McLachlan & Hamann, 2011:429). Though the Millennium Developmental Goal (MDG) of halving global poverty by 2015 has been achieved, an astounding 1.2 billion people are still affected (UNDP, 2014). The United Nations (UN) has already started developing a post-2015 agenda. This includes the following topics: inequalities, health, food security and nutrition, energy, governance, education, conflict and fragility, water, growth and employment, environmental sustainability and population dynamics (UN, 2014). As the cut-off date of 2015 arrived, the question remains, has South Africa (SA) done enough to realise the first MDG? While the first goal entails halving the number of people surviving on less than a dollar per day, halving unemployment and hunger (StatsSA, 2013:26), for this study the focus will fall on the hunger aspect. In 2002, 29.2% of SA's population were experiencing hunger. This has significantly been improved to 12.9% in 2013 (StatsSA, 2013:33). Despite that SA has achieved the goal of halving the proportion of people suffering from food insecurity (StatsSA, 2013:27), the goal to halve the number of underweight children in SA has not yet been realised as 8.3% of children were specified as such in 2008. This percentage needs to decrease to 4.7% before 2015 (StatsSA, 2013:27).

Lacking food security is a constant hazard to which several households in SA are exposed. Food security exists when individuals have material, communal and financial access to adequate amounts of safe and wholesome food. Furthermore, food should meet individuals' dietary needs and food preferences to accommodate an active and healthy lifestyle (DoA, 2002). This definition highlights the importance of preferred and nutritious food making it clear that a household with enough food is not necessarily food secure if they do not possess enough healthy food to their liking. Considering this definition, SA is classified as a food secure country, however, individual households within the country are not necessarily food secure (Altman *et al.*, 2009:365). Food insecurity is a constant hazard to a third of the South African population (Drimie *et al.,* 2009:247) and half of the population experience some form of food shortage (Labadarios *et al.,* 2005:540).

Different aspects could have an impact on food security in SA, including demographic factors, income and employment, and education levels. The demographic environment consists of individuals' age, gender, occupation and education, especially associated with income (Blythe, 2008:365; Schiffman *et al.,* 2010:76). StatsSA (2012: xvi) reported that unemployment rates were higher for individuals without a matric qualification, which amounted to 29.3% of the total

4.5 million (25.2%) unemployed individuals. Thus, it illustrates the importance of employment and income and its contribution towards a household's food security status (De Cock *et al.,* 2013:280; Sekhampu, 2013:547). Additionally, Oldewage-Theron and Slabbert (2010:5) reported that 67% of their study population lived in poverty, and of that, 91% were unemployed. Thus, a clear association between unemployment and poverty can be made. A vicious cycle of school drop-outs and unemployment continues to exist, as children leave school to head a household, or parents die as a result of Human Immunodeficiency Virus Infection/Acquired Immune Deficiency Syndrome (HIV/AIDS) (Meintjies *et al.,* 2010:40). Statistics South Africa (StatsSA, 2012:12) reported that only 27.2% of the country's population who are 20 years and older have acquired a Grade 12 qualification. This could indicate that education is affecting households' food security status.

South Africa's poorest households spend an average of 33.5% of their household income on food and beverages, contrasting to households with a higher income who only spend 10.8% on food and beverages (StatsSA, 2014:53). The urban poor communities also spend a larger portion of their income on food since they are only able to purchase reduced amounts of food with their available household income (Van der Merwe, 2011:2). Furthermore, consumers rely on income to obtain food and other items to fulfil their basic needs, hence the importance of income affecting individuals' food security status (Grobler, 2013:1). Poverty in SA puts large constraints on efforts to decrease food insecurity figures, since 10.2% of the South African population suffers from extreme poverty and lives below the food line, while a further 45.5% of the population is considered to be affected by poverty, however not as extreme as the 10.2% (StatsSA, 2014:12).

Additionally, most urban households are net buyers of food, since land is not available for food production, and accessibility of staple foods to most households became increasingly challenging with the food price increases in SA (Altman *et al.,* 2009:347). Following global food price increases, poor individuals were more susceptible to the negative effect of the sudden price escalations (Hart, 2009:366; Nawrotzki *et al*., 2014:284). Moreover, the elevated prices of staple food further contributed to the urgency of food insecurity among those with limited monetary resources (Altman *et al.,* 2009:347). The stability of food markets in SA progressively affected households' ability to access food, and was not only constricted to the availability of food, but consequently influencing poor households' food security situation (Altman *et al.,* 2009:346).

In addition to the socio-demographic factors affecting food security, family, social class, subculture and culture contribute to the socio-cultural environment of a household (Schiffman & Kanuk, 2007:54) which could also have an impact on food security. Regarding individuals' culture, certain food traditions are transferred by older generations to younger individuals; these

individuals are likely to continue with certain food traditions when they are older (Labadarios *et al.,* 2011:895; Puoane *et al.,* 2006:89). In most Southern African cultures it is tradition for the men of a household to eat before the women and children (McWilliams, 2011:258), while women often ate more food than necessary since they associate body size with socio-economic standings (Puoane *et al.,* 2006:91). Special social events, such as weddings or funerals often dictate what food products should be consumed (Puoane *et al.,* 2006:91). This illustrates how socio-cultural factors may influence aspects of food consumption indicators. The different demographic and socio-cultural environments have a direct effect on a household's food consumption, and food specific knowledge, hence it may further have an impact on the health and nutritional status of a household and ultimately affect their food security status.

Culture specifically influences eating habits and food preferences. Some households may go to immense measures to maintain their cultural identity (Viljoen *et al.,* 2005:58) regarding food practices. During times of food shortages unhealthy food choices and limited dietary diversity are usually evident among poor households (Drimie *et al.,* 2013:916), the diet consisting mostly of maize meal (McWilliams, 2011:260). Food items consumed on a regular basis by South Africans including women in informal settlements are maize, brown bread and hard margarine, which are frequently consumed with milk, tea and sugar (Acham *et al.,* 2012:27; Labadarios *et al.,* 2005:540). Usually the staple diets of households comprise mostly grain cereals such as maize (Oldewage-Theron & Kruger, 2011:426) and provide them with adequate amounts of energy, but lack sufficient micronutrients (Vorster, 2010:2) such as zinc (Zn), vitamin A, iodine (I), iron (Fe) and folate (Steyn & Ochse, 2013:14).

Nevertheless, Viljoen *et al.* (2005:59) established that consumers might adjust their standard food practices in order to accommodate a healthier lifestyle, opening a market for new or enriched products. Consumers also indicated that they received health guidelines from staff at clinics to adjust their diet in order to be healthier (Viljoen *et al.,* 2005:59). Thus households making food choices based on a limited budget need attention. Furthermore, the implementation of development programmes will contribute to households' needs and improve their wellbeing. Improving the food- consumption patterns of a household, may improve their choice and variety of food, subsequently contributing to the household's health and nutritional situation, as well as their food security status.

Thandeka *et al.* (2011:196) noted that a decline in the consumption of traditional leafy vegetables (TLV) is evident especially in SA (Jansen van Rensburg *et al.,* 2007:324). Traditional leafy vegetables can be described as plants that are commonly used for the vegetable part of the plant (Jansen van Rensburg *et al.,* 2007:317) and are typically found in the wild or cultivated by inhabitants of the land (Matenge *et al.,* 2012:2243). Commonly consumed TLV include amaranth leaves, sweet potatoes, pumpkin leaves and sorghum among others

(Cloete & Idsardi, 2013:907). Thus, considering the effects of urbanisation and the declining use of traditional vegetables among consumers, a high risk of losing vital knowledge and culture regarding TLV exists. Incorporating TLV to staple diets in the households of most black African households is part of their cultural traditions; in addition it contributes to alleviating their food security concerns (Matenge *et al.,* 2011:32; Vorster *et al.,* 2007:10). The knowledge of the nutritional benefits gained from consuming TLV is further transferred to younger generations through cultural practices (Jansen van Rensburg *et al.,* 2007:324).

Nonetheless, with the decline in TLV consumption and the effects of urbanisation and an adopted westernised diet, usually accompanied by increased consumption of processed and fatty foods, TLV-containing products should be reintroduced to suit the lifestyles of the urbanised population. Focusing on the North West Province of SA where the study will take place, amaranth (*Amaranthus hybridus*) is considered one of the most frequently consumed TLV (Cloete & Idsardi, 2013:908). Additionally, *Amaranthus cruentus* can be utilised for both grains and leaves, adding more value and opportunities especially for poor households (Olofintoye, 2015). Amaranth is classified as a pseudo-cereal, since the grain is similar to that of actual cereal (Alvarez-Jubete *et al.,* 2010:107) and amaranth grows well in warmer areas and has been indicated to grow in adverse conditions including high soil salinity and acidity content (Achigan-Dako *et al.,* 2014:307).

To enhance products' nutritional value and protein content, Schoenlechner *et al.* (2010:661) established that amaranth is the ideal choice for the enhancement of recipes. Additionally, Alvarez-Jubete *et al*. (2010:111) indicated that amaranth is rich in Fe, calcium (Ca) and fibre. Research in SA shows that amaranth seeds are not only rich in protein, but it is also an excellent source of Vitamin C and it can be used to improve the diets of consumers, especially in the rural areas (Mnkeni *et al.,* 2007:380). Moreover, Mburu *et al.* (2012:597) established that the superior nutrient content of grain amaranth facilitated the nutritional status of especially children, illustrating the importance of grain amaranth in contributing to nutritional security.

One technique that could be employed to contribute to enhancing households' health and nutrition, food choices and creating variety, is by means of recipe development and standardisation utilising concerning a staple food source. By standardising the adjusted recipe, it allows the researcher to accurately reproduce the recipe, while obtaining similar results every time (Pizam, 2010:555). Enriching frequently consumed food products such as bread with amaranth could improve the nutritional value thereof, but also the variety in diets, since poor households commonly consume a repetitious diet (Mavengahama *et al.,* 2013:230). By changing a household's dietary pattern, thus increasing food choices and health and nutrition, food security could be addressed, as proposed by Oldewage-Theron and Kruger (2011:426). Enriched food products should be sensory-acceptable to consumers and not only to the

reseracher's liking. Taking into account that products should be sensory-acceptable to consumers, Macharia-Mutie *et al.* (2011:384), concluded that respondents were fond of amaranth porridge's texture and taste and indicated that it was digested effortlessly.

According to Linneman *et al.* (2006:184), recipe development is essential in providing new food products with enriched nutritional quality. The new food products should be of a higher quality than existing food products that are improved and may contribute to their wellbeing. Moreover, enhancing current traditional recipes may progress their dietary intake, contribute to a healthier lifestyle and offer a wider variety of food choices. Hence, it is important that the ingredients used to improve the recipes should be of high quality and contribute adequate nutritional value to the traditional recipes (Barba de la Rosa *et al.,* 2009:117).

During the recipe development process the households' and individuals' needs and what motivates them should be considered. Blythe (2008:448) defines motivation as the core power that drives an individual to behave in a specific manner. Consumer contribution is essential to the success of a new product. Hence, consumers' needs, which are an apparent absence of something (Blythe, 2008:448), in this case nutritional food, should be recognised for the food product to be a success (Kaczorowska, 2011:207; Resurreccion, 2008:368). This will lead to an increased acceptance of the newly-developed food products. Consumers' acceptance of the products will be tested through sensory evaluation which can be defined as techniques used for the identification and analysis of specific food product characteristics by means of an individual's sensory organs, whilst preventing product information to influence consumers' opinions (Lawless & Heymann, 2010:1). However, should consumers not accept the product, the researcher will have to adjust the product accordingly. Furthermore, once the respondents' acceptance is assured, the researcher aims to test the acceptance of these products amongst individuals from two different groups, one of lower income and one of middle to high income. The purpose thereof is to determine whether individuals from the middle to higher income group have a need for the enriched food product, and if they would be interested in purchasing the products. This will allow for an expansion in the market. The purpose thereof is to enable the households to develop new products and ultimately sell and market it, in order to make these products profitable. Van Wyk (2011:866) suggests that more local markets are involved in developing and selling food products made from TLV. This presents the opportunity to build an entrepreneurial culture with the prospect of extra income, which may lessen a household's risk for food insecurity. If households that are at risk, or are food insecure, can achieve this it might be a realistic way to improve household food security within a cultural environment in South Africa.

1.2 Problem statement

In South African households food security remains problematic; even though the country is classified as food secure, a third of the country's population experience food insecurity. For this specific study the relevant aspects that can contribute to household's food security status are provided in the conceptual framework (Fig 1–1). In several households incomes are insufficient to meet the nutritional variety and demands. It is further difficult to identify households that may require assistance. Nonetheless, these households exist and it is crucial that an effective method of addressing their food security status is implemented. New innovative ways of addressing food security such as enriching staple food products need to be implemented, while considering traditional food to attain this. Where other research has aimed to establish agricultural means to support their food security status, the researcher of this study will aim to introduce a new recipe, namely an amaranth enriched bread product that is affordable to poor households. However, the amaranth flour had to be imported from Kenya, yet it was still affordable. In addition, it is necessary to develop enriched food products that will improve the status of food insecure households in SA and provide them with options to diversify their monotonous diets. By further supplementing traditional staple recipes with alternative ingredients, such as grain amaranth, the households' nutritional status could improve. The purpose of this product is to provide households with alternative recipes to their usual traditional and preferred recipes, thus increasing their variety of food choices and contributing to enhanced nutritional consumption.

1.3 Aim and Objectives

Aim

The aim of this study was to explore households' food security status and to improve household food security of low-income households by enhancing the nutritional quality of a frequently consumed staple food product with grain amaranth.

Objectives

- To determine the household food security status of lower and higher income households of respondents working at an academic institution, North West University (NWU)
- To enhance a frequently consumed staple food with grain amaranth flour
- To determine acceptance and preference of the newly developed amaranth-containing product

1.4 Summary of methodology

A quantitative non-experimental research approach in two phases was followed to explore household food consumption patterns and food security statuses of income-earning households. It was also important to determine the acceptability of a frequently consumed staple food product enhanced with grain amaranth. The study consisted of two phases and was conducted on the campus of the North-West University (SA) among 144 income-earning individuals. Respondents were recruited from staff employed by the university and contractors of the university. Non-probability, purposive sampling was identified to be an appropriate sampling method to accommodate the inclusion criteria for respondents (Strydom, 2011). Inclusion criteria entailed that respondents need to be 18 years and older, be able to read and write English and earn a salary. Moreover, no respondents should have had any food allergies as they were required to evaluate food samples.

The respondents were divided into two groups. The first group of respondents (Group A) comprised of lower income categories and mainly presented positions requiring lower skills. The second group of respondents (Group B) mainly consisted of administration and academic staff members and presented middle to higher income levels. During Phase I food consumption patterns and household food security status was determined with the questionnaire of Labadarios *et al*. (2009). Bread was consumed by the majority of the respondents and was thus chosen to be supplemented with grain amaranth to be analysed for acceptability among respondent in Phase II of the study. Sensory characteristics were evaluated by means of consumer sensory panel tastings and assisted with a questionnaire using a seven-point hedonic scale. The degree of liking or disliking of three wheat and amaranth containing bread samples were determined.

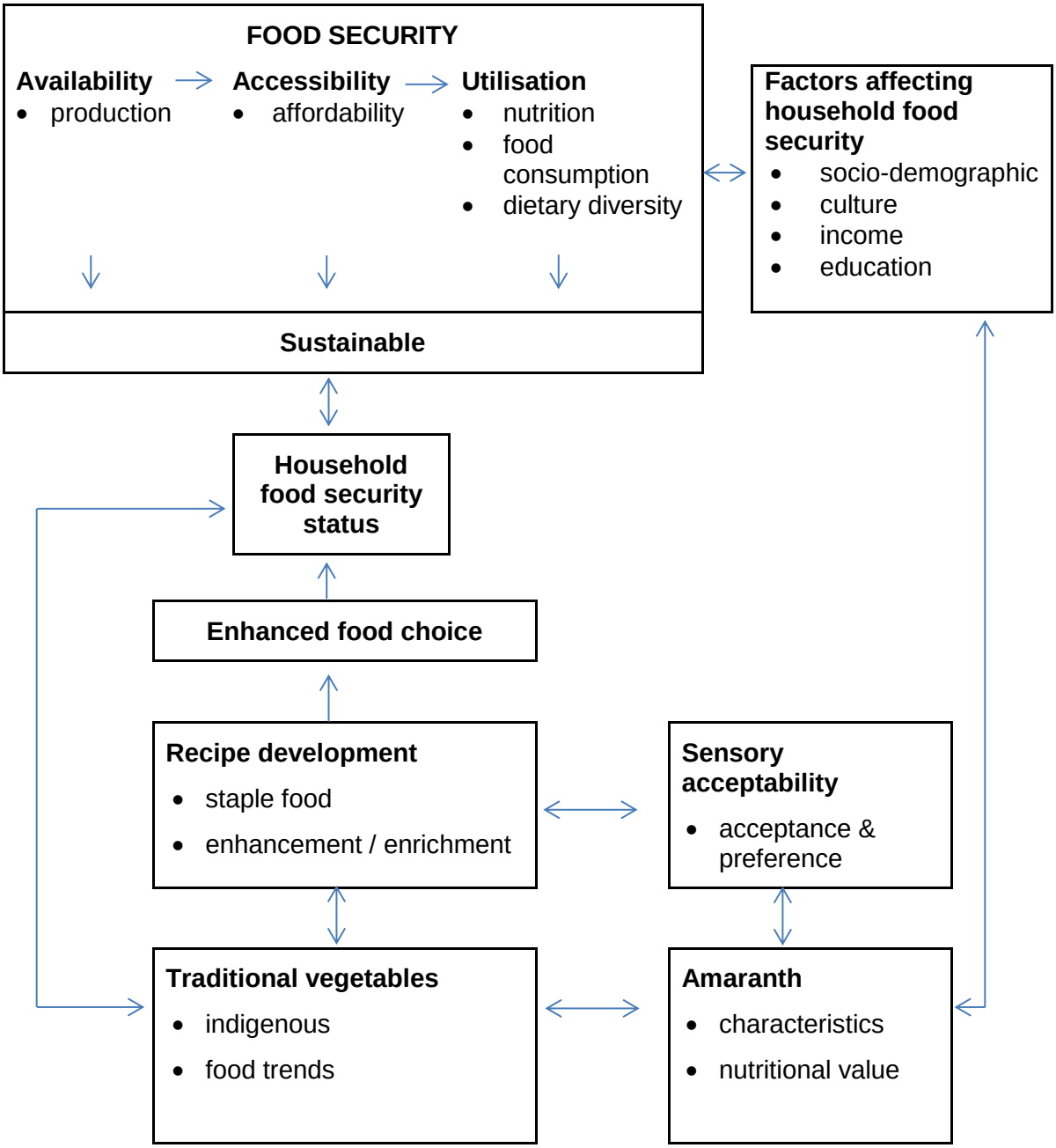
The data analysis for both questionnaires during the two phases was performed with the assistance of Statistical Consultation Services, NWU. Descriptive and inferential statistics were used to describe the data and to draw conclusions from the study. The pre-coded questions of the household survey were analysed by means of SPSS (Statistical Package for the Social Sciences), in addition to Microsoft Excel. Moreover, guidelines suggested by Labadarios *et al.* (2009), were used to evaluate the household food security questions. Furthermore, bar charts and box plots were used to highlight significant results and present summarised data in an illustrative manner.

Ethical considerations

Ethical approval for this study was acquired from the Health Research Ethical Committee of the Faculty of Health Sciences of the NWU (Reference number: NWU-00040-13-A1) and all ethical measures were practically applied.

1.5 Conceptual framework

Figure 1–1 Conceptual framework of factors contributing to household food security (Adapted from Ericksen *et al.*, 2009)



1.6 Author contribution

The aims and objectives of the study were accomplished through the cooperation of a group of academic researchers. The relevant role each researcher fulfilled is summarised in the table below

Author	**Contribution**
Miss L Coetzee	First author and responsible for the literature investigation contributed to the questionnaire design, data capturing and drafting of the Dissertation
Dr H de Beer	Supervisor
Dr A Mielmann	Co-supervisor

1.7 References

Acham, H., Oldewage-Theron, W.H. & Egal, A.A. 2012. Dietary diversity, micronutrient intake and their variation among black women in informal settlements in South Africa: A cross-sectional study. *International journal of nutrition and metabolism,* 4(2):24–39.

Achigan-Dako, E.G., Sogbohossou, O.E.D. & Maundu, P. 2014. Current knowledge on *Amaranthus* spp.: research avenues for improved nutritional value and yield in leafy amaranths in sub-Saharan Africa. *Euphytica,* 197(3):303–317.

Altman, M., Hart, T. & Jacobs, P. 2009. Food security in South Africa. Human Science Research Council. http://www.hsrc.ac.za/en/research-outputs/ktree-doc/2643 Date of access: 17 May 2012.

Alvarez-Jubete, L., Arendt, E.K. & Gallagher, E. 2010. Nutritive value of pseudo cereals and their increasing use as functional gluten free ingredients. *Trends in food science and technology*, 21(2):106–113.

Barba de la Rosa, A.P., Fomsgaard, I.S., Laursen, B., Mortensen, A.G., Olvera-Martínez, L., Silva-Sánchez, C., Mendoza-Herrera, A., González-Castañeda, J. & De León-Rodríguez, A. 2009. Amaranth (*Amaranthus hypochondriacus*) as an alternative crop for sustainable food production: Phenolic acids and flavonoids with potential impact on its nutraceutical quality. *Journal of cereal science*, 49(1):117–121.

Blythe, J. 2008. Consumer Behaviour. London: Thomson.

Cloete, P.C. & Idsardi, E.F. 2013. Consumption of indigenous and traditional food crops: perceptions and realities from South Africa. *Agroecology and sustainable food systems*, 37(8):902–914.

De Cock, N., D'Haese, M., Vink, N., Van Rooyen, C.J., Staelens, L., Schönfeldt, H.C. & D'Haese, L. 2013. Food security in rural areas of Limpopo province, South Africa. *Food security,* 5(2):269–282.

DoA. ***See*** South Africa. Department of Agriculture.

Drimie, S., Faber, M., Vearey, J. & Nunez, L. 2013. Dietary diversity of formal and informal residents in Johannesburg, South Africa. *BMC public health,* 13(1):911–919.

Drimie, S., Germishuyse, T., Rademeyer, L. & Schwabe, C. 2009. Agricultural production in Greater Sekhukhune: the future for food security in a poverty node of South Africa? *Agrekon*, 48(3):245–275.

Ericksen, P.J., Ingram, J.S., & Liverman, D.M. 2009. Food security and global environmental change: emerging challenges. *Environmental science & policy*, *12*(4), 373–377.

Grobler, W.C.J. 2013. Spending patterns of food insecure households in a low income neighbourhood in South Africa. Paper presented at the proceedings of World Business and Social Science Research Conference, Bangkok, Thailand, 24-25 October, 2013. http://www.wbiworldconpro.com/uploads/bangkok-conference-2013-october/economics/1382555073_205-Wynand.pdf Date of access: 12 Jun. 2015.

Hart, T.G.B. 2009. Exploring definitions of food insecurity and vulnerability: time to refocus assessments. *Agrekon: agricultural economics research, policy and practice in southern Africa*, 48(4):362–383.

Jansen van Rensburg, W.S., Van Averbeke, W., Slabbert, R., Faber, M., Van Jaarsveld, P., Van Heerden, I., Wenhold, F. & Oelofse, A. 2007. African leafy vegetables in South Africa. *Water South Africa*, 33(3):317–326.

Kaczorowska, J. 2011. Selected methods used in consumer-oriented food product development. (*In* Hartwell,H.H., Lugosi, P. & Edwards, J.S.A. *eds.* Culinary Arts and Sciences VII: Global, national and local perspectives by Bournemouth University, Poole. UK: International Centre for Tourism and Hospitality Research. p200–211).

Labadarios, D., Mchiza, Z.J., Steyn, N.P., Gericke, G. Maunder, E.M.W., Davids, Y.D. & Parker, W. 2011. Food security in South Africa: a review of national surveys. *Bulletin of the World Health Organization,* 89(12):891–899.

Labadarios, D., Steyn, N.P., Maunder, E., MacIntyre, U., Gericke, G., Swart, R., Huskisson, J., Dannhauser, A., Vorster, H.H., Nesmvuni, A.E. & Nel, J.H. 2005. The National Food Consumption Survey (NFCS): South Africa, 1999. *Public health nutrition*, 8(5):533–543.

Lawless, H.T. & Heymann, H. 2010. Sensory evaluation of food: Principles and practices. 2nd ed. Ithaca, NY: Springer.

Linnemann, A.R., Benner, M., Verkerk, R. & Van Boekel, M. 2006. Consumer-driven food product development. *Trends in food science and technology*, 17(4):184–190.

Macharia-Mutie, W.C., Van de Wiel, A.M., Moreno-Londono, A.M., Mwangi, A.M. & Brouwer, I.D. 2011. Sensory acceptability and factors predicting the consumption of grain amaranth in Kenya. *Ecology of food and nutrition*, 50(5):375–392.

Matenge, S.T., Van der Merwe, D., Kruger, A. & De Beer, H. 2011. Utilisation of indigenous plant foods in the urban and rural communities. *Indilinga: African journal of indigenous knowledge systems*, 10(1):17–37.

Matenge, S.T.P., Van der Merwe, D., De Beer, H., Bosman, M.J.C. & Kruger, A. 2012. Consumers' beliefs on indigenous and traditional foods and acceptance of products made with cow pea leaves. *African journal of agricultural research*, 7(14):2243–2254.

Mavengahama, S., McLachlan, M. & De Clercq, W. 2013. The role of wild vegetable species in household food security in maize based subsistence cropping systems. *Food security*, 5(2):227–233.

Mburu, M.W., Gikonyo, N.K., Kenji, G.M. & Mwasaru, A.M. 2012. Nutritional and functional properties of a complementary food based on Kenyan amaranth grain *(Amaranthus cruentus*). *African journal of food, agriculture, nutrition and development,* 12(2):5959–5977.

McLachlan, M. & Hamann, R. 2011. Theme issue on food security. *Development southern Africa*, 28(4):429–430.

McWilliams, M. 2011. Food around the world: a cultural perspective. 10th ed. Upper Saddle River, NJ: Pearson. p509.

Meintjes, H., Hall, K., Marera, D. & Boulle, A. 2010. Orphans of the AIDS epidemic? The extent, nature and circumstances of child-headed households in South Africa. *AIDS Care: Psychological and socio-medical aspects of AIDS/HIV*, 22(1):40–49.

Mlakar, G.S., Turinek, M., Jakop, M., Bavec, M. & Bavec, F. 2010. Grain amaranth as an alternative and perspective crop in temperate climate. *Journal for geography*, 5(1):135–145.

Mnkeni, A.P., Masika, P. & Maphaha, M. 2007. Nutritional quality of vegetable and seed from different accessions of Amaranthus in South Africa. *Water South Africa*, 33(3):377–380.

Nawrotzki, R.J., Robson, K., Gutilla, M.J., Hunter, L.M., Twine, W. & Norlund, P. 2014. Exploring the impact of the 2008 global food crisis on food security among vulnerable households in rural South Africa. *Food security*, 6(2):283–297.

Oldewage-Theron, W.H. & Kruger, R. 2011. Dietary diversity and adequacy of women caregivers in a peri-urban informal settlement in South Africa. *Nutrition,* 27(4):420–427.

Oldewage-Theron, W. & Slabbert, T.J.C. 2010. Depth of poverty in an informal settlement in the Vaal region, South Africa. *Health SA Gesondheid,* 15(1):1–6.

Olofintoye, J.A.T., Abayomi, Y.A., & Olugbemi, O. 2015. Yield responses of grain amaranth (Amaranthus cruentus L.) varieties to varying planting density and soil amendment. *African journal of agricultural research*, *10*(21), 2218–2225.

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

Pizam, A. 2010. International encyclopaedia of hospitality management. 2nd ed. Oxford, UK:Elsevier.

Puoane, T., Matwa, P., Hughes, G. & Bradley, H.A. 2006. Socio-cultural factors influencing food consumption patterns in the black African population in an urban township in South Africa. *Human ecology*, 14:89–93.

Resurreccion, A.V.A. 2008. Consumer sensory testing for food product development. (In Brody, A.L. & Lord, J.B., ed. Developing new food products for a changing marketplace. 2nd ed. Boca Raton, FL: CRC Press. p.365 –405).

Schiffman, L.G. & Kanuk, L.L. 2007. Consumer behaviour. 9th ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Schiffman, L.G., Kanuk, L.L. & Wisenblit, J. 2010. Consumer behaviour: global edition. 10th ed. Upper Saddle River, NJ: Pearson. p591.

Schoenlechner, R., Mandala, I., Kiskini, A., Kastaropoulos, A. & Berghofer, E. 2010. Effect of water, albumen, and fat on the quality of gluten-free bread containing amaranth. *International journal of food science and technology,* 45(4):661–669.

Sekhampu, T.J. 2013. Determination of factors affecting the food security status of households in Bophelong, South Africa. *International business and economics research journal*, 12(5):543–550.

South Africa. Department of Agriculture. 2002. The integrated food security strategy for South Africa. Pretoria. http://www.nda.agric.za/doaDev/sideMenu/foodSecurity/policies.pdf Date of access: 12 Mar. 2012.

StatsSA (Statistics South Africa). 2012. Census 2011. http://www.statssa.gov.za/publications/P03014/P030142011.pdf Date of access: 8 Feb. 2013.

StatsSA (Statistics South Africa). 2013. General household survey. http://www.statssa.gov.za/publications/P0318/P03182014.pdf Date of access: 8 Jul. 2014.

StatsSA (Statistics South Africa). 2014. Poverty Trends in South Africa: an examination of absolute poverty between 2006 and 2011. http://www.statssa.gov.za/publications/Report-03-10-06/Report-03-10-06March2014.pdf Date of access: 7 Jul. 2014.

Steyn, N.P. & Ochse, R. 2013. "Enjoy a variety of foods": as a food-based dietary guideline for South Africa. *South African journal of clinical nutrition,* 26(3):13–17.

Thandeka, N., Sithole, N. & Thamaga-Chitja, J.M. & Makanda, I. 2011. The role of traditional leafy vegetables in household food security in rural KwaZulu-Natal. *Indilinga – African journal of indigenous knowledge systems*, 10(2):19 –5209.

UN (United Nations). 2014. Dialogues on Implementation of the Post-2015 development agenda. http://www.worldwewant2015.org/sitemap. Date of access: 17 Apr. 2014.

UNDP (United Nations Development Programme). 2014. The Millennium Development Goals Report 2014. http://www.undp.org/content/undp/en/home/librarypage/mdg/the-millennium-development-goals-report-2014.html Date of access: 22 Jun. 2015.

Van der Merwe, C. 2011. Key challenges for ensuring food security in South Africa's inner cities. *AISA policy brief,* 36:1–7.

Van Wyk, B.E. 2011. The potential of South African plants in the development of new food and beverage products. *South African journal of botany*, 77(4):857–868.

Viljoen, A.T., Botha, P. & Boonzaaier, C. 2005. Factors contributing to changes in food practices of a black South African community. *Journal of family ecology and consumer sciences*, 33(1):46–62.

Vorster, H.H. 2010. The link between poverty and malnutrition: A South African perspective. *Health SA Gesondheid,* 15(1):1–6.

Vorster, I.H.J., Jansen van Rensburg, W., Van Zijl, J.J.B. & Venter, S.L. 2007. The importance of Traditional Leafy Vegetables in South Africa. *African journal of food agriculture nutrition and development*, 7(4):1–13.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Escalating social issues and diminishing resources exert global pressure to provide an increased supply of safe and nutritious food to an ever-growing population (McLachlan & Hamman 2011:429), that increases the prevalence of food insecurity. In terms of Section 27 of the Constitution (1996), all South Africans reserve the right to sufficient food. Consequently it is evident that the nutritional wellbeing of individuals in SA is of extreme importance to the government. In SA, political, social and economic issues contribute to the food insecurity situation and place a strain on policy makers. These factors increase the difficulty of policy makers to ensure that adequate preventative measures are in place to contest poverty in the country (Frayne *et al.,* 2009:9). Food security has generally been addressed by paying attention to the four most important components affecting food security: availability, accessibility, utilisation and stability (Bashir & Schilizzi, 2013:1256; Burchi *et al.,* 2011:360). This may have proven to be useful in recent research; however, new innovative ways of addressing food security are required as the end vision of the Millennium Developmental Goals (MDG) was reached, especially since the reports show that, even though as a country the food security levels were halved, communities severely deprived and not having access to government support remain to exist (StatsSA, 2013:34).

Other factors influencing households' food security status include the demographic environment, employment, education and income (Blythe, 2008:365; Schiffman *et al.,* 2010:76). Households lacking income or not receiving governmental support, may find it difficult to acquire food products, thus contributing to the household food insecurity status (Kruger *et al.,* 2008:12). Culture and the effects of urbanisation influence food consumption within households (Puoane *et al.,* 2006:92), thus it is important to include cultural traditions when attempting to address food security issues. However, incorporating culture when attempting to deal with household food insecurity, has not been explored thoroughly, and could provide insights to improve food insecurity (Trefry *et al.,* 2014:555). With the unique approach of using consumer behaviour (Pinstrup-Andersen, 2009:7) as a way of incorporating culture, and developing new food products to address food security, innovative ways to contribute to the alleviation of food security may be identified. Knowledge and utilisation of edible wild plants traditionally used by various indigenous cultures may be seen as an excellent way to support households by supplementing staple foods with these traditional foods.

This study focussed on income-earning households' food security statuses and aimed to determine the acceptance of an amaranth enrichedamaranth enriched staple food product

among these households. Acceptance of this nutritionally enhanced product may support household food security. In addition, if a need among individuals of a higher socio-economic class could be developed it may result in an expansion of the existing market. Van Wyk (2011:866) supported the utilisation of traditional and especially indigenous plants in new products and the establishment of new local and international markets for these products. Thus, by incorporating traditional foods into frequently consumed food products, an opportunity for extra income could be created. This could allow an improvement of households' food and nutritional situation as well as their household income, consequently contributing to the improvement of their food security situation. Literature required to attain the objectives and gain background information will be reviewed henceforth.

2.2 Food security

November 1996 marked a significant conference in Rome, the World Food Summit, attended by leaders from member countries worldwide, in recognition of addressing the increasing hunger experienced in the world and accumulative pressure on world food resources. They made a commitment towards the eradication of hunger, malnutrition and food insecurity (FAO, 1996). In September of 2000 world leaders, including leaders in SA, reiterated their commitment towards a global initiative to diminish poverty in the world by 2015 through eight MDG (UNMP, 2006). The SA government's participation also supports this initiative to the improvement of food security and the wellbeing of the population. Accordingly, when focussing on the improvement of food security the first goal of the MDG, stipulating the eradication of extreme hunger and poverty is of great significance to revert the decline of the food security crisis in SA. Consequently SA established the Integrated Food Security Strategy (IFSS) to align SA's goals with that of the United Nations (UN) (DoA, 2002:11). However, Drimie and Ruysenaar, (2010) reported on the challenges the IFSS experienced to function optimally due to insufficient institutional collaboration, coordination and communication of this multi-disciplinary complex issue.

The causes of food insecurity in SA are multifaceted and interconnected (De Cock *et al.,* 2013: 270) making it difficult to address. Additionally, Coates (2013:191) suggests that apart from availability, accessibility and utilisation, attention should be given to the nutritional quality of available food and its cultural acceptability among households, while maintaining a stable environment to sustain food security. Some of the causes increasing the risk of food insecurity include an unstable political environment, agricultural unpredictability, accumulating unemployment and constant increase of poverty, all of which are prevalent in SA (Drimie & McLachlan, 2013:2).

Furthermore, the inequalities concerning income among South Africans persist to be a problem. The income and expenditure among households of individuals within a specific economy can be indicated through the Gini coefficient (The World Bank, 2014). The Gini coefficient is expressed through values between zero (0) and one (1), zero exemplifying equality within the economy, whereas one indicates inequality (The World Bank, 2014). According to the World Bank's (2014) the last measurement in 2011, the Gini coefficient for SA is 0.65. This is troublesome as the Gini coefficient was 0.70 in 2000, thus only 0.05 improvement in 11 years and far from the targeted 0.3 coefficient (UN, 2014:27).

South Africa has a sufficient supply of most staple foods including maize and wheat, and import other food products such as rice to meet the requirements of the national population. This indicates that the country is food secure at a national level (Moyo, 2007:105), but it does not mean that everyone possesses household food security (Hart, 2009:365). Contrasting to the circumstances at a national level, the recently published South African National Health and Nutrition Examination Survey (SANHANES-1) exhibited a different representation of food security at a household level, which determined that roughly a third of the population were food insecure (Shisana *et al.,* 2013:147). Therefore, to be able to address the issue of food security, it is essential to first contemplate the different aspects thereof, highlighted in the definition: food availability, - access, and - utilisation (FAO, 2008).

Availability, accessibility and utilisation

The availability, accessibility and utilisation of food form the basis of food security and all three aspects need to be considered to address food security. Food availability concerns the competence of a country to supply food and could be affected by economic factors, agricultural output and the retail supply chain (WFP, 2014). The agricultural division plays an important part in food security as sufficient food sources are dependent on the agricultural sector's ability to produce sufficient quantities of food. This mainly includes commercial farmers as net producers of food supplied to SA, while smallholder farms contribute marginally to food supply (Hendriks, 2014:10). The quantity in which food is obtainable is not the only factor contributing to availability, but also the cost of this commodity (Warr, 2014:2). Thus, price dictates availability just as much as the existence of food does and food availability cannot solely be accountable for addressing food insecurity (Roos, 2012:9).

The accessibility of food entails the capability of a country's population to access the food items available (WFP, 2014). It also influences rural communities or urban poor, where retailers are not as readily available as in urban developed areas (Roos *et al.,* 2013:199). Accessibility of food furthermore reflects the demand for food considering household members, and their access to food within a household. This entails the intra-household sharing of available food

resources and the importance of all members having access to adequate amounts of food in the household (Barrett, 2010:825). Moreover, accessibility includes acquiring food products through production, purchases, trade and even food relief from organisations (WFP, 2014). Rural communities are generally able to produce some of their own food, while urban communities are dependent on retail markets for food (Van der Merwe, 2011:2). Consequently, the urban poor rely solely on available retailers, which usually consist of spaza shops and small retailers or even informal vendors. A spaza shop is typically a small enterprise operating in a residential home usually in informal areas (Oxford dictionaries, 2015). These stores typically only stock the basic products and lack fresh fruit and vegetables, as well as fresh meat, decreasing the accessibility of healthy food to the communities (Roos *et al.,* 2013:199). Access to food depends on how individuals utilise their available resources such as agricultural or financial resources to acquire food (Ericksen, 2008:236). Inadequate access to healthy food products and resources to acquire them could affect a household's food security status. Moreover, escalating food prices could increase the difficulty of obtaining a variety of nutritious food products (Barrett, 2010:825).

By focusing on individual's resources including income, use of available land, and how he/she manages it, an improvement may be seen in the household's food security situation. The major problem, however, is the lack of resources available to households. Households with insufficient income often lack access to food, even though food is available (Moyo, 2007:106). This highlights the problem of SA that, although it is nationally food secure, a third of the country is too poor to afford sufficient quantities of food and escalating food prices will largely affect poor and low-income households.

Because of income deficiencies among food insecure households, poor households spend a large percentage of their total income on food purchases in comparison to higher income counterparts (StatsSA, 2014:53). Van der Merwe (2011:5) determined that consumers in urban communities spend a larger portion of their income on food, leaving minimal financial means to ensure a healthy lifestyle. Moreover, the increased expenditure on food does not essentially signify that households consume a healthy, diverse diet, as the opposite is evident in poorer communities where dietary diversity is lacking. Elevated spending on food could also be a result of increased retail food prices, hence the portion of income spent on food should be raised, but does not signify an increase in the amount or value of food (Hart, 2009:365). Consequently Altman *et al*. (2009:347) suggested that rising food prices resulted in limited varieties of food in poor households' diets. Thus, increased food expenditure does not necessarily equate to an improved food security situation. Accessibility to available food supply cannot be attained without the proper utilisation of food supplies.

Lastly, the appropriate usage of food resources available and accessible to individuals encompasses food utilisation (Barrett, 2010:825). Proper utilisation of food resources and applying accurate knowledge could ensure that individuals' nutritional needs are fulfilled and positively contribute towards food security. This highlights the importance of applying knowledge to utilise the available food in the appropriate manner to meet the nutritional needs of all individuals in a household. Most black African households associate protein with wealth, consequently, as their income increased, so would the consumption of protein sources (Puoane *et al.,* 2006:92). Traditional foods generally consumed among black African communities, are grains, lentils and green vegetables, and as a result of urbanisation, to mention one, the consumption of traditional food products is neglected (Puoane *et al.,* 2006:92). If traditional and/or wild food products could be modernised in such a way as to appeal to the urbanised Black African market, healthier food choices may be encouraged. Matenge *et al.* (2012:2252) determined that by preparing and presenting traditional foods in an innovative manner increased the acceptance of the products amongst younger and older generations.

If the availability and accessibility of food could be addressed, it would still not solve the state of the situation as stability and sustainability are still required. The stability or distribution of food depends on weather, political and economic factors influencing food security or the access and utilisation of food. Moreover, the availability, accessibility and utilisation of food, rest on the ability to provide stability within the three main aspects of food security. It is therefore essential to combine methods that address the three aspects and combining them with environmental, economic and agricultural sustainability (Aborisade & Bach, 2014:121). The majority of the population requires further education to improve food utilisation; however, the country needs a stable political and economic state of affairs to ensure food stability (Drimie & McLachlan, 2013:6). Unprecedented escalation in global food prices in 2007/2008 severely contributed to the international food security situation (Sommerville *et al.,* 2014:240). Fluctuating food prices impact on availability, accessibility and utilisation of food and will continuously threaten the food security situation globally. However, the effect on especially poor households are ineluctable.

2.3 The situation of household food security

Household food security could be defined as the capability of a household to maintain sufficient food access and availability for all its members (Pinstrup-Andersen, 2009:6; Labadarios *et al*., 2009:10). Lacking household food security is a constant hazard to at least 26% of the South African population and approximately every third household (28.3%) is at risk of experiencing a form of food scarcity (Shisana *et al*., 2013:145). Various factors could influence a household's vulnerability to food security, including urbanisation, unemployment and poverty (Du Toit *et al.,* 2011:3). Large numbers of individuals move to urban areas with career and increased income aspirations, yet urban areas may not be equipped to deal with the additional occupants. Hence,

unemployment, poverty and a lack of food resources contribute to increased food insecurity (Djurfeldt, 2015:5). Additionally, with the expansion of urban areas to accommodate the growing population, rural agricultural land size decreases to make way for urban development (Shackleton *et al.,* 2010:291). These developments most probably affect the availability of wild plants previously harvested by communities as food sources. As rural communities have diminished access to available agricultural land, agricultural production decreases, contributing to households' food insecurity risks (Drimie *et al.,* 2009:247).

Food price increases, largely impact households' food security status. Tanga and Tangwe (2014:286) suggest that the financial crisis in 2007/2008 could be considered as one of the world's worst economic crises. Presently, this crisis continues to increase the prevalence of poverty throughout South African households. Households that spend the majority of their monthly income on food are most susceptible to increased food prices (Brinkman *et al.,* 2010:154) and inevitably places a burden on their food security status. Consequently, cheaper or more affordable food products and less variety are the only options. Schönfeldt *et al*. (2013) stated that several households in SA have monotonous diets with limited nutritional adequacy. It was further argued that financial constraints challenge the suitability of prescribed dietary guidelines especially among poor households. Healthier options are thus not even a choice due to already restricted accessible resources. The most frequently consumed food products in SA are maize meal and brown bread (Labadarios *et al.,* 2005:540).

Given the above-mentioned food insecurity situation, it is evident that a food secure country may still experience food insecurity at household level. The DoA's definition of food security also includes "adequate food preferred" and this may further change the number of food secure households (DoA, 2002), implying that food insecurity will persist when a household has sufficient food available, but household members dislike the food and thus do not really approve it for consumption, but only eat it if nothing else is available. Oni *et al.* (2010:2295) reported that the majority of their study population did not like or prefer the food although sufficient quantities were available. Food preferences among different cultural groups are very important as food traditions adopted during early parts of individuals' lives, will still be followed (Puoane *et al.,* 2006:89). This illustrates the importance of food as a motivator to change behaviour if the 'food need' is not satisfied or culturally acceptable. The urgency to address household food insecurity is eminent, and individuals' behaviour should be taken into account when attempting to address household food insecurity concerns (Hefny, 2012:119).

Socio-demographic factors affecting household food security and food consumption choices

Socio-demographic factors are the combination of sociological and demographical variables including culture, income, employment and education. Food is part of the social structure of society and plays an important role in the household food consumption patterns, while culture and economic factors also contribute significantly (Puoane *et al.,* 2006). Additionally, it is significant that food consumption may vary between different cultural groups, income levels and different regions (Bopape & Myers, 2007:16). Therefore, when proposing a resolution concerning food products, it is imperative to take into account the differences in food consumption patterns among various individuals.

(a) Cultural influences

Solomon (2013:549) defines culture as an aggregate of acquired beliefs, traditions and principles that guides consumers' behaviour within a specific community. The lifestyle shared among a group of individuals can strongly be related to their culture, especially aspects such as behaviour and beliefs dictated through culture (Schiffman & Kanuk, 2007:370). Thus, to improve individuals' lifestyle, it is important to understand their culture.

Black Africans form the majority of the population, 79.2%, and in Potchefstroom the majority of the total population is also comprised of black Africans, 71.3%. The second largest population group in Potchefstroom is white, constituting a further 20.6% of the population (Stats SA, 2011b). A clear depiction of the different cultures in the country is necessary, as culture may influence food security. Individuals within a specific culture deal with their food security situation differently from other cultures through the social organisation within communities, where culture dictates what food and changes to food are acceptable (Bonnekessen, 2010:291). Accordingly interventions to improve household food security should be implemented in such a way that it is adaptable and suitable to different cultures, since food consumption and acceptability is often predicted through culture (Solomon, 2013:549).

Addressing the nutritional aspect of food security, it should be kept in mind that culture affects the way in which its members interpret nutrient dense food. In a study to explore the social and cultural impacts on food consumption it was established that black African individuals usually associate status with their body size (Puoane *et al.,* 2006:91). Social settings further impact their food choices which are usually foods lacking adequate nutrition, and often lead to weight gain (Puoane *et al.,* 2006), especially among students (Voorend *et al.,* 2012). Moreover, healthy options are limited for poor households, since healthy food products are typically more expensive than food lacking adequate nutrition (Temple *et al.,* 2011). However, it is recommended that households could incorporate healthier options into their diets without

increasing their food costs if they cultivate vegetables in their home garden or directly purchase food from farmers (Temple *et al.,* 2011). When these individuals move to urban areas, insufficient access to food and increasing food prices force them to resort to cheaper staples. An increased intake of sugar, fat and salt has also been noted among consumers moving to urban areas (Van der Merwe, 2011:3). This would then explain the double burden of malnutrition existing in SA, where there are various households suffering from undernutrition while others suffer from obesity (Vorster, 2010:2).

Furthermore, accessibility, affordability and convenience of new food products offered in the cities also transform different cultures' food consumption patterns. For example, bread is consumed more frequently than porridge as it is easier to prepare and readily available (Viljoen *et al*., 2005:60). It is evident that culture typically dictates what type of food should be eaten, (Bonnekessen, 2010:280) and even though urbanisation has had an effect on certain cultures, most food aspects remain of importance to them. This was illustrated by Viljoen *et al.* (2005:60) who realised that if households wanted to consume a staple food different to their usual maize meal, maize meal would still be prepared as the older men preferred it. Further contributing to households' food consumption patterns, are food traditions transferred by older generations to younger individuals, influencing the type of food preferred within a specific community (Puoane *et al.,* 2006:89).

Food portrays a substantial role in culturally specific traditions of African people. Especially significant social events, such as weddings and funerals are usually accompanied by associated traditional behaviour and food products (Puoane *et al.,* 2006:92) like maize meal, sorghum porridge and in some cases also fermented beer (Viljoen *et al.,* 2005:60). However, social development and urbanisation resulted in the occurrence of behavioural change, especially regarding food consumption, which lean towards a more westernised diet (MacIntyre *et al.,* 2002:249; Vorster, 2010:2). A westernised diet typically results in unhealthy food choices and can lead to weight gain (Puoane *et al.*, 2006), because it is characterised by an increased consumption of fatty foods, processed and sweetened food products of which the onset usually comes with urbanisation (Drimie *et al.,* 2013:912). Also, it was observed that less traditional vegetables were consumed to make way for western food items (Matenge *et al.,* 2011:18). In addition, with the decreased consumption of traditional vegetables, a decline in eagerness to learn about TLV is attributed to the stigma associated with these vegetables, labelling them as poverty foods (Vorster *et al.,* 2007:8). Hence one can perceive that a different (in this case westerrn) culture, can influence dietary eating patterns.

Unhealthy food choices, including processed fatty foods (Drimie *et al.,* 2013:912), may persist within cultures as it is convenient and culturally acceptable. Culture typically dictates what food items are prepared and acceptable for household members and also induce feelings of

nostalgia (Hodges & Wiggins, 2013). Thus, unhealthy food choices will not be altered easily, since cultures identify with these food items (Bonnekessen, 2010). Consequently, even if sufficient food is available, but not culturally acceptable, a household may still experience food insecurity. Thus, when trying to initiate a new product, cultural preference, such as their staple food products, should be kept in mind and care should be taken when considering dietary changes in order to address food insecurity.

(b) Education, income and employment

Education levels among South Africans have improved significantly since 1996, when approximately 20% of the population over 20 years of age had no education. The 2011 census indicated that the number of people with no education decreased to 8.6% of the population over 20 years of age (StatsSA, 2012:21). The percentage of individuals in the North West province with no education decreased from 23% (1996) to 11.8% (2011) (StatsSA, 2011a:21). Even though an improvement was reported for school completion; only 28.9% of the total population (SA) and 19.8% of Potchefstroom's population (StatsSA, 2011b) have attained a matric qualification.

This despondent depiction of education levels is important as it is suggested to influence the nutritional status of a household. De Cock *et al.* (2013:280) found that education had a major impact on the household food security status of individuals participating in their study. It is recommended that by enhancing individuals' education levels, their household food security status may also be improved (Ndhleve *et al.,* 2013:17). Simister and Piesse (2003:175) suggest that women with a higher education level, in control of family spending, have an advantageous influence on the household's nutrition. Sekhampu (2012:453) proposed that the head of the household who has received education usually spend more on food products than household heads with no education. Additionally Oldewage-Theron and Egal (2012:6) acknowledged that nutritional education have an impact on individual's nutritional status, including food security. Healthier eating habits were observed among impoverished groups with improved education levels, in the UK and Australia, illustrating the relationship between food security, socio-demographic factors and healthy eating habits (Thornton *et al*., 2014:8). This illustrates the importance of nutritional education as part of formal education.

A vicious cycle exists when children need to leave school to head a household on the death of parents due to diseases such as HIV/AIDS (Meintjies *et al.,* 2010:40; Vorster, 2010:4). Furthermore, Mogotlane *et al.* (2010:29) found that the absence of parents in households may have a severe influence on the children's' education, because 46% of their study population were not able to attend school. This may indicate that education may affect the food security status of households. Moreover, Chibba and Luiz (2011:312) suggest that provinces with higher

poverty rates also have an increased unemployment rate, further indicating the relationship between poverty, unemployment and education. Accordingly, Thandeka *et al.* (2011:200) found that individuals with a higher education level earned a higher income, illustrating the significant role education plays in food security. Simister and Piesse (2003:179) recommend that the wellbeing of households could be improved if educational levels of women who head the household were improved.

Additionally, Oldewage-Theron and Egal (2012) suggest that nutritional education can also influence a household's nutritional status and a lack thereof could lead to poor food choices. An improved level of education can result in healthier food choices, knowledge regarding agricultural practices and utilising available resources (Nam, 2011). This includes the production of TLV, which could contribute to household food security and decrease food expenditure within a household (Cloete & Idsardi, 2013).

2.4 Traditional leafy vegetables

Traditional leafy vegetables are still consumed regularly, especially in rural communities with access to land. Information regarding the use and benefits of the TLV is communicated through cultural beliefs to younger groups in the communities (Jansen van Rensburg *et al.,* 2007:324). Moreover, TLV generally adapt better to changing environmental fluctuations such as droughts than cultivated crops, thus it would be more readily available during difficult times, and could contribute to alleviating households' food security problems (Vorster & Jansen van Rensburg, 2005:671). Furthermore, TLV not only contribute nutritional value to the diet, but add variety to a diet that may sometimes become monotonous (Mavengahama *et al.,* 2013:230).

However, the consumption patterns of households are rapidly changing as a result of urbanisation and consequently TLV are not consumed as frequently (Jansen van Rensburg *et al.,* 2007:324) and their value underestimated (Schönfeldt & Pretorius, 2011:1141). Therefore, innovative ways of using TLV should be introduced to regain the popularity of TLV among rural and urban communities. Dietary changes as a result of urbanisation will remain, but healthier adaptations could be suggested to improve a diet characterised by unhealthy convenient and processed foods (Drimie *et al.,* 2013:912).

The role of TLV to support food security within households and the adaptation of TLV in such a way to increase dietary diversity will be explored.

The role of traditional vegetables as a food source to households' food security situation

Plant species utilised for their leaves, flowers or stems, which are not necessarily cultivated at a commercial level, may be regarded as a vegetable source by the majority black African

individuals, and is known as wild vegetables (Mavengahama *et al.,* 2013:227) or TLV if mostly the leaves of the plant are consumed (Jansen van Rensburg *et al.,* 2007:317). Wild vegetables are primarily consumed as a relish to accompany most staple food products (Drimie *et al.,* 2013:912; Vorster *et al.,* 2007:6), adding to the taste of the dish, as well as the nutritional components thereof (Mavengahama *et al.,* 2013:227). Traditional vegetables are also commonly consumed for their nutritional qualities and affordability (Cloete & Idsardi, 2013:912). TLV dishes commonly consumed in the North West province of SA are boiled amaranth leaves known as *thepe,* and a mixture of boiled cowpea, amaranth and spider plant leaves known as *Morogo* (Matenge *et al.,* 2011:28).

Traditional vegetables have unfortunately been regarded as weeds by the majority of researchers, resulting in the perception that they are nutritionally and agriculturally insignificant (Vorster *et al.,* 2007:3). In a study investigating the use of traditional vegetables as a food source, Vorster and Jansen van Rensburg (2005:670) determined that traditional vegetables were characterised as food commonly consumed by impoverished communities. Consequently, traditional vegetables are less acceptable among the younger generation as the stigmatised labelling of these vegetables decreased their popularity (Rastogi & Shukla, 2013:109; Vorster *et al.,* 2007:6). The decreased consumption could also be attributed to a lack of knowledge regarding the access and utilisation of TLV (Taleni *et al.,* 2012:6). However, Cloete and Idsardi (2013:911) confirmed that the stigmatisation of traditional vegetables as food for the less privileged was unfounded. Nevertheless, considering the effects of urbanisation and the declining use of traditional vegetables among younger individuals, a high risk of losing this vital knowledge exists.

The importance of traditional vegetables being incorporated into the diets of the majority of black African households is not only culturally significant, but it also contributes to their food security situation (Matenge *et al.,* 2011:32; Schönfeldt & Pretorius, 2011:1141; Vorster *et al.,* 2007:10). Faber *et al.* (2011) determined that the cultivation of TLV in communal or home gardens could positively affect food security and decrease food expenditure. Additionally, pressure to reach global requirements for commercial crops such as maize is increasing. Hence, an opportunity exists for underutilised crops such as amaranth to be cultivated, and support food security (Mlakar *et al.,* 2010; Rastogi & Shukla, 2013). A TLV such as amaranth should be considered as an alternative to commercial crops since it can successfully be grown in regions often experiencing drought (Rastogi & Shukla, 2013).

Cloete and Idsardi (2013:912) indicated that there exists market potential for traditional vegetables, since most households are unaware of their existence. This could lead to an income opportunity for lower-income households, provided they have an established platform to market their harvest (Cloete & Idsardi, 2013:912; Schönfeldt & Pretorius, 2011:1141). Moreover,

indigenous vegetables including amaranth could contribute considerably to the dietary requirements of a household (Jansen van Rensburg *et al.,* 2007:324; Schönfeldt & Pretorius, 2011:1146), especially considering the high amounts of crude fibre, protein and minerals present in these vegetables (Afolayan & Jimoh, 2009:427). This illustrates the importance of traditional vegetables and the transference of knowledge regarding these traditional vegetables from one generation to the next (Jansen van Rensburg *et al.,* 2007:324), especially to households that are at risk of being food insecure. Moreover, DoAFF (2013:15) recommends the increased awareness and consumption of TLV, particularly amaranth, especially among rural communities, since this will add essential micronutrients to diets as well as improve their economic situation if they cultivate it.

In the North West Province of SA the five most commonly consumed traditional vegetables are sorghum, cowpeas, sweet potato and amaranth leaves (Cloete & Idsardi, 2013:908). Sorghum, cowpeas and sweet potatoes are readily available for purchase, which is not the case for amaranth products. Amaranth is not commercially cultivated in SA, as it has been the general consensus that it grows naturally and remains available to the communities (Jansen van Rensburg, 2007:320). Additionally, research has not been conducted to establish the true availability of this plant among other TLV (Matenge *et al.,* 2011:18). In addition, other species of amaranth known for their seeds as grain food source are not as well known.

Cultivation of the amaranth grain species on a large scale is successfully implemented in Uganda, and although it is still regarded as novel, it has been indicated as being able to successfully generate income (Ainebyona *et al.,* 2012:189). The low production cost of cultivating grain amaranth as a fast growing crop that provides additional nutrients to the diets of vulnerable households has made it a desirable crop (Rastogi & Shukla, 2013:109). In Kenya amaranth has been recognised as a commercial crop since 1991 (Kariuki *et al.,* 2013:19). In SA amaranth has not been cultivated as a commercial crop; however, the Department of Agriculture, Forestry and Fisheries (2010) has released a production guideline for the plant, perhaps indicating potential interest in amaranth as a crop.

2.5 Significance of grain amaranth as a food source

Amaranth originated in Central and South America, particularly among the Aztec and Inca civilizations, where it was consumed as a staple food (Caselato-Sousa & Amaya-Farfán, 2012:R93). It is believed to be one of the oldest crops in the world (DoAFF, 2010:1). Even though it gained popularity abroad in the United States (US), Van Wyk (2011:859) lists amaranth (leafy species), as an indigenous South African plant and according to Schönfeldt and Pretorius, (2011:1142) it is one of the most popular crops consumed among rural communities. Matenge (2011:96) reported that amaranth leaves were very popular among communities in the

North West Province. In SA amaranth (Fig. 2.1) is also known as Pigweed (English) or “Hanekam” (Afrikaans) (DoAFF, 2010:1). Known leafy amaranth species include *A. hybridus* (Taleni *et al.,* 2012:13), *A. thunbergii, A. hypochondriacus* (Gerrano *et al.,* 2015:39) and *A. caudatus* (DoAFF, 2010:2). Grain amaranth has not been commercialised and may indicate a gap in the South African market. This nutritious grain is classified as a pseudo-grain (Amicarelli & Camaggio, 2012:6), since the composition of the grain is similar to cereals regarding nutritional composition (Alvarez-Jubete, 2010:107).

A full-grown plant can reach an average height of about two (2) metres (Taleni *et al.,* 2012:9) and has a green-purple colour with a large seed head, which can contain up to a 100 000 seeds (Garrett *et al.,* 2012:106). The specie that yields the largest seed production and is optimal for milling purposes is *A. hypocaundriacus* (Mwase *et al.,* 2014:239).

Figure 2-1 *Amaranthus spp* (DoAFF, 2010)

The word ‘amaranth’ is a derivative from the Greek word Anthos, denoted as unwilting or everlasting, and belongs to the family Amaranthaceae (Rastogi & Shukla, 2013:109). Moreover, amaranth displays characteristics of ecological resilience and adaptability to climate changes such as drought, and utilises water sparingly (Mlakar *et al.,* 2010:140). Furthermore, growth is promoted in areas with an abundance of sunlight and elevated temperatures (Ainebyona *et al.,* 2012:178), making this plant particularly suitable for the South African climate.

2.5.1 Nutritional value of grain amaranth

Amaranth is not only agriculturally important as an environmentally-adaptable alternative crop (Mlakar *et al.,* 2010:142), but has exceptional nutritional value important for human consumption (Kariuki *et al.,* 2013:21). Households with lactating mothers or small children will especially benefit from food products enriched with amaranth grain flour (Ayo, 2001:350; Mburu *et al.,*

2012:5967), especially lactating mothers suffering from anaemia (Sharanya & Chaturvedi, 2014:64). Additionally, it is also proven to decrease cholesterol in certain individuals (Achigan-Dako *et al.,* 2014:309).

As a result of increasing food insecurity in SA, food sources with extraordinary nutritive value should be explored. Amaranth is an example of a valuable underutilised food source, of which the leaves and seeds (grain) can be used for food (Kariuki *et al.,* 2013:19). Grain amaranth possesses nutritional benefits as most researchers established in the late eighties already (Bressani, 1989; Pedersen *et al.,* 1987; Tucker, 1986). This research formed the basis for most nutritional value information regarding grain amaranth, hence new research studies still continue to site their work (Ayo, 2001; Kariuki *et al.,* 2013; Mlakar *et al.,* 2010). Consequently, older resources are still highly regarded and will thus also be utilised for this research study.

An increased demand for protein-rich foods exists, increasing pressure to not only supply sufficient quantities of food, but also to enhance the nutritional value thereof (Barba de la Rosa *et al.,* 2009:117). Amaranth could be utilised to enhance the nutritional value of staple foods as 100g of amaranth contains 14 g of protein (Whitney & Rolfes, 2008: H-6). As a result of the particular balance between protein, fat and carbohydrate content of grain amaranth it can be consumed in smaller quantities when compared to other cereals (Kariuki *et al.,* 2013:20).

The protein content of amaranth can positively be compared to that of other staple food products, including rice and maize (Mnkeni *et al.,* 2007:379). Cereal grains including barley and millet contain an average of 10% protein, whereas amaranth has an increased protein content of 13.1 to 21% (Mlakar *et al.,* 2010:136). Grain amaranth can be used to enhance the nutritional value of food products lacking sufficient amounts of protein, including staple food products. Tibagonzeka (2014:74) suggests that the addition of grain amaranth could enhance the protein quality of a staple product since it has a balanced protein profile. The protein and fibre content of the bread increased significantly along with the Zinc (Zn), Magnesium (Mg) and Ca content, with a mere 10% addition of popped amaranth seeds (Bodrože-Solarov *et al.,* 2008:615). Tibagonzeka *et al.* (2014:8987) successfully incorporated amaranth flour into traditional Ugandan recipes, which also contributed to increased nutritional value of the products.

What makes amaranth protein so significant is the elevated content of an amino acid, Lysine (Kariuki *et al.,* 2013:21), which is lacking in other staple grains (Mlakar *et al.,* 2010:139). The high Lysine content makes it especially suitable to be incorporated into processed foods (Achigan-Dako *et al.,* 2014:309). Lysine is a limiting amino acid (Mlakar *et al.,* 2010:139), which is not available in large enough quantities in the body to sustain protein production (Whitney & Rolfes, 2008:195). It is this quality that makes the protein content of amaranth so important, since vegetable proteins are usually seen as inferior to animal protein. However, the protein

content of amaranth compares positively to animal protein (Bressani, 1989:14) when combined with other cereals (Tucker, 1986:9).

Rastogi and Shukla (2010:114) reported that amaranth contains significant mineral levels including Zinc (Zn), Magnesium (Mg), Phosphorous (P), Iron (Fe), Calcium (Ca) and vitamin A (Onyango *et al.,* 2008:383), which is noteworthy since there is a high prevalence of Vitamin A and Zn deficiency in SA (DoAFF, 2013:14). Amaranth is also an excellent source of Vitamin C and it can be used to improve the diets of individuals in need of nutritional improvement, especially in the rural areas (Mnkeni *et al*., 2007:380). Thus, households experiencing food insecurity should be made attentive to the nutritional value of grain amaranth to improve their nutritional status (Vorster & Jansen van Rensburg, 2005:671). Also, Bodrože-Solarov *et al.* (2008:615) determined that the addition of 10% grain amaranth increased the Ca, Mn, Mg and Zn content of bread. Considering the importance of nutritional value of food, the researcher will focus on grain amaranth to substitute a part of the wheat in a frequently used recipe and improve the nutritional quality thereof. Schoenlechner *et al.* (2010:661) confirms the concept to enhance products' nutritional value and protein content, suggesting that amaranth would be an ideal choice, while Mlakar *et al.* (2010:140) suggests flour from grain amaranth could be used to enhance the nutritive value of food products. From the above-mentioned benefits it is clear that grain amaranth has the ability to improve the nutritional quality of diets, and grain amaranth flour can successfully be utilised to enhance traditional recipes.

2.5.2 Recipe enrichment with grain amaranth

In order to accomplish dietary diversity and improved nutritional intake, recipes of frequently consumed food products could be enhanced to attain the objective of improving nutritional intake, if it is deemed acceptable by the consumers. Matenge *et al.* (2012:2252) determined that a modernised adjustment to traditional recipes using TLV increased its acceptability among younger consumers while also adding to their nutritional situation, thus illustrating the effectiveness of incorporating frequently consumed traditional products with consumer preference. During the recipe development process the households' and individuals' needs and motivation should therefore be considered. A need is an apparent absence of something required by individuals e.g. a need for food (Blythe, 2008:448). Consumer contribution is essential and their needs should be recognised in order for the product to be a success (Kaczorowska, 2011:200; Resurreccion, 2008:368). This will ensure the households' acceptance of the products.

A staple food product recipe, such as a bread recipe, can be adapted to be nutritionally improved and standardised to suit consumer acceptance (Payne-Palacio & Theis, 2009:260). Since most wheat-based breads lack essential amino acids such as lysine, adjusting the recipe

and incorporating nutritionally superior ingredients such as grain amaranth can improve the nutritional quality of bread (Mlakar *et al.,* 2010:140; Škrbić & Filipčev, 2008:119). This is further illustrated by Gambuś *et al.* (2010), who determined that in a 70g gluten-free bread roll, 10% amaranth addition increased protein levels to 6.37%. Additionally, Sanz-Penella *et al.,* (2013) established that the addition of 20% amaranth flour increased the protein content of wheat bread to 14.96g per 100g, while the Zn (18.55g/100g) and Fe (30.05g/100g) contents were also significantly increased. Furthermore, Arendt *et al.* (2009:109) established that the fibre and protein content of bread can be improved with the addition of amaranth flour. Venskutonis and Kraujalis (2013:403) determined that the addition of grain amaranth flour had a minimal effect on the moisture content and volume of breads. Moreover, enhancing current traditional recipes may improve households' dietary intake, contributing to a healthier lifestyle and offer a wider variety of food choices. Hence it is important that the ingredients used to improve the recipes should be of high quality and contribute adequate nourishment to the traditional recipes (Barba de la Rosa *et al.,* 2009:117).

It is proposed that if poor households could be educated to cultivate their own grain amaranth, and produce the suggested bread on a commercial level instead of merely being self-sufficient, they could generate income for the community and increase their dietary diversity (Temple *et al.,* 2011); hence the necessity to determine the sensory acceptability of the proposed recipe enhancement in order to determine whether it would be feasible to introduce to both lower- and higher-income households.

2.5.3 Sensory acceptability

From the above literature it is illustrated that the addition of amaranth to a staple food product could enhance its nutritional value. However, it would be pointless to develop a product if it is not acceptable to the consumers, since its acceptability determines the products' success (Montouto-Graña, 2012:S40). Sensory acceptability of a newly developed recipe should be conducted to establish if the enhanced product would succeed in the market. Research indicated that various food products enriched with amaranth could be sensory-acceptable to consumers (Bodroža-Solarov *et al.,* 2008:615; Chávez-Jáuregui *et al.,* 2003:798; Macharia-Mutie *et al.,* 2011:384). This indicates that amaranth can successfully be used to enhance the nutritional value of food products, whilst still being sensory-acceptable to consumers. Sensory evaluation is a quantitative method to determine the perception of consumers, utilising their sensory organs to evaluate sensory attributes of a food product (Civille & Oftedal, 2012:598). The aim of sensory tests are to assess these sensory attributes such as appearance, flavour and texture, that influence the consumers' preference (Chlopicka *et al.,* 2012:548) and ascertain which aspects are most liked or disliked by the consumer (Meilgaard *et al.,* 2007:7; Resurreccion, 2008:266).

In order to guide the researcher in achieving the best possible food product, consumer sensory tests are vital (Resurreccion, 2008:365), since consumers ultimately determine the success of a product (Moskowitz *et al.,* 2012:2). The food product should be acceptable to different communities, taking into account their cultural habits. When developing new food products, the target consumers should be part of the sensory panel (Macharia-Mutie *et al.,* 2011:376).

Bodroža-Solarov *et al.* (2008:615) determined that bread supplemented with up to 15% grain amaranth flour, was acceptable to consumers. An alternative study determined that flavoured, extruded products, made from a mixture of bovine lung, chickpea and amaranth, were highly acceptable to consumers (Chávez-Jáuregui *et al.,* 2003:798). Moreover, Tibagonzeka *et al.* (2014:8987) evaluated various traditional items containing grain amaranth to be acceptable to farmers from rural Uganda. This indicates that grain amaranth can be added to various dishes, with the likelihood of consumers approving of the taste.

However, Chlopicka *et al*. (2012:548) suggests that amaranth should not be used to improve the quality of bread, as the taste is unacceptable to consumers. In contrast to Chlopicka *et al*. (2012:548), Ayo (2001:350) suggests that bread could be supplemented with 15% amaranth grain flour to enhance the nutritional quality of the bread, while still maintaining sensory acceptability of the product. Thus the researcher will aim to confirm the findings of Ayo (2001:350) in a South African setting.

Resurreccion (2008:369) highlights two types of sensory evaluation procedures: descriptive sensory analyses and consumer-affective tests. For descriptive tests a highly trained panel is selected to evaluate a food product, while consumers are used during consumer-affective tests (Brown, 2015:25). The purpose of the research should guide the researcher to choose the correct procedure to measure what is intended to be measured (Civille & Oftedal, 2012:600). Consumer-affective tests, including preference- and acceptance tests, can be used to establish their approval of a new food product (Moskowitz *et al.,* 2006:202; Resurreccion, 2008:369). Thus, consumer-affective testing was selected for this study, since the opinion of regular users of the food product would determine the acceptance and success of the evaluated product.

(c) Consumer-sensory testing – acceptance and preference tests

When consumers' acceptance of food products are determined, it is usually an experience regarded as an optimistic viewpoint by the consumer towards the food product being evaluated (Moskowitz *et al.,* 2006:221). Moreover, consumers' approval of a food product is usually tested using acceptance and preference test methods (Lawless, 2013:101) where the acceptability of a product is established based on different sensory aspects, such as flavour, taste and appearance, generally using hedonic scales (Chlopicka *et al.,* 2012:550; Civille & Oftedal,

2012:598). In contrast to acceptance tests, preference tests are conducted to establish the liking of one product above another (Meilgaard *et al.,* 2007:274).

Preference of a specific product does not necessarily have to be tested separately through ranking or paired preference tests, since the hedonic scales used to establish acceptance can be analysed to calculate preference of products (Lawless & Heymann, 2010:326). By using the scores established through acceptance testing, preference of a certain product can be determined. The product with the highest score is the most preferred (Lawless & Heymann, 2010:326; Meilgaard *et al.,* 2007:276). This highlights the importance of the scales used to establish the acceptance of products. Hedonic scales that are not balanced, i.e. maintaining a balance between positive and negative selections with a neutral option in the middle, should not be utilised during the acceptance tests. By employing a balanced scale the manipulation of results will be prevented, avoiding the possibility that there might be more positive than negative options from which to choose (Meilgaard *et al.,* 2007:276).

Different acceptance tests can be used, including hedonic scales, pictorial scales, Just About Right scales (JAR) and Food Action Rating scales (FACT) (Lawless & Heymann, 2010:326–341). This study will focus on the hedonic scale as it is a straightforward method and requires minimal guidelines to complete (Lawless & Heymann, 2010:327) which makes it ideal for consumers with low literacy skills. Chlopika *et al.* (2012:550) determined consumers' acceptance of pseudocereal bread by using a hedonic scale, with simple instructions to evaluate different aspects of bread samples. A hedonic scale provides a way to quantitatively measure individual's behaviour toward the evaluated product (Maree & Pietersen, 2010). Since hedonic scales can be used to indicate and establish the degree of liking or disliking regarding a specific product (Meilgaard *et al.,* 2007:275) by allocating a definite number to each selection on the hedonic scale (Resurreccion, 2008:372), these scales will be used. Additionally, the numbers assigned can be converted to numerical data to facilitate statistical analysis. Further details regarding the measuring instrument are provided in Section 3.4.2 (iii).

The most frequently used scale in consumer-sensory testing is the nine-point hedonic scale. Stone and Sidel (2004:88) mention that the nine-point hedonic scale is comprehensible and straightforward to use, and delivers consistent data. Various adjustments have been made to the nine-point hedonic scale, but literature suggests that this standardised scale should not be changed (Lawless & Heymann, 2010:327; Resurreccion, 2008:374). However, a study performed by Matenge *et al*. (2012:2249) among South African consumers demonstrated that a five-point hedonic scale can successfully measure acceptance amongst consumers with a primary education as the lowest level of education. Furthermore, research studies that conducted sensory consumer panels in Spain and America, using a seven-point hedonic scale successfully (Aniedu & Agugo, 2010:163; Montouto-Graña *et al.,* 2012:S42; Ndabikunze *et al.,*

2011:170; Rosales Soto *et al.,* 2012:595) and a five-point hedonic scale (Sharanya & Chaturvedi, 2014:63) demonstrate the adaptability of hedonic scales. Additionally it also illustrates that the traditionally used nine-point hedonic scale can be adjusted to suit specific consumer needs, such as a lower educational level.

Even though the hedonic scale can be used to determine acceptance and preference of food products, it cannot be used to establish a consumer's intention to buy a product (Stone & Sidel, 2004:248), thus it is important for the researcher to establish this separately. Matenge *et al.* (2012:2245) used a FACT scale to establish the respondents' purchase intent for dishes prepared from traditional leafy vegetables.

(d) Panellists

Depending on the type of data required from the sensory test, the most appropriate test method should be chosen to suit the type of data required. That is, if descriptive data is required, trained panellists should be used in concurrence with a suitable descriptive test. Descriptive tests require trained panellists to identify and quantify the strength of an observed attribute of the provided food samples (Lawless, 2013). However, if acceptability is the aim, affective tests are more suitable since affective test methods evaluate the acceptance of the product among intended consumers, thus an untrained panel is required (Deliza & Glória, 2011), hence the suitability for this study where consumers' evaluation through affective test methods is required (Fuller, 2011:242).

The target population used for the sensory evaluation should be regular users of the product being assessed (Stone *et al.*, 2012:237), therefore an untrained consumer panel, which are regular users of the product to be evaluated, would be appropriate (Civille & Oftedal, 2012:599). Additionally, for this study, consumers' opinions are more important to the researcher than descriptive analysis of attributes regarding the food product (Fuller, 2011:242). Moreover, Resurreccion (1998:74) suggests that using consumers instead of trained panellists increases the face validity of the study.

Stone *et al.* (2012:293) suggest that approximately 50 to 75 panellists are sufficient for consumer sensory tests. Meilgaard *et al*. (2007:271) supports this and suggests that more than 50 respondents are required to successfully evaluate sensory characteristics of a product. However, Chlopicka *et al.* (2012:550) successfully used 31 consumers for acceptability tests on pseudocereal breads while Ndabikunze *et al.* (2011:170) used 20 consumers for jam evaluation. Nevertheless, it is important for the researcher to adhere to the specified quantity of consumers, as it may influence statistical significance of the consumer sensory tests (Moskowitz *et al.,* 2006:233).

Bearing in mind the specifications required to conduct a successful consumer sensory test, the literature reviewed enabled the researcher to apply it practically. Furthermore, through establishing sensory acceptability among consumers, the newly developed nutritious food product could contribute to household dietary diversity and enhance their food and nutrition security situation (Amicarelli & Camaggio, 2012:10; Rastogi & Shukla, 2013:121).

2.6 Dietary diversity and food groups

Dietary diversity is of utmost importance since it can positively contribute to a household's food security situation (Msaki & Hendriks, 2013:175). The South African food-based dietary guidelines illustrate the importance of a diverse diet, since the first guideline states: "enjoy a variety of foods" (Vorster *et al*., 2013:S6). Individuals consuming a variety of food products within the various food groups during a given period, are said to have a diverse diet (Ruel, 2003:39216S). Hence, nutritional vulnerability can be seen in those lacking a diverse diet (Drimie *et al*., 2013:916) as illustrated by Labadarios *et al.* (2011:896), who indicated that poor South Africans generally have a diet low in variety. Social structures including friends' influence on food choices at school and shopping centres can negatively impact the dietary diversity of individuals and result in unhealthy, fast food options (Voorend *et al.,* 2012). Furthermore, Hough and Sosa (2015) suggest that poor households often consume any food items available, generally energy-dense foods that are unhealthy.

Inadequate access to food and a variety thereof, may lead to insufficient nutrient consumption, causing undernutrition (Oldewage-Theron & Kruger, 2011:426) and in some cases obesity (Vorster, 2010:2). Various factors contribute to households' inability to consume a variety of healthy food products. The most prevalent factor in SA is limited financial funds (Oldewage-Theron & Kruger, 2008:129). Drimie *et al*. (2013:917) also confirm that a shortage of resources can prevent households from acquiring a diverse diet. However, if food-insecure households were to cultivate some of their own food, this could lead to increased dietary diversity while also decreasing food costs (Temple *et al.,* 2011).

Using country specific Food Based Dietary Guidelines (FBDG), the focus on food security was redirected to address both the need for food and proper nutrition (Schönfeldt *et al*., 2013:233). Despite the fact that the FBDG are effective in regulating South Africans' nutritional needs, individuals who are experiencing financial problems find it difficult to adhere to the guidelines. In addition to the guidelines, certain staple foods such as bread and maize meal are required by law to be fortified. This, however, is not sufficient to fulfil individuals' nutritional requirements and therefore supplementary mediations are required. Accumulative accessibility of a diversity of nutritionally adequate food products could serve as an additional intervention (Schönfeldt *et al*.,

2013:234). A nutritionally superior food product could add to the diversity in the diets of households affected by food insecurity.

2.7 Conclusion

The concept of food security is complex and consists of three important aspects, with stability as a fourth, without which food security cannot be fully comprehended. It is evident that availability of food does not equate to food security. Also, the proper utilisation of household resources could enhance their food security situation. Additionally, culture affects communities' utilisation of food. It is therefore important to incorporate food cultural aspects to fully comprehend affected households' situation. Addressing the three main aspects of food security may improve the situation; however, without acknowledging that these aspects rest on the stability of the country, food security cannot be entirely addressed.

What sets SA apart from other countries and making the food security situation unique, are the different cultures within the country. Culture normally predicts what type of food products are consumed within a community. This poses a unique problem to decision makers. Even if there is enough food for all the households in the country, some households may still experience food insecurity as the available food might not be suitable for their specific culture. Thus, when addressing household food security, it is imperative to develop a strategy specific to the needs of all the different cultures, satisfying their food preferences.

Contributing to the household food security situation are socio-demographic factors such as education, income and employment. The educational levels of South Africans are troublesome, as only 28.9% of the population attained a matric qualification. Without a proper education, prospects for satisfactory employment opportunities diminish. Even though government provides forms of monetary assistance to certain households, this may not be enough without a proper income. Moreover, individuals who do not possess the necessary knowledge to utilise their monetary resources to acquire adequate food products, risk malnutrition and food insecurity.

A nutritious diverse diet is essential to the wellbeing of all human beings. If the monotonous diet of most South Africans could be improved to incorporate more nutrients and to create variety, it could positively influence their household food security situation. However, since culture significantly dictates what is acceptable to consume within communities, initiatives involving food items should take into account consumers' cultural preferences. Thus, the utilisation of TLV is well suited for this venture, since it is already consumed within black African communities. Traditional vegetables have been used for generations to add variety to monotonous diets and to improve the nutritional quality of food products. TLV generally consumed in the North West

province are cowpeas, pumpkin and amaranth leaves, and these plants generally grow in the wild, while amaranth has been grown as a crop in Uganda and Kenya, illustrating the agricultural possibilities of this plant. Among others, amaranth is adaptable to severe environmental conditions including high temperatures and drought conditions, making it suitable for growing in the South African environment. Furthermore, TLV contribute significant nutritional value to households' diet and if they are grown commercially they could contribute economic benefits to the communities. However, with the effects of urbanisation imminent, the loss of knowledge and the use of traditional vegetables have resulted in diminishing use of these vegetables. Nonetheless, if the awareness of underutilised plants could be improved and communities are educated regarding the benefits of TLV, household food security may also be improved to a certain extent.

Making use of underutilised plants, such as amaranth, to improve frequently consumed food products, the nutritional situation of households could be adjusted. Amaranth has exceptional nutritional qualities, particularly its high protein content. Thus, enhancing the nutritional value of staple food products such as bread with amaranth may improve dietary diversity as well as nutritional security of a household. However, it is of utmost importance to consider the consumers' preferences and acceptance of newly developed products. Thus, before introducing a new product, it is vital to test acceptance of the specific product among predicted consumers. This nutritionally-enriched bread can reach the vast majority households in SA and can facilitate the approach to incorporate additional nutrients into individuals' diets. Therefore, amaranth enriched bread could improve households' well-being and eventually their household food security situation.

2.8 References

Aborisade, B. & Bach, C. 2014. Assessing the pillars of sustainable food security. *European international journal of science and technology,* 3(4):117–125.

Achigan-Dako, E.G., Sogbohossou, O.E.D. & Maundu, P. 2014. Current knowledge on *Amaranthus* spp.: research avenues for improved nutritional value and yield in leafy amaranths in sub-Saharan Africa. *Euphytica,* 197(3):303–317.

Afolayan, A.J. & Jimoh, F.O. 2009. Nutritional quality of some wild leafy vegetables in South Africa. *International journal of food sciences and nutrition*, 60(5):424–431.

Ainebyona, R., Mugisha, J., Kwikiriza, N., Nakimbugwe, D., Masinde, D. & Nyankanga, R.O. 2012. Economic evaluation of grain amaranth production in Kamuli District, Uganda. *Journal of agricultural science and technology,* 2(2):178–190.

Altman, M., Hart, T. & Jacobs, P. 2009. Food security in South Africa. Human Science Research Council. http://www.hsrc.ac.za/en/research-outputs/ktree-doc/2643 Date of access: 17 May 2012.

Alvarez-Jubete, L., Arendt, E.K. & Gallagher, E. 2010. Nutritive value of pseudo cereals and their increasing use as functional gluten free ingredients. *Trends in food science and technology*, 21(2):106–113.

Amicarelli, V. & Camaggio, G. 2012. Amaranthus: a crop to rediscover. *Forum ware international,* 2:4–11. http://forumware.wu-wien.ac.at/archiv/1364801634.pdf Date of access: 1 Feb. 2014.

Aniedu, C. & Agugo, U.A. 2010. Acceptability of bread produced from Hausa-potato and sweet potato composite flours. *Journal of agriculture and social research,* 10(2):162–166.

Arendt, E.K., Renzetti, S. & dal Bello, F. 2009. Dough microstructure and textural aspects of gluten-free yeast bread and biscuits. (*In Gallagher, E., ed.* Gluten-free food science and technology. West Sussex: Wiley-Blackwell. p107–129).

Ayo, J.A. 2001. The effect of amaranth grain flour on the quality of bread. *International journal of food properties*, 4(2):341–351.

Barba de la Rosa, A.P., Fomsgaard, I.S., Laursen, B., Mortensen, A.G., Olvera-Martínez, L., Silva-Sánchez, C., Mendoza-Herrera, A., González-Castañeda, J. & De León-Rodríguez, A. 2009. Amaranth (*Amaranthus hypochondriacus*) as an alternative crop for sustainable food production: Phenolic acids and flavonoids with potential impact on its nutraceutical quality. *Journal of cereal science*, 49:117–121.

Barrett, C.B. 2010. Measuring food insecurity. *Science*, 327(5967):825–828.

Bashir, M.K. & Schilizzi, S. 2013. Determinants of rural household food security: a comparative analysis of African and Asian studies. *Journal of the science of food and agriculture*, 93(6):1251–1258.

Blythe, J. 2008. Consumer Behaviour. London: Thomson.

Bodroža-Solarov, M., Filipčev, B., Kevrešan, Ž., Mandić, A. Šimurina, O. 2008. Quality of bread supplemented with popped *Amaranthus cruentus* grain. *Journal of food process engineering*, 31(5):602–618.

Bonnekessen, B. 2010. Food is good to teach: an exploration of the cultural meanings of food. *Food, culture and society: an international journal of multidisciplinary research*, 13(2):280–295.

Bopape, L. & Myers, R. 2007. Analysis of household demand for food in South Africa: model selection, expenditure endogeneity, and the influence of socio-demographic effects. Paper presented at the Annual Conference of the African Econometrics Society, Cape Town, South Africa, 4 – 6 July. http://www.africametrics.org/documents/conference07/Day%203/Session%207/Bopape%20household%20demand%20for%20food%20data.pdf Date of access: 4 Mar. 2014.

Bressani, R. 1989. The proteins of grain amaranth. *Food reviews international*, 5(1):13–38.

Brinkman, H., de Pee, S., Sanogo, I., Subran, L. & Blome, M.W. 2010. High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *Journal of nutrition*, 140(1):153–161.

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

Burchi, F., Fanzo, J. & Frison, E. 2011. The role of food and nutrition system approaches in tackling hidden hunger. *International journal of environmental research and public health,* 8(2):358–373.

Caselato-Sousa, V.M. & Amaya-Farfán, J. 2012. State of Knowledge on Amaranth Grain: A Comprehensive Review. *Journal of food science*, 77(4):R93–R104.

Chávez-Jáuregui, R.N., Cardoso-Santiago, R.A., Pinto e Silva, M.E.M. & Arêas, J.A.G. 2003. Acceptability of snacks produced by the extrusion of amaranth and blends of chickpea and bovine lung. *International journal of food science and technology*, 38(7):795–798.

Chibba, M. & Luiz, J.M. 2011. Poverty, inequality and unemployment in South Africa: context, issues and the way forward. *Economic papers,* 30(3):307–315.

Chlopicka, J., Pasko, P., Gorinstein, S., Jedryas, A. & Zagrodzki, P. 2012. Total phenolic and total flavonoid content, antioxidant activity and sensory evaluation of pseudocereal breads. *LWT-Food science and technology*, 46(2):548–555.

Civille, G.V. & Oftedal, K.N. 2012. Sensory evaluation techniques — Make “good for you” taste “good”. *Physiology & behaviour,* 107(4):598–605.

Cloete, P.C. & Idsardi, E.F. 2013. Consumption of indigenous and traditional food crops: perceptions and realities from South Africa. *Agroecology and sustainable food systems*, 37(8):902–914.

Coates, J. 2013. Build it back better: deconstructing food security for improved measurement and action. *Global food security,* 2(3):188–194.

Constitution ***See*** South Africa.

De Cock, N., D’Haese, M., Vink, N., Van Rooyen, C.J., Staelens, L., Schönfeldt, H.C. & D’Haese, L. 2013. Food security in rural areas of Limpopo province, South Africa. *Food security,* 5(2):269–282.

Deliza, R. & Glória, M.B.A. 2011. Sensory perception. (*In* Nollet, L.M.L. & Toldrá, F., *ed*. Sensory analysis of foods of animal origins. Boca Raton, FL: CRC Press. p61–86).

Djurfeldt, A.A. 2015. Urbanization and linkages to smallholder farming in sub-Saharan Africa: Implications for food security. *Global food security*, 4:1–7.

DoA. ***See*** South Africa. Department of Agriculture.

DoAFF. ***See*** South Africa. Department of Agriculture, Forestry & Fisheries.

Drimie, S., Faber, M., Vearey, J. & Nunez, L. 2013. Dietary diversity of formal and informal residents in Johannesburg, South Africa. *BMC Public Health*, 13(1):911–919.

Drimie, S., Germishuyse, T., Rademeyer, L. & Schwabe, C. 2009. Agricultural production in Greater Sekhukhune: the future for food security in a poverty node of South Africa? *Agrekon*, 48(3):245–275.

Drimie, S. & McLachlan, M. 2013. Food security in South Africa—first steps toward a trans-disciplinary approach. *Food security*, 5(2):217–226.

Drimie, S. & Ruysenaar, S. 2010. The integrated food security strategy of South Africa: an institutional analysis. *Agricultural economics research, policy and practice in Southern Africa,* 49(3):316–337.

Du Toit, D.C., Ramonyai, M.D., Lubbe, P.A. & Ntushelo, V. 2011. Food security. Department of Agriculture, Forestry and Fisheries. http://www.nda.agric.za/docs/genreports/foodsecurity.pdf Date of access: 11 May 2015.

Ericksen, P.J. 2008. Conceptualizing food systems for global environmental change research. *Global environmental change*, 18(1):234–245.

Faber, M., Witten, C. & Drimie, S. 2011. Community-based agricultural interventions in the context of food and nutrition security in South Africa. *Sout African journal of clinical nutrition,* 24(1):21–30.

FAO (Food and Agriculture Organization). 1996. World food summit. http://www.fao.org/wfs/index en.htm Date of access: 31 Mar. 2015.

FAO (Food and Agriculture Organization). 2008. An introduction to the basic concepts of food security. http://www.fao.org/docrep/013/al936e/al936e00.pdf Date of access: 7 Nov. 2013.

Frayne, B., Battersby-Lennard, J., Fincham, R. & Haysom, G. 2009. Urban Food Security in South Africa: Case study of Cape Town, Msunduzi and Johannesburg. Development Planning Division Working Paper Series No.15, Development Bank of South Africa: Midrand.

Fuller, G.W. 2011. New food product development: from concept to marketplace. 3rd ed. Boca Raton, FL: CRC.

Gambuś, H., Pastuszka, D., Gambuś, F., Wrona, P., Ziobro, R., Mickowska, B. & Sikora, M. 2010. Nutritional and dietary value of gluten-free rolls enriched in amaranth flour. *Journal of pre-clinical and clinical research,* 4(2):26–30.

Garrett, H., Ferduson, J. & Amaranthus. M. 2012. Organic management for the professional: the natural way for landscape architects and contractors, commercial growers, golf course managers, park administrators, turf managers, and other stewards of the land. Austin, TX: University of Texas Press.

Gerrano, A.S., Jansen van Rensburg, W.S. & Adebola, P.O. 2015. Genetic diversity of *Amaranthus* species in South Africa. *South African journal of plant and soil,* 32(1):39–46.

Hart, T.G.B. 2009. Exploring definitions of food insecurity and vulnerability: time to refocus assessments. *Agrekon: agricultural economics research, policy and practice in southern Africa*, 48(4):362–383.

Hefny, M.A. 2012. Changing behaviour as a policy tool for enhancing food security. *Water policy,* 14(10):106–120.

Hendriks, S. 2014. Food security in South Africa: Status quo and policy imperatives. *Agrekon: agricultural economics research, policy and practice in Southern Africa*, 53(2):1–24.

Hodges, C.E.M. & Wiggins, G. 2013. Three families—one street: a study of culture, food, and consumption in East London. *Family and consumer sciences research journal,* 41(3):254–266.

Hough, G. & Sosa, M. 2015. Food choice in low income populations – a review. *Food quality and preference,* 40():334–342.

Jansen van Rensburg, W.S., Van Averbeke, W., Slabbert, R., Faber, M., Van Jaarsveld, P., Van Heerden, I., Wenhold, F. & Oelofse, A. 2007. African leafy vegetables in South Africa. *Water South Africa*, 33(3):317–326.

Kaczorowska, J. 2011. Selected methods used in consumer-oriented food product development. (*In* Hartwell, H.H., Lugosi, P. & Edwards, J.S.A. *eds.* Culinary Arts and Sciences VII: Global, national and local perspectives by Bournemouth University, Poole. UK: International Centre for Tourism and Hospitality Research. p200–211).

Kariuki, S., Sila, D. & Kenji, G. 2013. Nutritional profile of amaranth grain varieties grown in Kenya. *Food science and quality management*, 17(1):19–24.

Kruger, R., Schönfeldt, H.C. & Owen, J.H. 2008. Food-coping strategy index applied to a community of farm-worker households in South Africa. *Food and nutrition bulletin*, 29(1):3–14.

Labadarios, D., Mchiza, Z.J., Steyn, N.P., Gericke, G. Maunder, E.M.W., Davids, Y.D. & Parker, W. 2011. Food security in South Africa: a review of national surveys. *Bulletin of the World Health Organization,* 89(12):891–899.

Labadarios, D., Davids, Y.K., Mchiza, Z. & Weir-Smith, G. 2009. The assessment of food insecurity in South Africa. Pretoria: Centre for poverty, employment and growth. Human Sciences Research Council Report.

Labadarios, D., Steyn, N.P., Maunder, E., MacIntyre, U., Gericke, G., Swart, R., Huskisson, J., Dannhauser, A., Vorster, H.H., Nesmvuni, A.E. & Nel, J.H. 2005. The National Food Consumption Survey (NFCS): South Africa, 1999. *Public health nutrition*, 8(5):533–543.

Lawless, H.T. 2013. Laboratory exercises for sensory evaluation. Ithaca, NY: Springer.

Lawless, H.T. & Heymann, H. 2010. Sensory evaluation of food: Principles and practices. 2nd ed. Ithaca, NY: Springer.

Macharia-Mutie, W.C., Van de Wiel, A.M., Moreno-Londono, A.M., Mwangi, A.M. & Brouwer, I.D. 2011. Sensory acceptability and factors predicting the consumption of grain amaranth in Kenya. *Ecology of food and nutrition*, 50(5):375–392.

MacIntyre, U.E., Kruger, H.S., Venter, C.S. & Vorster, H.H. 2002. Dietary intakes of an African population in different stages of transition in the North West Province, South Africa: the THUSA study. *Nutrition research*, 22(3):239–256.

Maree, K. & Pietersen, J. 2010. Surveys and the use of questionnaires. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p155–169).

Matenge, S.T.P., Van der Merwe, D., De Beer, H., Bosman, M.J.C. & Kruger, A. 2012. Consumers' beliefs on indigenous and traditional foods and acceptance of products made with cow pea leaves. *African journal of agricultural research*, 7(14):2243–2254.

Matenge, S.T., Van der Merwe, D., Kruger, A. & De Beer, H. 2011. Utilisation of indigenous plant foods in the urban and rural communities. *Indilinga: African journal of indigenous knowledge systems*, 10(1):17–37.

Mavengahama, S., McLachlan, M. & De Clercq, W. 2013. The role of wild vegetable species in household food security in maize based subsistence cropping systems. *Food security*, 5(2):227–233.

Mburu, M.W., Gikonyo, N.K., Kenji, G.M. & Mwasaru, A.M. 2012. Nutritional and functional properties of a complementary food based on Kenyan amaranth grain *(Amaranthus cruentus*). *African journal of food, agriculture, nutrition and development,* 12(2):5959–5977.

McLachlan, M. & Hamann, R. 2011. Theme issue on food security. *Development southern Africa*, 28(4):429–430.

Meilgaard, M.C., Civille, G.V. & Carr, T.B. 2007. Sensory evaluation techniques. 4th ed. New York, NY: CRC Press.

Meintjes, H., Hall, K., Marera, D. & Boulle, A. 2010. Orphans of the AIDS epidemic? The extent, nature and circumstances of child-headed households in South Africa. *AIDS Care: Psychological and socio-medical aspects of AIDS/HIV*, 22(1):40–49.

Mlakar, G.S., Turinek, M., Jakop, M., Bavec, M. & Bavec, F. 2010. Grain amaranth as an alternative and perspective crop in temperate climate. *Journal for geography*, 5(1):135–145.

Mnkeni, A.P., Masika, P. & Maphaha, M. 2007. Nutritional quality of vegetable and seed from different accessions of Amaranthus in South Africa. *Water South Africa*, 33(3):377–380.

Mogotlane, S.M., Chauke, M.E., Van Rensburg, G.H., Human, S.P. & Kganakga, C.M. 2010. A situational analysis of child-headed households in South Africa. *Curationis,* 33(3):24–32.

Montouto-Graña, M., Cabanas-Arias, S., Porto-Fojo, S., Vázquez-Odériz, M.L. & Romero-Rodríguez, M.A. 2012. Sensory characteristics and consumer acceptance and purchase intention toward fresh-cut potatoes. *Journal of food science*, 77(1):S40–S46.

Moskowitz, H.R., Beckley, J.H. & Resurreccion, A.V.A. 2006. Sensory and consumer research in food product design and development. Ames, IA: Blackwell Publishing.

Moskowitz, H.R., Beckley, J.H. & Resurreccion, A.V.A. 2012. Sensory and consumer research in food product design and development. 2nd ed. Ames, IA: Blackwell Publishing

Moyo, D. 2007. The future of food: elements of integrated food security strategy for South Africa and food security status in Africa. Paper presented at the Annual Meeting of the American Society of International Law, Washington, DC, 28 – 31 March. http://www.jstor.org.nwulib.nwu.ac.za/stable/pdfplus/25660167pdf?acceptTC=true&jpdConfirm=true Date of access: 24 Feb. 2014.

Msaki, M.M. & Hendriks, S.L. 2013. Do food quality and food quantity talk the same? Lesson from household food security study in Embo, South Africa. *Journal of American college of nutrition,* 32(3):165–176.

Mwase, W.F., Kachiguma, N., Manduwa, D. & Maliro, M.F.A. 2014. Agromorphological diversity of Amaranthus species in Central Malawi. *International journal of AgriScience,* 4(4):235–241.

Nam, P. 2011. Food security: a crucial element in transforming society through quality education. (*In* Bwire, A., Huang, Y., Masingila, J. & Ayot, H. *eds*. Quality education for societal transformation: 2nd International conference on education organised by Kenyatta University, Nairobi, Kenya. p234–244.)

Ndabikunze, B.K., Masambu, B.N., Tiisekwa, B.P.M. & Issa-Zacharia, A. 2011. The production of jam from indigenous fruits using baobab (*Adansonia digitata* L.) powder as a substitute for commercial pectin. *African journal of food science,* 5(3):168–175.

Ndhleve, S., Musemwa, L. & Zhou, L. 2013. Household food security in a coastal rural community of South Africa: Status, causes and coping strategies. *African journal of food security,* 1(1):15–20.

Oldewage-Theron, W.H. & Egal, A. 2012. Impact of nutrition education on nutrition knowledge of public school educators in South Africa: A pilot study. *Health SA Gesondheid*, 17(1):1–8.

Oldewage-Theron, W.H. & Kruger, R. 2008. Food variety and dietary diversity as indicators of the dietary adequacy and health status of an elderly population in Sharpeville, South Africa. *Journal of nutrition for the elderly*, 27(1-2):101–133.

Oldewage-Theron, W.H. & Kruger, R. 2011. Dietary diversity and adequacy of women caregivers in a peri-urban informal settlement in South Africa. *Nutrition*, 27(4):420–427.

Oldewage-Theron, W.H. & Slabbert, T.J.C. 2008. Impact of food and nutrition interventions on poverty in an informal settlement in the Vaal Region of South Africa. *Proceedings of the Nutrition society*, 67(1):91–97.

Oni, S.A., Maliwichi, L.L. & Obadire, O. 2010. Socio-economic factors affecting smallholder farming and household food security: a case of Thulamela local municipality in Vhembe District of Limpopo Province, South Africa. *African journal of agricultural research,* 5(17):2289–2296.

Onyango, C.M., Shibairo, S.I., Imungi, J.K. & Harbinson, J. 2008. The physico-chemical characteristics and some nutritional values of vegetable amaranth sold in Nairobi-Kenya. *Ecology of food and nutrition,* 47(4):382–398.

Oxford dictionaries. 2015. Spaza. http://www.oxforddictionaries.com/definition/english/spaza. Date of access: 13 May 2015.

Payne-Palacio, J. & Theis, M. 2009. Introduction to foodservice. 11th ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Pedersen, B., Kalinowski, L.S. & Eggum, B.O. 1987. The nutritive value of amaranth grain (*Amaranthus caudatus*). *Plant foods for human nutrition*, 36(4):309–324.

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

Puoane, T., Matwa, P., Bradley, H.A & Hughes, G. 2006. Socio-cultural factors influencing food consumption patterns in the black African population in an urban township in South Africa. *Human ecology*, 14:89–93.

Rastogi, A. & Shukla, S. 2013. Amaranth: a new millennium crop of nutraceutical values. *Critical reviews in food science and nutrition*, 53(2):109–125.

Resurreccion, A.V.A. 1998. Consumer sensory testing for product development. Gaithersburg, MD: Aspen Publishers.

Resurreccion, A.V.A. 2008. Consumer sensory testing for food product development. (In Brody, A.L. & Lord, J.B., ed. Developing new food products for a changing marketplace. 2nd ed. Boca Raton, FL: CRC Press. p.365-405).

Roos, J.A. 2012. Food system analysis and the development of a system dynamics approach to improve food security for a vulnerable community in the Breede river region, Western Cape Province, South Africa. Stellenbosch, SUN. (Thesis – Masters).

Roos, J.A., Ruthven, G.A., Lombard, M.J. & McLachlan, M.H. 2013. Food availability and accessibility in the local food distribution system of a low-income, urban community in Worcester, in the Western Cape Province. *South African journal of clinical nutrition,* 26(4):194–200.

Rosales Soto, M.U., Brown, K. & Ross, C.F. 2012. Antioxidant activity and consumer acceptance of grape seed flour-containing food products. *International journal of food science and technology*, 47(3):592–602.

Ruel, M.T. 2003. Operationalizing dietary diversity: a review of measurement issues and research priorities. *Journal of nutrition*, 133(11):3911S–3926S.

Sanz-Penella, J.M., Wronkowska, M., Soral-Smietana, M. & Haros, M. 2013. Effect of whole amaranth flour on bread properties and nutritive value. *Food science and technology*, 50(2):679–685.

Schiffman, L.G. & Kanuk, L.L. 2007. Consumer behaviour. 9th ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Schiffman, L.G., Kanuk, L.L. & Wisenblit, J. 2010. Consumer behaviour: global edition. 10th ed. Upper Saddle River, NJ: Pearson. p591.

Schoenlechner, R., Mandala, I., Kiskini, A., Kastaropoulos, A. & Berghofer, E. 2010. Effect of water, albumen, and fat on the quality of gluten-free bread containing amaranth. *International journal of food science and technology,* 45(4):661–669.

Schönfeldt, H.C., Hall, N. & Bester, M. 2013. Relevance of food-based dietary guidelines to food and nutrition security: A South African perspective. *Nutrition bulletin*, 38(2):226–235.

Schönfeldt, H.C. & Pretorius, B. 2011. The nutrient content of five traditional South African dark green leafy vegetables: A preliminary study. *Journal of food composition and analysis*, 24(8): 1141–1146.

Sekhampu, T.J. 2012. Socio-economic determinants of household food expenditure in a low income township in South Africa. *Mediterranean journal of social sciences*, 3(3):449–453.

Sekhampu, T.J. 2013. Determination of factors affecting the food security status of households in Bophelong, South Africa. *International business and economics research journal*, 12(5):543–550.

Shackleton, C., Paumgarten, F., Mthembu, T., Ernst, L., Pasquini, M. & Pichop, G. 2010. Production of and trade in African indigenous vegetables in the urban and peri-urban areas of Durban, South Africa. *Development Southern Africa,* 27(3):291–308.

Sharanya, D. & Chaturvedi, A. 2014. Development and evaluation of nutrient rich snack bars from grain amaranth. *The journal of research ANGRAU*, 42(2):63–64.

Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., Zuma, K., Dhansay, A., Reddy, P., Parker, W., Hoosain, E., Naidoo, P., Hongoro, C., Mchiza, Z., Steyn, N.P., Dwane, N., Makoae, M., Maluleke, T., Ramlagan, S., Zungu, N., Evans, M.G., Jacobs, L. & Faber, M. 2013. The South African National Health and Nutrition Examination Survey (SANHANES-1). Cape Town: Human Science Research Council Press.

Simister, J. & Piesse, J. 2003. Bargaining and household dynamics: the impact of education and financial control on nutrition outcomes in South Africa. *South African journal of economics*, 71(1):163–180.

Škrbić, B. & Filipčev, B. 2008. Nutritional and sensory evaluation of wheat breads supplemented with oleic-rich sunflower seed. *Food chemistry*, 108(1):119–129.

Solomon, S.R. 2013. Consumer behaviour: Buying, having and being. 10th ed. Essex, England: Pearson.

Sommerville, M., Essex, J. & Le Billon, P. 2014. The 'global food crisis' and the geopolitics of food security. *Geopolitics*, 19(2):239–265.

South Africa. 1996. Constitution of the Republic of South Africa 1996. http://www.justice.gov.za/legislation/acts/1996-108.pdf Date of access: 14 Apr. 2014.

South Africa. Department of Agriculture. 2002. The integrated food security strategy for South Africa. Pretoria. http://www.nda.agric.za/doaDev/sideMenu/foodSecurity/policies.pdf Date of access: 12 Mar. 2012.

South Africa. Department of Agriculture, Forestry & Fisheries. 2010. Amaranthus: production guidelines. Pretoria. http://www.nda.agric.za/docs/Brochures/Amaranthus.pdf Date of access: 10 Nov. 2010.

South Africa. Department of Agriculture, Forestry & Fisheries. 2013. National policy on food and nutrition security. http://www.nda.agric.za/docs/media/NATIONAL%20POLICYon%20food%20and%20nutririon%20security.pdf Date of access: 15 Apr. 2015.

StatsSA (Statistics South Africa). 2011a. Census 2011 Municipal factsheet. https://www.statssa.gov.za/Census2011/Products/Census_2011_Municipal_fact_sheet.pdf Date of access: 2 Dec. 2014.

StatsSA (Statistics South Africa). 2011b. Tlokwe city council. http://beta2.statssa.gov.za/?page_id=993&id=tlokwe-city-council-municipality Date of access: 6 Feb. 2014.

StatsSA (Statistics South Africa). 2012. Census 2011. http://www.statssa.gov.za/publications/p03014/p030142011.pdf Date of access: 8 Feb. 2013.

StatsSA (Statistics South Africa). 2013. Millennium Development Goals, Country Report 2013. South Africa: Pretoria. http://www.statssa.gov.za/wp-content/uploads/2014/02/MDGR_Report_2013_Final.pdf Date of access: 23 Apr. 2014.

StatsSA (Statistics South Africa). 2014. Poverty Trends in South Africa: an examination of absolute poverty between 2006 and 2011. http://www.statssa.gov.za/publications/Report-03-10-06/Report-03-10-06March2014.pdf Date of access: 7 Jul. 2014.

Stone, H. & Sidel, J.L. 2004. Sensory evaluation practices. 3rd ed. Redwood city, CA: Elsevier Academic Press.

Stone, H., Bleibaum, R. & Thomas, HA. 2012. Sensory evaluation practices. 4th ed. Waltham, MA: Academic Press.

Taleni, V., Nyoni, P. & Goduka, N. 2012. People's perceptions on indigenous leafy vegetables: A case study of *Mantusini* Location of the Port St Johns Local Municipality, in the Eastern Cape, South Africa. Paper presented at the Strategies to overcome poverty and inequality: towards Carnegie III conference, University of Cape Town, CT, 3–7 September. http://carnegie3.org.za/docs/papers/260_Taleni_People's%20perceptions%20on%20indigenous%20leafy%20vegetables%20-%20a%20case%20study%20of%20Mantusini%20location%20of%20the%20Port%20St%20JOhns%20Local%20MUnicipality.pdf Date of access: 13 May 2015.

Tanga, P.T. & Tangwe, M.N. 2014. Perceived impact of the global financial crisis on social grant recipients in the Eastern Cape, South Africa. *Mediterranean journal of social sciences*, 5(2):2747-287.

Temple, N.J., Steyn, N.P., Fourie, J., & De Villiers, A. 2011. Price and availability of healthy food: A study in rural South Africa. *Nutrition,* 27(1):55–58.

Thandeka, N., Sithole, N., Thamaga-Chitja, J.M. & Makanda, I. 2011. The role of traditional leafy vegetables in household food security in rural KwaZulu-Natal. *Indilinga – African journal of indigenous knowledge systems*, 10(2):195–209.

The World Bank. 2014. GINI Index. http://data.worldbank.org/indicator/SI.POV.GINI Date of access: 24 Feb. 2014.

Thornton, L.E., Pearce, J.R. & Ball, K. 2014. Sociodemographic factors associated with healthy eating and food security in socio-economically disadvantaged groups in the UK and Victoria, Australia. *Public health nutrition*, 17(1):20–30.

Tibagonzeka, E.J. 2014. Potential of grain amaranth to improve food and nutrition security in rural Uganda: the case study of Apac, Kamuli and Nakasongola districts. Kampala: Makerere University. (Thesis – MSc).

Tibagonzeka, J., Wambete, J., Muyinda, A.M., Nakimbugwe, D. & Muyonga, J.H. 2014. Acceptability and nutritional contribution of grain amaranth recipes in Uganda. *African journal of food, agriculture, nutrition and development,* 14(3):8979–8997.

Trefry, A., Parkins, J.R. & Cundill, G. 2014. Culture and food security: a case study of homestead food production in South Africa. *Food security*, 6(4):555–565.

Tucker, J.B. 1986. Amaranth: The one and future crop. *Bioscience*, 36(1):9–13.

UN (United Nations). 2014. Dialogues on Implementation of the Post-2015 development agenda. http://www.worldwewant2015.org/sitemap. Date of access: 17 Apr. 2014.

UNMP (United Nations Millennium Project). 2006. Millennium developmental goals: what they are. http://www.unmillenniumproject.org/goals/ Date of access: 24 Feb. 2014.

Van der Merwe, C. 2011. Key challenges for ensuring food security in South Africa's inner cities. *AISA policy brief,* 36:1–7.

Van Wyk, B.E. 2011. The potential of South African plants in the development of new food and beverage products. *South African journal of botany*, 77(4):857–868.

Venskutonis, P.R. & Kraujalis, P. 2013. Nutritional components of amaranth seeds and vegetables: a review on composition, properties, and uses. *Comprehensive reviews in food science and food safety*, 12(4):381–412.

Viljoen, A.T., Botha, P. & Boonzaaier, C. 2005. Factors contributing to changes in food practices of a black South African community. *Journal of family ecology and consumer sciences*, 33(1):46–62.

Voorend, C.G.N., Norris, S.A., Griffiths, P.L., Sedibe, M.H., Westerman, M.J. & Doak, C.M. 2012. 'We eat together; today she buys, tomorrow I will buy the food': adolescent best friends' food choices and dietary practices in Soweto, South Africa. *Public health nutrition*, 16(3):559–567.

Vorster, H.H. 2010. The link between poverty and malnutrition: a South African perspective. *Health SA Gesondheid,* 15(1):1–6.

Vorster, H.H., Badham, J.B. & Venter, C.S. 2013. An introduction to the revised food-based dietary guidelines for South Africa. *South African journal of clinical nutrition*, 26(3):S5–S12.

Vorster, H.J. & Jansen van Rensburg, W.S. 2005. Traditional vegetables as a source of food in South Africa: Some experiences. In *African crop science conference proceedings*, 7 No 2 of 3: 669–671.

Vorster, I.H.J., Jansen van Rensburg, W., Van Zijl, J.J.B. & Venter, S.L. 2007. The importance of Traditional Leafy Vegetables in South Africa. *African journal of food agriculture nutrition and development*, 7(4):1–13.

Warr, P. 2014. Food insecurity and its determinants. Paper presented at the 58th AARES Annual Conference, Port Macquarie, New South Wales, 4–7 February. http://www.aares.org.au/aares/ documents/2014AC/IPWarr.pdf Date of access: 16 Apr. 2014.

WFP (World Food Programme). 2014. What is food security? https://www.wfp.org/node/359289 Date of access: 15 Apr. 2014.

Whitney, E. & Rolfes, S.R. 2008. Understanding nutrition. 11th ed. Belmont, CA: Thomson Wadsworth.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The purpose of this study was to: i) explore the household food security situation among two groups, a lower income and middle to higher income group; ii) to identify a frequently consumed food product and; iii) to nutritionally enhance the identified product with grain amaranth and then determine the acceptability of the food product. Although amaranth is widely utilised among black South Africans for its leaves as a traditional vegetable (Gerrano *et al*., 2015:39), the grain varieties are not familiar in SA. Through sensory evaluation the acceptance and preference of the enriched food product samples were determined among the two groups. When developing a new product, consumers' acceptance of a food product is crucial (Moskowitz *et al*., 2006:219). The study was conducted on the Potchefstroom campus of the North-West University (NWU), SA. Furthermore, this chapter provides information regarding the research process, sampling, data collection and analysis and ethical issues addressed.

3.2 Research design

A non-experimental, quantitative design utilising surveys was employed in two phases to collect data for this study. When a study population is too large to be monitored, surveys are the best alternative to gather information about the characteristic of the specific population (Babbie, 2015:279). It was suitable for this study since availability and access to respondents within a large population were restricted. Furthermore, a quantitative approach was utilised since the relationship between variables was explored and measured, enabling the researcher to draw conclusions regarding the relationships (Fouché & Delport, 2011:64). Information regarding the food security status of households and especially households with lower-incomes is limited, thus the need to explore this study population and variables influencing it. The variables included were the respondents' demographic characteristics, food consumption patterns and households' food security situation, as well as the sensory evaluation of enriched bread samples.

Furthermore, numerical data was collected for a quantitative research design to be executed (Maree & Pietersen, 2010c:153). Exploratory research typically intends to evaluate variables that may influence aspects of a population (Babbie & Mouton, 2010:76). Since a demographic variable such as household income could have a large effect on household food security (Kneafsey *et al*., 2013:110), the food utilisation and the security status of each group (lower income group and medium to higher income group) were first evaluated, forming the first part of two phases of the research, briefly illustrated in Figure 3–1.

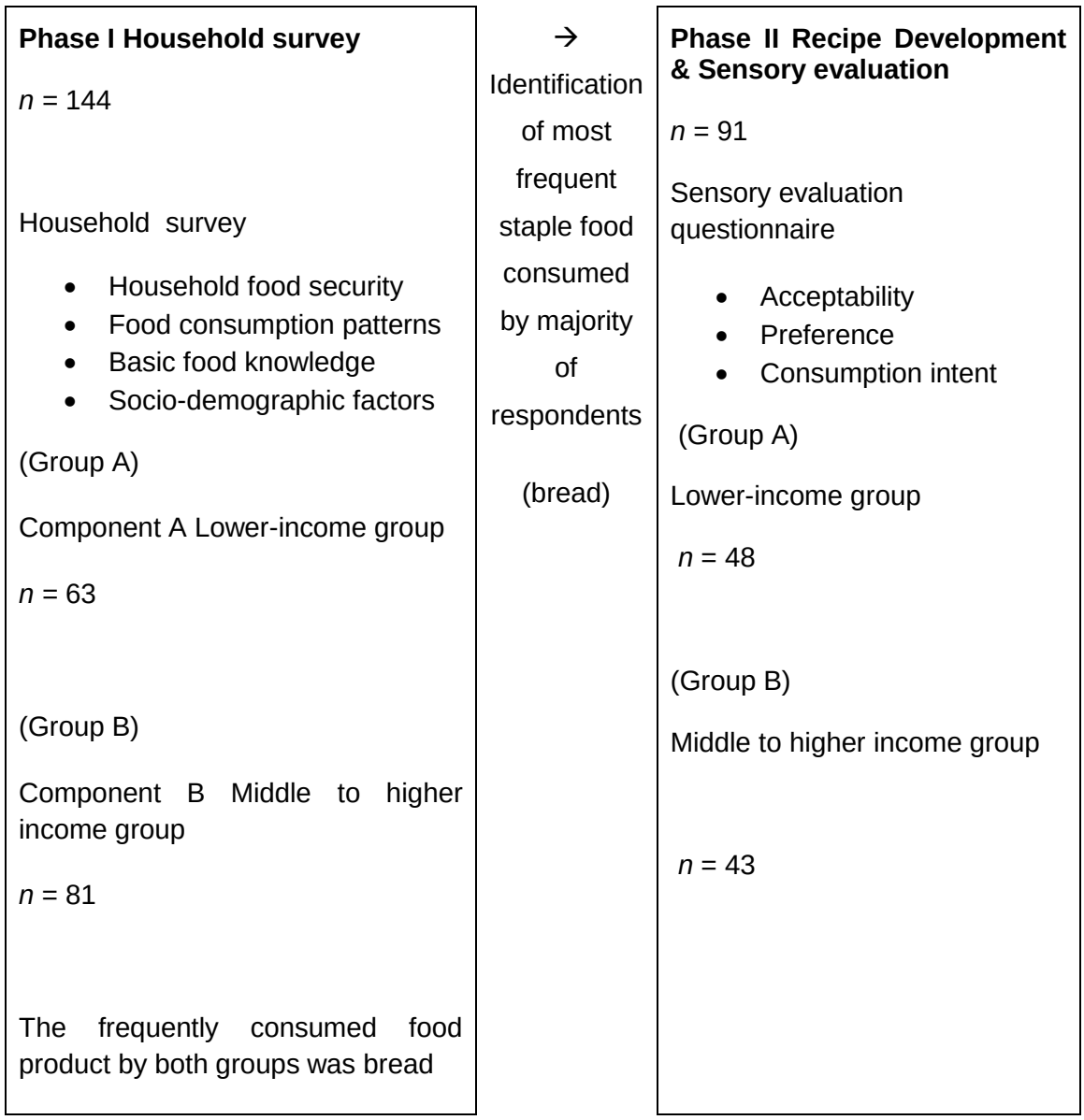


Figure 3–1 Diagrammatic representation of the methodology of two phases for the attainment of the research objectives

The research conducted was used to explore the household food utilisation and food security situation of lower-income households and to determine whether food security is a given status experienced in higher income households. Apart from exploring the household food security status for the respective groups, the data collection was also used to explore the food utilisation within households. The household survey collected households' food consumption data and the staple food mostly consumed on a daily basis by the majority of the households, was bread. The second phase commenced encompassing the development of a recipe for bread enriched with grain amaranth flour as it was aimed to improve nutritional consumption among the lower-income group (Group A). Quantitative surveys were utilised during sensory evaluation to explore the acceptance of the bread samples.

3.3 Sampling

3.3.1 Study location and population

The study consisted of two phases and was conducted on the Potchefstroom campus of the NWU, in the North-West province of SA among 144 income-earning individuals (Fig 3–1). Inclusion criteria to select the most suitable respondents entailed that voluntary individuals, 18 years and older were required, and they should have been able to read and write Basic English. Additionally the respondents should have been employed at the NWU, Potchefstroom campus and earned a salary. No respondents should have had any food allergies as they were required to evaluate food samples.Respondents fitting the inclusion criteria were identified and approached through purposive sampling as described in section 3.3.2, and they had to complete a consent form providing permission to the researcher to utilise the data and indicate voluntary participation. Also, by signing the consent form, the respondents confirmed that they did not have any food allergies and especially those from the listed ingredients which included wheat flour, gluten, soy, dairy products and eggs.

Phase I and II of the study was conducted with 144 and 91 employees, respectively, at the NWU, Potchefstroom campus in the North-West province of SA. The first group of respondents comprised employees from cleaning services at the NWU, with a lower income level (Group A). The second group of respondents mostly consisted of academic, administration as well as a few supporting staff personnel from the NWU, who were typically from middle to higher income levels (Group B).

The NWU as a research location was chosen since: i) it was convenient to locate a large number of income-earning respondents from lower and middle to higher income groups; ii) there were no additional transportation costs, therefore fewer expenses were incurred; iii) the researcher was able to gather the information conveniently within secure boundaries of the University as the employees were easily accessible; and iv) the location was appropriate, as the sensory evaluation laboratory at Consumer Sciences was accessible to all respondents. This further illustrates the practicality of the location to the researcher and respondents, especially regarding resources and the control of the environment.

3.3.2 Method of sampling

Non-probability, purposive sampling was identified to be an appropriate sampling method, whereindividuals did not have an equal chance of being selected for the study population (Strydom, 2011b:231). In order for the researcher to identify respondents that fit the inclusion criteria, probability sampling would not have been suitable. Makofane and Mogoane (2012:310) relied on purposive sampling to select their participants since they also had specific criteria in

mind that the participants needed to fulfil. Therefore, purposive sampling was implemented since particular criteria (Section 3.3.1) for the respondents' inclusion were formulated (Maree & Pietersen, 2010a:178), while the researcher's judgement could also be applied to select appropriate individuals (Strydom, 2011b:232). Adrinah and Base (2012:1539) employed a similar sampling method by also depending on the judgement and criteria formulated by the researchers to select respondents to participate in their quantitative research.

This study aimed to include lower-income consumers, thus the inclusion of cleaners, usually presenting lower-skilled workers and mostly recruited among the contracted cleaning services company at the university. Most of these cleaners earned a basic salary equal to the basic salary of contract cleaners in SA, of R13.09 per hour (Anon, 2015), thus the researcher could predict that the cleaners fall in the lower-income group. As such information is not typically available on a database since the information is confidential (Maree & Pietersen, 2010a:172), purposive sampling was a suitable method to recruit respondents, while the researcher's judgement could be used to select suitable respondents (Babbie, 2015:187) who may provide significant information regarding the research problem.

Moreover, in order to recruit an adequate amount of respondents conforming to the inclusion criteria, the cleaning service provider and the Campus Registrar were consulted and explanations regarding the purpose of study were given. A copy of the questionnaire was provided. Approval and permission to conduct the survey among various employees were granted. Additionally, the heads of departments from various faculties, including the Faculty for Educational Sciences, the Department of Academic Administration and the Faculty of Health Sciences were contacted and provided with the relevant information before acquiring permission to collect data from available and willing personnel. Appointments were arranged according to individuals' work schedules and additional confirmations of voluntary participation prior to the completion of the questionnaires were obtained to minimise disruption during working hours as far as possible.

3.3.3 Sample size

A hundred and forty four valid questionnaires were collected from the respondents for the household survey (phase I) and 91 respondents from the first phase, evaluated the food samples (phase II). The sample size for the research study was determined by the Statistical Consultation Services of the NWU, and established 50 respondents per group would be statistically significant. Difficulty in finding sufficient quantities of volunteering respondents from both black and white ethnic groups from higher income levels limited them to a single group. Since the respondents could not be recruited from a database, it was challenging to find respondents that fit the inclusion criteria, and who were willing to participate.

As sensory evaluation form a critical part of the study, the sample size for the whole study was calculated according to literature suggestions to comply with sensory evaluation criteria. Literature recommends that sensory evaluation should include at least 50 respondents as suggested by Resurreccion (2008:369) and Stone *et al.* (2012:293). Therefore, in line with the suggestion by the Statistical Consultation Services and literature, no less than 50 respondents were recruited. Additional respondents were incorporated to account for the possibility that some respondents may be absent. Accordingly, Group A, consisting of Servest personnel, entailed 48 respondents while Group B consisted of 43 NWU personnel respondents. With the assistance of the Statistical Consultation Services (SCS), the statistical significance of the study population's sample size was verified.

3.4 Data collection

During the data collection of this study information were gathered throughout two phases. The first phase consisted of an interviewer-administered household survey while the second phase involved sensory evaluation of amaranth enriched breads. The duration of the data collection process for both phases, was approximately seven months from February 2013 until October 2013 as it was difficult to get the adequate amount of respondents from the targeted groups willing to take part in the study.

3.4.1 Phase I: Household survey

The household survey (Annexure 1B) consisted of the following sections:

- → Section A: Food consumption and production
- → Section B: Food preparation
- → Section C: Food storage
- → Section D: Food security
- → Section E: Food knowledge
- → Section F: Demographic information
- → Section G: Living environment
- → Section H: Income and food expenditure

For this study, a questionnaire (Annexure 1B) was developed and used to collect data on households' food consumption (Section A) and to determine the household's food security status (Section D) (phase I), prior to sensory evaluation. The questionnaire was adapted from the food security related questionnaire of Labadarios *et al.* (2009), the General Household Survey (GHS) (StatsSA, 2010a) and Income and Expenditure Survey (IES) (StatsSA, 2010b). This questionnaire addressed the following aspects: i) food consumption and production; ii) food

preparation; iii) food storage; iv) food security; v) food knowledge; vi) demographic information; vii) living environment; and ix) income and food expenditure. However, this questionnaire was used in two other research studies and thus only sections applicable to this study were utilised during data collection. This included i) Section A: Food consumption and production; ii) Section D: Food security; iii) Section F: Demographic information; iv) Section H: Income and Food expenditure and v) Section G: Living environment. The respondents answered the questions requested by the researcher and responses, which could be chosen from a restricted selection of answers, were documented on the questionnaire (Denscombe, 2003:166).

Nominal-, ordinal scale measurement levels were utilised in the questionnaire to measure variables. Nominal questions included aspects such as the gender of a respondent in Question 20 (Annexure 1B), while food consumption in Question 2 (Annexure 1B) were measured with ordinal questions and scales were utilised to gather information such as age of the respondents in Question 21 (Annexure 1B), and measured aspects such as highest degree of education (Question a) (Maree & Pietersen, 2010c:148).

Closed-ended questions e.g. Question 2: “How often do you eat the following food products” (Annexure 1B) with multiple choice options available formed the basis of the questionnaire. However some open-ended questions were available to acquire additional information, such as Question 12.1 “What time do you eat your first meal of the day” (Babbie, 2015:249).

Household food security status was determined with the questionnaire of Labadarios *et al*. (2009:16), grouping households as: i) food secure; ii) at risk of being food insecure; and iii) food insecure. This was determined by the number of affirmative answers indicated by the respondents. Zero affirmative answers signified food secure households; while one to four affirmative answers by respondents indicated a risk of becoming food insecure. Lastly, respondents that provided between five and nine affirmative responses represented food insecure households. Additionally, the indicated affirmative responses, representing specific situations, could have occurred within the preceding month, or more than five days within the preceding month. This would give an indication of how often a specific situation occurred in households, e.g. respondents did not have enough money to buy food within the preceding month.

A pilot study was conducted on the NWU Potchefstroom campus to ensure errors were omitted from the questionnaire (Babbie, 2015:259) and to explore the practicability of the questionnaire and the research study (Fouché & Delport, 2011:73). Additionally, the pilot study provided an estimate of the time taken to complete the questionnaire, and assisted in improving the face and content validity thereof (Delport & Roestenburg, 2011:195). Moreover, it was established that it

took 20 to 30 minutes to complete the questionnaire, thus it is in line with the time recommendation suggested by Maree and Pietersen (2010b:159).

The questionnaires were completed in the comfort of the respondents' office block. For the second phase of the study contact details of all respondents were attained with their permission, in order for the researcher to communicate arrangements regarding the sensory evaluation,. However, these contact details were captured separately from their questionnaires and consent forms to avoid anyone being able to trace their contact details to their responses.

3.4.2 Phase II: Recipe development and sensory evaluation

After the commencement of the first phase during which the household survey was answered, the data indicated which food item should be enriched with grain amaranth flour (see chapter 4 section 4.2.4).

(a) Recipe development of bread enriched with amaranth flour

Recipe books were consulted to acquire a suitable recipe for the development of the enriched bread sample (Basemzansi & Moroka, 2004; De Villiers, 2010). Recipes were selected on the basis of familiarity to consumers and easily accessible ingredients, and thereafter tested without the addition of amaranth flour to first test the final product without any enhancements. However, the chosen recipes contained both an extensive list of ingredients, some of which were not easily accessible and required prolonged time periods to prove. Therefore, lower-income employees from the Consumer Science subject group (NWU), originating from the North West province, were approached to provide and demonstrate a bread recipe traditionally used in their communities. The recipe provided by the employees was tested in order to standardise the recipe and showed positive results, since the prove time significantly decreased as well as the amount of ingredients, as opposed to the recipes acquired from the recipe books. Consequently, the researcher chose a traditional recipe that was practically feasible and economically reasonable, while the taste was familiar to the target population group (Section 3.3.2) of this study.

All the ingredients used for the production of the bread were readily available from any retail store; however, *InCas* pure grain amaranth flour was imported from Nairobi, Kenya (Figure 3–2). The amaranth flour was imported as sufficient quantities were not yet available and affordable in SA at the time of the study. Other ingredients were bought at the local *Pick n Pay* and *Turkstra* (a bakery that supplies baking goods and ingredients on large scale to the public in Potchefstroom). Manufacturers' details are listed in Table 3–1. The bread recipe consisted of brown bread flour, sugar, salt, instant yeast and water, while the enriched bread had the addition of amaranth flour (15% or 25%). Three different bread samples were prepared for the

sensory evaluation: i) the standard (control) wheat bread; ii) a bread with 15% amaranth flour; and iii) a bread with 25% amaranth flour supplanting a similar amount of wheat flour (Table 3–2) for evaluating the findings of the enriched bread samples.

Figure 3–2 **The variety of InCas flour available. The InCas Pure amaranth uji-flour (Second top left) was used in this study**

Table 3–1 **Bread ingredients and manufacturers' details**

Ingredients	Manufacturer	Address
Brown bread flour	*Sasko grain: Bokomo*	PO Box 24, Malmesbury 7299, RSA
Grain amaranth flour	*InCas*	PO Box 11105 - 00100 Nairobi, Kenya
Yeast	*Anchor yeast*	PO Box 43143 Industria 2042, RSA
White sugar	*TSB: Selati*	PO Box 47 Malalane 1320,RSA
Table salt	*Cerebos*	PO Box 7137, Newton Park, Port Elizabeth, 6055, RSA

Table 3-2 Composition of the different bread samples

Ingredients (g)	Bread sample *A*	Bread sample *B*	Bread sample *C*
	Control bread	15 % Amaranth	25% Amaranth
Brown bread (wheat) flour	1000	850	750
Water	700	700	700
Amaranth flour	0	150	250
Sugar	20	20	20
Yeast	15	15	15
Salt	15	15	15

For the production of the bread the dough was formulated using the brown bread flour as basis (1000g) (Sample A) and replacing it with 15% and 25% grain amaranth flour respectively labelled Sample B and Sample C. The amaranth concentration levels were decided upon on the basis of literature suggestions (Ayo, 2001:350; Sanz-Penella *et al.,* 2013:684), where 15% to 20% amaranth replacement was reported to be acceptable. However, since the literature's findings were not based on SA consumers and the fact that untrained panels were used, the researcher decided on the chosen levels to determine if SA consumers would find it acceptable.

The bread samples were prepared by combining the flour(s), table salt, sugar and instant yeast with lukewarm water (42–45°C), placed in the *Crypto-Peerless* electrical mixer (Fig. 3–3) and the dough was mechanically kneaded for ten minutes with a dough hook. The dough was transferred to a large mixing bowl, lightly greased with sunflower oil, to prevent a hard crust from forming (De Villiers, 2010:73) and covered with cling film. The covered dough was placed into an *Inc-O-mat* proofer (Fig 3–4) for 60 minutes at 43°C. Successively the dough was removed, weighed and divided into two equal portions. Then it was rolled, formed and placed into a baking tin (40cm x 10cm x 10cm), covered with cling film and placed into the proofer for 20 minutes at 43°C. Finally, the proofed dough was placed in a *Miele* H217 oven and baked at 180°C for 55 to 60 minutes. This process was repeated threefold to ensure the recipe is standardised and delivered the same results every time.

Figure 3-3 Crypto-Peerless mixer

Figure 3-4 Inc-O-mat proofer

(b) Sensory evaluation (SE)

The laboratory located in the Consumer Science subject group, NWU, was used for the preparation of the bread samples and the sensory evaluation, since it was the most suitable location for affective tests and it was easily accessible to the panellists (Stone *et al.,* 2012:307). Furthermore, the test location could be regulated and control could be implemented over all aspects of the sensory evaluation process. This was applied in the form of using separation booths between respondents. Using the booths reduced the likelihood of bias, since it prevented individuals from communicating with each other (Meilgaard *et al.,* 2007:26). Additionally, further benefits provided by the test location included the preparation of bread samples performed under controlled conditions (Meilgaard *et al.,* 2007:263). This allowed the researcher to focus on creating samples identical in appearance, in addition to organising the preparation and evaluation in one location.

(i) Preparation of samples

In preparation of the sensory evaluation, bread samples were prepared one day prior to the evaluation to allow thorough cooling at room temperature (25°C). Thereafter the bread was cut into one centimetre slices and a square cookie cutter of 2cm x 2cm was used to prepare all the bread samples into uniform size. This was done to minimise any aesthetic differences between the bread samples. Preparation of the samples was conducted under the supervision and assistance of professional sensory analysts.

(ii) Panellists and measurement instrument

Respondents from Phase I were contacted, continuation of participation were confirmed and voluntary participation in sensory evaluation sessions was scheduled. Since the respondents forming the sensory evaluation panel were the same as the respondents partaking in the household survey, consent had already been provided, but it was again affirmed that no respondents had any food allergies (see Section 3.3.1 and 3.4.2: *iii*). The respondents evaluated the food samples at the SE laboratory, using a quantitative questionnaire frequently used to describe sensory characteristics (Annexure 2B). A consumer sensory test, namely the acceptance test, with the use of a seven-point hedonic scale (Aniedu & Agugo, 2010:163) was utilised to evaluate respondents' acceptance of the bread samples (Lawless, 2013:101). Additionally, the respondents' actual intent of consumption was also measured during acceptance testing (Moskowitz *et al.*, 2006:221).

For the data to be statistically important regarding most sensory evaluations, 50 or more respondents are recommended (Meilgaard *et al.,* 2007:271; Moskowitz *et al.,* 2006:233). Thus, the researcher aimed to recruit at least 70 respondents in total from Group A and B. This was to ensure sufficient response and to provide for respondents not showing up. In addition, reminders were sent to respondents prior to sessions (Moskowitz *et al.,* 2006:240). Hence a total of 91 respondents completed the sensory evaluation questionnaire, of which there were 43 from Group A and 48 panellists from Group B.

(iii) Consumer sensory evaluation

Consumer sensory evaluation sessions were conducted from August until October 2013. A maximum of seven sessions were scheduled per day in 30 minute intervals, with a 30 minute preparation period between sessions with a maximum of 18 panellists that could be seated per session. The duration for each respondent was not more than 15 minutes. Preceding the commencement of the sensory evaluation, a short introduction was provided by the researcher, to exclude any confusion that could have arisen during the evaluation process. Additionally the panellists were required to sign a consent form, informing them of the scope of the sensory

evaluation, their duties and once again ensuring they did not have any food allergies. The respondents were required to evaluate three samples (20mm x 20mm x 20mm); that consisted of one control sample, a standard brown bread sample, while the two other samples were enriched with 15% and 25% amaranth flour respectively (Table 3–2).

Each panellist received one white tray with three separate smaller plates, each containing one sample of bread. Thus each respondent received three (3) samples to evaluate during one session. A random number was assigned to each sample in order to ensure reliability and validity of the results. During the evaluation process respondents were encouraged to make use of the palate cleansers provided (water and carrot slithers) between tasting the three samples.

A short questionnaire (see Annexure 2B) was provided to determine consumers' acceptance and preference towards the bread samples. The sensory evaluation questionnaire was developed by combining different questionnaires frequently used for sensory evaluation purposes. Matenge (2011:205) used an acceptability table to determine a group of South African's acceptance of cowpea leaves. Thus, this published questionnaire, combined with standard demographic information, was used to develop the sensory evaluation questionnaire.

Section A of the questionnaire measured the extent of acceptability of the three bread samples. Each sample was evaluated for degree of liking of appearance, aroma, taste and texture on a seven-point hedonic scale (Aniedu & Agugo, 2010:163; Ndabikunze *et al.,* 2011:170) with the categories 1: Dislike very much; 2: Dislike; 3: Dislike slightly; 4: Neither like nor dislike; 5: Like slightly; 6: Like; and 7: Like very much (Fig. 3–5).

	Extent of acceptability							
Criteria	Sample codes	1 Dislike Very much	2 Dislike	3 Dislike slightly	4 Neither like nor dislike	5 Like slightly	6 Like	7 Like Very much

Figure 3-5 The seven-point hedonic scale used to measure extent of acceptability

Subsequent to the hedonic scale measurement, follow-up questions, e.g. 5. "*Which sample did you like most? Fill in the sample code*", were asked to gather more information regarding preference for specific samples. Section A was finalised with open- and closed-ended questions concerning the bread samples, including consumption intent of the respondents. Section B measured the basic demographic information of the respondents, including i) age; ii) gender; iii) race; iv) highest level of education and vi) occupation.

A pre-test was conducted prior to the data collection and it took place on the NWU Potchefstroom campus. The purpose of this test was to establish the time it would take to complete the sensory evaluation and the questionnaire and to improve face validity (Delport & Roestenburg, 2011:195). Additionally, it highlighted errors in the questionnaire that enabled the researcher to minimise mistakes in the questionnaire.

3.5 Data analysis

The data collected from the respondents were converted to numerical data to simplify statistical analysis (Babbie, 2015:430). The data analysis for both questionnaires during the two phases was performed with the assistance of Statistical Consultation Services, NWU.

3.5.1 Phase I: Household food survey

The pre-coded questions of the household survey (Annexure 1B) were analysed by means of SPSS (Statistical Package for the Social Sciences), in addition to Microsoft Excel. Moreover, guidelines suggested by Labadarios *et al.* (2009:16), were used to evaluate the household food security questions. Data analysis comprised of descriptive statistics to outline the dispersal of the study population across a wide range of variables (Fouché & Bartley, 2011:251). Also, frequency and percentage distributions were depicted and represented in tables to provide a collective overview of the variables evaluated, including demographic characteristics and food consumption patterns. Furthermore, bar charts and box plots were used to highlight significant results and present summarised data in an illustrative manner. Additionally, descriptive data were also used to arrange data in a significant way and to outline the data to portray information in a comprehensible manner (Pietersen & Maree, 2010c:195).

Inferential statistics were used to draw conclusions from the study population's characteristics and enabled the researcher to test theories formulated from the descriptive data (Fouché & Bartley, 2011:251). Statistical significance was determined through the use of *p*-values and effect sizes to determine the extent of the correlation being evaluated (Pietersen & Maree, 2010d:210). Levels of significance were considered at $p<0.05$ or $p<0.001$, where the probability of an effect occurring by chance is less than five times per 100 incidents or less than once every 1 000 samples analysed (Babbie *et al.*, 2010:263). Moreover, non-parametric tests, including the Chi-square test that determine randomness across categories and the Mann-Whitney U test to compare independent samples were used to indicate significant relationships between variables and groups. Furthermore, cross-tabulations were used to indicate significant relationships between variables using the Chi-square test, where significant relationships are indicated by $p<0.05$. Additionally, significant relationships were tested for strength of associations between the variables and illustrated by using *Cramer's V* coefficient designated

by values between +1 and -1; where values closest to -1 or +1 designate a perfect relationship (Mehta & Patel, 2012:189).

Also, the Mann-Whitney test relies on ranked scores between groups and the group with the highest mean rank signifies the group containing the highest scores (Field, 2009:548). Additionally, the Mann-Whitney test provides an indication of the significance of the results, with the two-tailed probability being statistically significant at levels $p<0.05$ (Pietersen & Maree, 2010a:234). Moreover, effect sizes were calculated to indicate practical significance and *Cohen's r* were utilised to interpret the effect size between means and variables (Pietersen & Maree, 2010d:211). The effect was considered small if $r=0.1$; medium if $r=0.3$ and a large effect if $r=0.5$ (Crano *et al.,* 2015:422).

3.5.2 Phase II: Sensory evaluation–acceptance and preference

The sensory evaluation questionnaire was analysed using SPSS. For the acceptability of the bread sample characteristics, mean scores from the hedonic scale were calculated for the three bread samples. Analysing the data from hedonic scales delivers frequency distribution, standard deviations and average scores (Stone *et al.,* 2012:301). Cross-tabulations were conducted to compare the extent of acceptability of the bread samples within the two groups and significant values were accepted as $p< 0.05$ (Field, 2009:340). Additionally, the effect sizes were interpreted using Cohen's *r* (Pietersen & Maree, 2010d:212). Both these methods were described in Phase I of the data analysis (Section 3.5.1) and similar significant values were used. In addition to cross-tabulations, the Mann-Whitney test was used to explore whether associations between independent variables (Appearance, aroma, taste, texture) exist (Salkind, 2014:310). This method was specifically applied to explore if a difference in scoring existed between the two groups for each sensory characteristic of the bread samples. With this test it can be assumed that the group with the higher average also had a higher rank, which was confirmed with *p*-values to indicate statistical significance (Pietersen & Maree, 2010a:233), similar to Phase I.

3.6 Validity and reliability

Validity implies that the measurement, in this case the questionnaire (Annexure 1B & 2B), should measure what it was intended for. Different procedures can be employed to ascertain the validity of a study. This includes face validity, content validity, and construct validity and criterion validity (Delport & Roestenburg, 2011:173). To incorporate face validity, the measuring instrument was examined by professionals in the subject field (Pietersen & Maree, 2010b:217). These professionals, primarily in the Consumer Sciences subject group of the NWU in collaboration with Statistical Consultation Services were approached, ensuring that the

questions were in line with the research objectives. Content validity implies that the measuring instrument should encompass the most important aspects of the specific concept to be measured (Pietersen & Maree, 2010b:217). Thus, content validity was assured in the same manner as face validity through experts evaluating the measuring instrument (Delport & Roestenburg, 2011:173). Moreover, the survey was based on questions from previously published research (Labadarios *et al.*, 2009; StatsSA, 2010a; StatsSA, 2010b) that had also been tested. To enhance the face and content validity of the questionnaire, and ensure the questionnaire is comprehensible by the target population, the questionnaire was available in English and Afrikaans, while a pilot study was conducted prior to the commencement of the research study (Delport & Roestenburg, 2011:195).

Reliability encompasses the extent to which the same study could be repeated within the same sample population, and obtains dependable results similar to the original study (Pietersen & Maree, 2010b:215). To assure reliability in this study the researcher would make use of internal reliability (Pietersen & Maree, 2010b:215). The internal reliability was measured with Cronbach's Alpha coefficient. This coefficient makes use of a range between zero (0) and one (1), with values closer to one (1), being indicative of a higher reliability measurement instrument (Delport & Roestenburg, 2011:177). For the household survey, Cronbach's Alpha coefficient measured 0.74 to 0.93, while the sensory evaluation questionnaire measured 0.90. Thus it can be concluded that the instruments can be deemed as consistent in measurements (Delport & Roestenburg, 2011:177).

3.7 Ethical considerations

Ethical approval for this study was acquired from the Health Research Ethical Committee (HREC) of the Faculty of Health Sciences of the NWU (Reference number: NWU-00040-13-A1). Permission to recruit respondents was obtained from Department heads in Faculties mentioned in Section 3.3.2, the Campus Registrar, and the manager of the cleaning service provider. All respondents voluntarily participated in the study and acknowledged the fact that they were allowed to withdraw from the study at any time by completing the consent form (Annexure 1A & 2A). Moreover, appointments with the respondents were arranged according to their schedule to ensure that disruption during working hours was minimised. The practical research was conducted on the basis of the Nuremberg code of ethics (HHS, 2005), which was developed for participants of medical research; however, this code presently forms the foundation of most ethical codes (Henn *et al.,* 2009:81), ensuring that all ethical factors are taken into consideration.

One of the most important aspects of ethical considerations is the responsibility of the researcher to ensure that respondents are not subjected to any harm, may it be physical or

emotional (Strydom, 2011a:115). Respondents were requested to indicate if they have any allergies or sensitivities to food items. If they were, these respondents were informed that they could not participate in the study. The researcher did not make use of fieldworkers, thereby limiting the exposure of respondents and their confidential information to other individuals. During the course of the research no physical contact between the researcher and respondents was engaged in. Some respondents may be sensitive to reveal information such as their income, thus income levels were provided from which the respondents made an applicable choice. Respondents were therefore not obligated to indicate an exact amount and they had the option not to respond to the question if they did not feel comfortable in doing so. No personal details were requested in the questionnaire, thus confirming that the respondents' income or any other responses could not be traced back to the individual.

The doctrine of informed consent was applied through the use of consent forms (Annexure 1A & 2A) that had to be signed by the respondents (Henn *et al.,* 2009:85). The researcher comprehensively informed the supervisors and respondents about the impending study and their role during this time in a manner that the respondents could understand (Strydom, 2011a:115). Furthermore, by allowing the respondent to read the consent form and the information provided by the researcher, deception of the respondents was avoided as no information was withheld (Strydom, 2011a:119). With the availability of all the relevant information, respondents were thus able to contemplate their participation, allowed to make an informed decision and had the right to withdraw from the study at any given time without being penalised. They were informed of this.

One of the leading concerns in social research is the confidentiality of respondents' identity and responses (Maree & Van der Westhuizen, 2010:41). The consent form (Annexure 1A & 2A) was stored separately from the questionnaire (Annexure 1B), further ensuring that respondents' signatures could not be traced to their respective questionnaire. Codes were given to each questionnaire for the researcher to keep track of progress and facilitate data entry, and to confirm no personal details were contained in the questionnaire. In addition, the consent form stated that the individuals' identity and results would remain completely confidential and provided details of the research procedure and researcher, should the respondents have any queries. This offered peace of mind to the respondents and they were more likely to provide permission to the researcher to use data collected from the respondents (Maree & Van der Westhuizen, 2010:42).

Data are password protected and would be stored appropriately in the Consumer Sciences building on the Potchefstroom campus for five years. During this time only the researchers involved in the study would be able to utilise and access the stored data. After the period of five years data would be disposed of in an appropriate manner.

Lastly, no compensation was awarded to the respondents to avoid manipulating them to participate in the research (Strydom, 2011a:121). However, after the completion of the questionnaire and the sensory evaluation, refreshments were provided as a token of appreciation. The snacks were not visible prior to the completion of the data collection and respondents were also not informed that they would receive anything, thereby ensuring respondents were not biased.

3.8 Conclusion

To achieve the objectives set out for this research study a non-experimental, quantitative research design was employed. Moreover, non-probability purposive sampling was utilised to recruit respondents employed at the NWU, Potchefstroom. Respondents were recruited according to specific inclusion criteria and consisted of two groups, one of a lower-income and the second of middle to higher income. The research consisted of two phases, with the first phase consisting of data collection by means of the household survey. Information regarding food consumption patterns, food security status, demographics and income and expenditure were obtained from the study population. Subsequently, recipe development and sensory evaluation commenced in preparation of the second phase.

A recipe sourced from local respondents was utilised, while ingredients were sourced from Kenya, local stores and supermarkets. Respondents participating in the sensory evaluation were recruited from those who took part in the household survey and participated in the first phase, , thus maintaining the two groups. During the sensory evaluation, acceptance and preference tests were conducted using a seven point hedonic scale. For both phases SPSS and Microsoft Excel were utilised to analyse the data, with the assistance of the Statistical Consultation Services of the NWU. Descriptive and inferential statistics were utilised to explore relationships between variables, while cross-tabulations and the Mann-Whitney U test highlighted the significance of relationships between variables.

Validity of the questionnaire was attained by utilising the expertise of professionals from the Consumer Sciences subject group and Statistical Consultation Services. Reliability was tested and confirmed using Cronbach's Alpha coefficient, while ethical approval as acquired from the HREC of the Faculty of Health Sciences of the NWU and ethical considerations were based on the Nuremberg code of ethics in order to conduct research in the appropriate manner.

3.9 References

Adrinah, M.S. & Base, K.L. 2012. Assessment of the knowledge of midwives regarding prevention of low Apgar score. *Life science journal*, 9(4):1537–1545.

Aniedu, C. & Agugo, U.A. 2010. Acceptability of bread produced from Hausa-potato and sweet potato composite flours. *Journal of agriculture and social research*, 10(2):162–166.

Anon. 2015. Minimum Wages in South Africa for the year 2012-13. http://www.mywage.co.za/main/salary/minimum-wages/minimum-wages-2011-12/minimum-wages-for-contract-cleaning-in-south-africa-from-december-1-2011-to-november-30-2012 Date of access:13 Feb. 2015.

Ayo, J.A. 2001. The effect of amaranth grain flour on the quality of bread. *International journal of food properties*, 4(2):341–351.

Babbie, E.R. 2015. The practice of social research. 14th ed. Boston, MA: Cengage Learning.

Babbie, E., Halley, F.S., Wagner, W.E. & Zaine, J. 2010. Adventures in Social Research: Data Analysis Using IBM SPSS Statistics. 7th ed. Thousand Oaks, CA: Pine Forge Press.

Babbie, E. & Mouton, J. 2010. The practice of social research. 10th ed. Cape Town: Oxford.

Basemzansi, B. & Moroka, T. 2004. South African indigenous foods: a collection of recipes of indigenous foods, prepared by generations of women of the region. South Africa: IndiZAFoods, South Africa.

Crano, W.D., Brewer, M.B & Lac, A. 2015. Principles and methods of social research. 3rd ed. New York: Routledge.

De Villiers, S.J.A. 2010. Cook and Enjoy. 8th ed. South Africa: Nb Publishing Limited.

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. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p171–205).

Denscombe, M. 2003. The good research guide: for small-scale social research projects. 2nd ed. Berkshire: McGraw-Hill.

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

Fouché, C.B. & Bartley, A. 2011. Quantitative data analysis and interpretation. (*In* de Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p248–294).

Fouché, C.B. & Delport, C.S.L. 2011. Introduction to the research process. (*In* de Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p61–76).

Gerrano, A.S., Jansen van Rensburg, W.S. & Adebola, P.O. 2015. Genetic diversity of *Amaranthus* species in South Africa. *South African journal of plant and soil,* 32(1): 39–46.

Henn, M., Weinstein, M. & Foard, N. 2009. A Critical introduction to social research. 2nd ed. London, UK: Sage Publications.

HHS (United States department of Health and Human Sciences). 2005. The Nuremberg code. http://www.hhs.gov/ohrp/archive/nurcode.html Date of access: 28 Nov 2013.

Kneafsey, M., Dowler, E., Lambie-Mumford, H., Inman, A. & Collier, R. 2013. Consumers and food security: Uncertain or empowered? *Journal of rural studies*, 29(2):101–112.

Labadarios, D., Davids, Y.K., Mchiza, Z. & Weir-Smith, G. 2009. The assessment of food insecurity in South Africa. Pretoria: Centre for poverty, employment and growth. *Human Sciences Research Council Report*.

Lawless, H.T. 2013. Laboratory exercises for sensory evaluation. Ithaca, NY: Springer.

Makofane, M.D. & Mogoane, O.M. 2012. Adolescents' perspectives on child-parent relationships following parental divorce: Suggestions for social work practice. *Social work,* 48(3):308–324.

Maree, K. & Pietersen, J. 2010a. Sampling. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p171–181).

Maree, K. & Pietersen, J. 2010b. Surveys and the use of questionnaires. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p155–169).

Maree, K. & Pietersen, J. 2010c. The quantitative research process. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p144–153).

Maree, K. & Van der Westhuizen, C. 2010. Planning a research proposal. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p21–45).

Matenge, S.T.P. 2011. Utilisation of traditional and indigenous foods in the North West Province of South Africa. Potchefstroom: NWU. (Thesis – PhD).

Mehta, C.R. & Patel, N.R. 2012. IBM SPSS exact test statistics. http://www.sussex.ac.uk/its/pdfs/SPSS_Exact_Tests_21.pdf Date of access: 25 Jun. 2015

Meilgaard, M.C., Civille, G.V. & Carr, T.B. 2007. Sensory evaluation techniques. 4th ed. New York, NY: CRC Press.

Moskowitz, H.R., Beckley, J.H. & Resurreccion. A.V.A. 2006. Sensory and consumer research in food product design and development. Iowa: IFT.

Ndabikunze, B.K., Masambu, B.N., Tiisekwa, B.P.M. & Issa-Zacharia, A. 2011. The production of jam from indigenous fruits using baobab (*Adansonia digitata* L.) powder as a substitute for commercial pectin. *African journal of food science*, 5(3):168–175.

Pietersen, J. & Maree, K. 2010a. Overview of statistical techniques. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p225–254).

Pietersen, J. & Maree, K. 2010b. Standardisation of a questionnaire. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p214–223).

Pietersen, J. & Maree, K. 2010c. Statistical analysis I: descriptive statistics. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p185–196).

Pietersen, J. & Maree, K. 2010d. Statistical analysis II: inferential statistics. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p198–213).

Resurreccion, A.V.A. 2008. Consumer sensory testing for food product development. (*In* Brody, A. & Lord, J.B., *ed*. Developing food products for a changing market place. Boca Raton: CRC Press. 366–401).

Salkind, N.J. 2014. Statistics for people who (think they) hate statistics. 5th ed. Thousand oaks, CA: Sage.

Sanz-Penella, J.M., Wronkowska, M., Soral-Smietana, M. & Haros, M. 2013. Effect of whole amaranth flour on bread properties and nutritive value. *Food science and technology*, 50(2):679–685.

StatsSA (Statistics South Africa). 2010a. General household survey. http://www.datafirst.uct.ac.za/ dataportal/index.php/catalog/192 Date of access: 10 Feb 2013.

StatsSA (Statistics South Africa). 2010b. Income and expenditure survey 2010/2011. http://www.datafirst .uct.ac.za/dataportal/index.php/catalog/316 Date of access: 11 Feb 2013.

Stone, H., Bleibaum, R. & Thomas, H.A. 2012. Sensory evaluation practices. 4th ed. San Diego, CA: Elsevier.

Strydom, H. 2011a. Ethical aspects of research in the social sciences and human service professions. (*In* de Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p113–130).

Strydom, H. 2011b. Sampling in the Quantitative paradigm. (*In* de Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p222–235).

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

Households often struggle to meet the demands of providing sufficient variety of nutritional foods for household members. Although it is assumed that poor households are more likely to suffer from food insecurity, food security status and consumption patterns of low to medium income households are not known. Households' food security status is influenced by several factors that include the demographic environment, employment, education and income (Blythe, 2008:365; Schiffman *et al.,* 2010:76). Increasing food prices and lower-income are aspects that contribute to insufficient food consumption. Culture further influences food choice and consumption. However, urbanisation lessens access to and utilisation of edible wild plants that are traditionally used. TLV were consumed widely especially among poor households, and contributed to the household's nutritional intake (Matenge *et al.,* 2011:32; Vorster *et al.,* 2007:10). However, urbanisation and other factors caused a decline and defamiliarisation in wild plant consumption with consequential decrease in food security status (Puoane *et al.,* 2006:92).

In order to explore income earning households' food security status and in an attempt to improve the household food utilisation and food security situation of low-income households, a frequently consumed staple food product was enriched with grain amaranth flour and evaluated among respondents from both low and middle to higher income groups.

4.2 Phase I: Household survey results

A total of 144 respondents participated in this study. Group A (*n*=63) were recruited among cleaners, at the NWU, as they were expected to earn lower incomes while the rest of respondents were recruited from other departments at the university (Group B, *n*=81). The focus of Phase I of this study was to determine represented households' food consumption patterns, their foo d security status and to identify a frequently consumed food product to be supplemented with grain amaranth.

4.2.1 Demographic characteristics

Results supported the expectation that cleaners presented lower income levels and lower education levels. Group A consisted of 11.1% male and 88.9% female respondents, while Group B consisted of 24.7% males and 75.3% females from a total of 144 respondents, as can be seen in Table 4–1. The majority of the respondents for Group A were between the ages of 25 to 34 (41.3%) and 35 to 44 (27.2%) for Group B. Group A consisted of black Africans (100%) while the

majority of Group B (59.3%) were from the white population group, whereas the two home languages spoken by the majority of the respondents were Setswana (61.9%) for Group A and Afrikaans (70.4%) for Group B. Considering the total population, 38.9% of the respondents indicated Setswana was their home language while 41% indicated Afrikaans to be their home language. Data from StatsSA (2011b) on Potchefstroom (Tlokwe city council), also suggested that Setswana (40%) and Afrikaans(27.1%) were two of the home languages most often spoken.

Regarding the respondents' highest educational levels, 62.9% of the respondents from Group A achieved education levels between Grade 8 and Grade 11 (Table 4–1). Furthermore, 48.1% of Group B respondents completed a tertiary qualification, while the highest level of education attained by individuals from Group A were Grade 12 (21.0%). However, when comparing the tertiary education levels, the study population accomplished higher tertiary education levels (27.3%) than the city population (13.9%) (StatsSA, 2011a:24). This could be attributed to the fact that the study population consisted of employees from the NWU Potchefstroom campus.

Table 4-1 Summary of demographic characteristics of the study population (*n*=144)

Demographic	**Group A**		**Group B**		**Total**	
characteristics	***n***	***%***	***n***	***%***	***n***	***%***
Gender	*n*=63		*n*=81		*n*=144	
Male	7	*11.1*	20	*24.7*	27	*18.8*
Female	56	*88.9*	61	*75.3*	117	*81.2*
Age (years)	*n*=63		*n*=81		*n*=144	
18–24	3	*4.8*	10	*12.3*	13	*9.0*
25–34	26	*41.3*	20	*24.7*	46	*31.9*
35–44	19	*30.2*	22	*27.2*	41	*28.5*
45–54	12	*19.0*	19	*23.5*	31	*21.5*
55–64	3	*4.8*	10	*12.3*	13	*9.0*
Race	*n*=63		*n*=81		*n*=144	
White	0	*0*	48	*59.3*	48	*33.3*
Black	63	*100*	23	*28.4*	86	*59.7*
Coloured	0	*0.0*	9	*11.1*	9	*6.3*
Other	0	*0.0*	1	*1.2*	1	*0.7*
Home language*	**Respondents were allowed to choose more than one home language*					
Setswana	39	*61.9*	17	*21.0*	56	*38.9*
IsiXhosa	12	*19.0*	5	*6.2*	17	*11.8*
Sepedi	1	*1.6*	1	*1.2*	2	*1.4*
isiZulu	5	*7.9*	1	*1.2*	6	*4.2*
Sesotho	9	*14.3*	3	*3.7*	12	*8.3*

Tshivenda	1	*1.6*	1	*1..2*	2	*1.4*
isiNdebele	1	*1.6*	0	*0.0*	1	*0.7*
Xitsonga	1	*1.6*	0	*0.0*	1	*0.7*
siSwati	1	*1.6*	0	*0.0*	1	*0.7*
English	1	*1.6*	10	*12.3*	11	*7.6*
Afrikaans	2	*3.2*	57	*70.4*	59	*41.0*
Education level	*n*=63		*n*=81		*n*=143	
None	1	*1.6*	0	*0.0*	1	*0.7*
Primary school	9	*14.5*	0	*0.0*	9	*6.3*
Secondary (Grade 8 – 11)	39	*62.9*	6	*7.4*	45	*31.5*
Matric (Grade 12)	13	*21.0*	30	*37.0*	43	*30.1*
Tertiary education	0	*0.0*	39	*48.1*	39	*27.3*
Diploma	0	*0.0*	6	*7.4*	6	*4.2*

4.2.2 Living environment and income and expenditure distribution of the study population

The living environment of the respondents comprised of permanent structures made from bricks, or informal structures constructed using materials such as wood or corrugated iron. The greater part (74.6%) of Group A lived in some form of formal permanent structure, while only 25.4% of the households lived in informal structures (Table 4–2). All respondents from Group B resided in permanent brick structures (84.0%) or brick complex structures (16.0%). This is in accordance with the statistical findings regarding the city, where 81.1% of the Tlokwe population reside in formal permanent structures (StatsSA, 2011a:36).

The housing structures of the respondents all included kitchen facilities; however 20.6% of Group A and 13.6% of Group B did not have kitchen facilities in a separate room within the house (Table 4–2). Additionally, the water facilities available to the households ranged from tap water inside the residence to fetching water elsewhere. The majority (60.3%) of Group A had access to water from outside their residence, while 88.9% of Group B had access to water from a tap inside the house.

While there were some households from both groups that had more than eight (8) residents (3.5%) in one house, the majority of Group A (54.0%) and B (80.2%) had a household size between one to four members. This is consistent with the average household size (3.3%) in the North West province of SA (StatsSA, 2011a:56). Considering the above data which can be seen in Table 4–2, the majority of households from both groups resided in permanent dwellings while having access to water in or near the house, while households had between one to four members

per household. This indicated that the majority of the households had access to kitchen facilities and running water, signifying that the study population would be able to reproduce the amaranth enriched bread recipe.

Table 4-2 Living environment characteristics of the respondents (*n=144)*

Living environment characteristic	Group A *n*	*%*	Group B *n*	*%*	Total *n*	*%*
Type of dwelling	*n=63*		*n=81*		*n=144*	
Permanent structure: brick	47	*74.6*	68	*84.0*	115	*79.9*
Permanent structure: part of complex	0	*0.0*	13	*16.0*	13	*9.0*
Semi-permanent structure: corrugated iron/wood	16	*25.4*	0	*0.0*	16	*11.1*
Households with kitchen in separate room	*n=63*		*n=81*		*n=144*	
Yes	50	*79.4*	70	*86.4*	120	*83.3*
No	13	*20.6*	11	*13.6*	24	*16.7*
Household water source	*n=63*		*n=80*		*n=143*	
Tap inside house	24	*38.1*	72	*88.9*	96	*67.1*
Tap outside house	38	*60.3*	5	*6.2*	43	*30.1*
Borehole	0	*0.0*	3	*3.7*	3	*2.1*
Fetch water elsewhere	1	*1.6*	0	*0.0*	1	*0.7*
Access to waste removal facilities	*n=63*		*n=79*		*n=142*	
Yes	61	*96.8*	76	*96.2*	137	*96.5*
No	2	*3.2*	3	*3.8*	5	*3.5*
Household size	*n=63*		*n=81*		*n=144*	
1–4	34	*54.0*	65	*80.2*	99	*68.8*
5–8	26	*41.2*	14	*17.2*	40	*27.8*
>8	3	*4.8*	2	*2.4*	5	*3.5*

4.2.3 Income and expenditure distribution of Group A and Group B

The majority of Group A (50.8%) indicated a household income between R1 364 to R1 928 per month (Table 4–3). Contrastingly, Group B's household income were more dispersed with the largest concentration of households (16.7%) earning between R9 320 to R13 209 per month. With lower household incomes when compared to Group B, it is to be expected that Group A would purchase groceries on a less frequent basis than Group B. The majority of Group A (85.7%) purchased household groceries once per month, while 39.5% and 33.3% of Group B purchased groceries once every week and once per month, respectively. Furthermore, 73% of

Group A purchased groceries at a *spaza* shop, in contrast to the 11.1% of Group B. However, the total population from Group A also purchased groceries at supermarkets, while 97.5% of Group B purchased groceries at supermarkets.

Additionally, half of Group A (50.8%) spent between R501 and R1 000 on food every month (Table 4–3). Considering that the largest part of Group A only earned between R1 364–R3 137, their food expenses amount presented a large part of their household income. For Group B, 19% spent between R1 501 and R2 000 and only 17.7% between R501 and R1 000 on food during the month while 51.3% of Group B also indicated food to be their largest expense and 41.3% housing aspect in Table 4–3. In contrast, the vast majority of Group A (73%) spent the majority of their income on food during the month.

Brinkman *et al.* (2010:154) determined that households spending the largest portion of their income on food expenses are most susceptible to increased food prices, resulting in more money being spent on food. While increased food expenditure could indicate improved food purchases and consumption, it is more likely to indicate the negative effect of elevated food prices (Hart, 2009:365). For example, *Spaza shops* typically charge higher food prices than supermarkets, but since various households, including the urban poor, do not have access to supermarkets, they are forced to pay the increased prices of these informal institutions (Roos, 2012:30). Hence, one can deduce that a large part of this study population is most likely susceptible to food price fluctuations, and this could lead to decreased food purchases, if the households' income does not increase on a par with their food accessibility. Considering most households have between two to four members, it is reason for concern that households, especially from Group A, most probably only have between R501 to R1 000 to provide food for up to four members every month.

Table 4-3 Summary of income and expenditure practices of the study population (*n*=144)

Income & demographic characteristic	**Group A**		**Group B**		**Total**	
	n	***%***	***n***	***%***	***n***	***%***
Household income (R)	*n*=63		*n*=78		*n*=141	
< 1 363	5	*7.9*	1	*1.3*	6	*4.3*
1 364–1 928	32	*50.8*	1	*1.3*	33	*23.4*
1 929–2 257	11	*17.5*	1	*1.3*	12	*8.5*
2 258–3 137	5	*7.9*	3	*3.8*	8	*5.7*
3 138–4 164	7	*11.1*	4	*5.1*	11	*7.8*
4 165–6 321	3	*4.8*	11	*14.1*	14	*9.9*
6 322–9 319	**0**	***0.0***	**11**	***14.1***	**11**	***7.8***

Income & demographic characteristic	Group A		Group B		Total	
	n	*%*	*n*	*%*	*n*	*%*
9 320–13 209	0	*0.0*	13	*16.7*	13	*9.2*
13 210–17 987	0	*0.0*	5	*6.41*	5	*3.6*
17 988–26 705	0	*0.0*	10	*12.8*	10	*7.1*
26 706–32 521	0	*0.0*	4	*5.1*	4	*2.8*
> 32 522	0	*0.0*	14	*17.9*	14	*9.9*
Frequency of grocery purchases	*n*=63		*n*=81		*n*=144	
Every day	0	*0.0*	9	*11.1*	9	*6.3*
Once week	2	*3.2*	32	*39.5*	34	*23.6*
Once a month	54	*85.7*	27	*33.3*	81	*56.3*
More than once a month	7	*11.1*	13	*16.0*	20	*13.9*
Food purchases*	**Respondents were allowed to choose more than one option*					
Spaza shop	46	*73.0*	9	*11.1*		
Street vendor	33	*52.4*	6	*7.4*		
Supermarkets	63	*100.0*	79	*97.5*		
Total income spent on food (R)	*n*=63		*n*=79		*n=142*	
100–500	18	*28.6*	2	*2.5*	*20*	*14.1*
501–1 000	32	*50.8*	14	*17.7*	*46*	*32.4*
1 001–1 500	11	*17.5*	10	*12.7*	*21*	*14.8*
1 501–2 000	2	*3.2*	15	*19.0*	*17*	*12.0*
2 000–2 500	0	*0.0*	12	*15.2*	*12*	*8.5*
2 501–3 000	0	*0.0*	11	*13.9*	*11*	*7.7*
>3 000	0	*0.0*	12	*15.2*	*12*	*8.5*
Do not know	0	*0.0*	3	*3.8*	*3*	*2.1*
Income mostly spent on	*n*=63		*n*=80		*n=143*	
Food	46	*73.0*	41	*51.3*	*87*	*60.8*
Clothing	4	*6.3*	1	*1.3*	*5*	*3.5*
Housing aspects	6	*9.5*	33	*41.3*	*39*	*27.3*
Transport	4	*6.3*	1	*1.3*	*5*	*3.5*
School/University	0	*0.0*	3	*3.8*	*3*	*2.1*
Other	3	*4.8*	1	*1.3*	*4*	*2.8*

4.2.4 Food consumption patterns

In view of the extensive food expenses incurred by most of the study population, it is important to consider the food consumption patterns of the respondents. Regularity of consuming food items was not based on quantities consumed as this was not the focus of this study. The most frequent food items consumed daily and several days during the week were milk, chicken, bread, maize meal, potatoes, eggs and breakfast cereals. Vegetables and other meat were consumed mostly once a week. Fig 4–1 presents the most frequent food items consumed during the week.

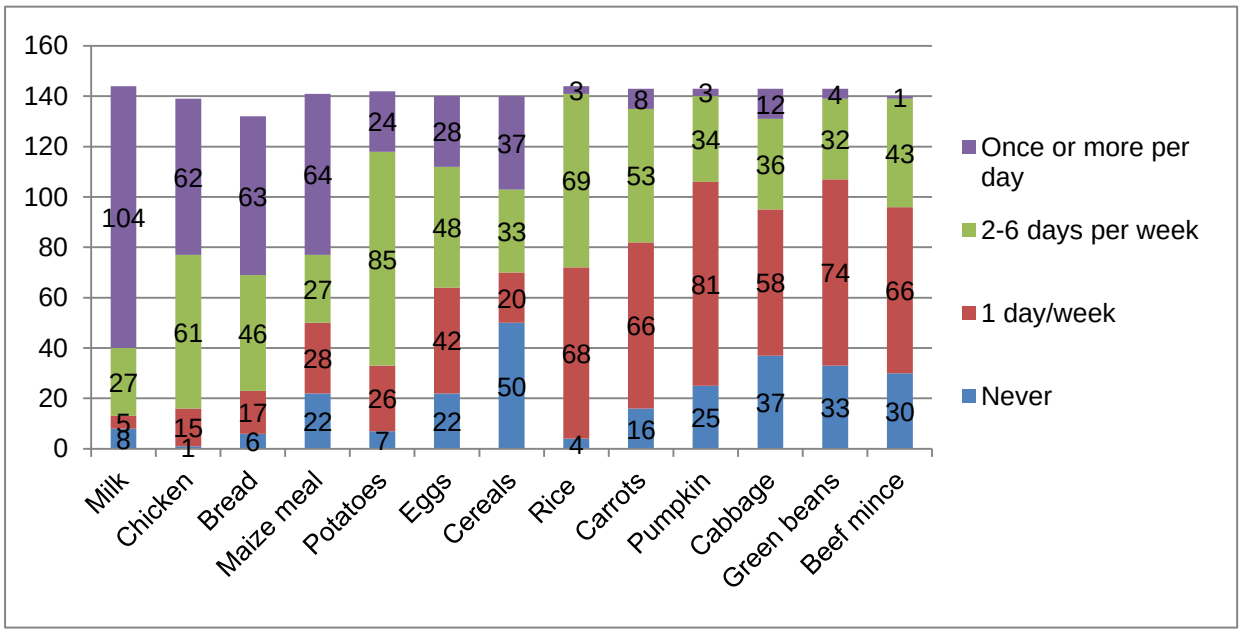
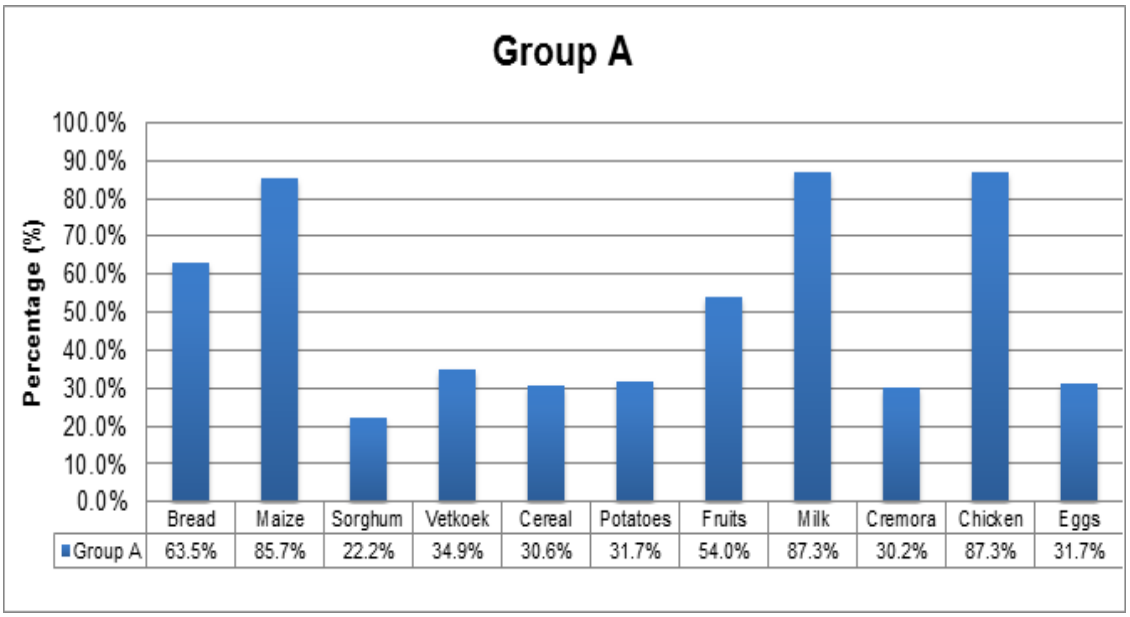


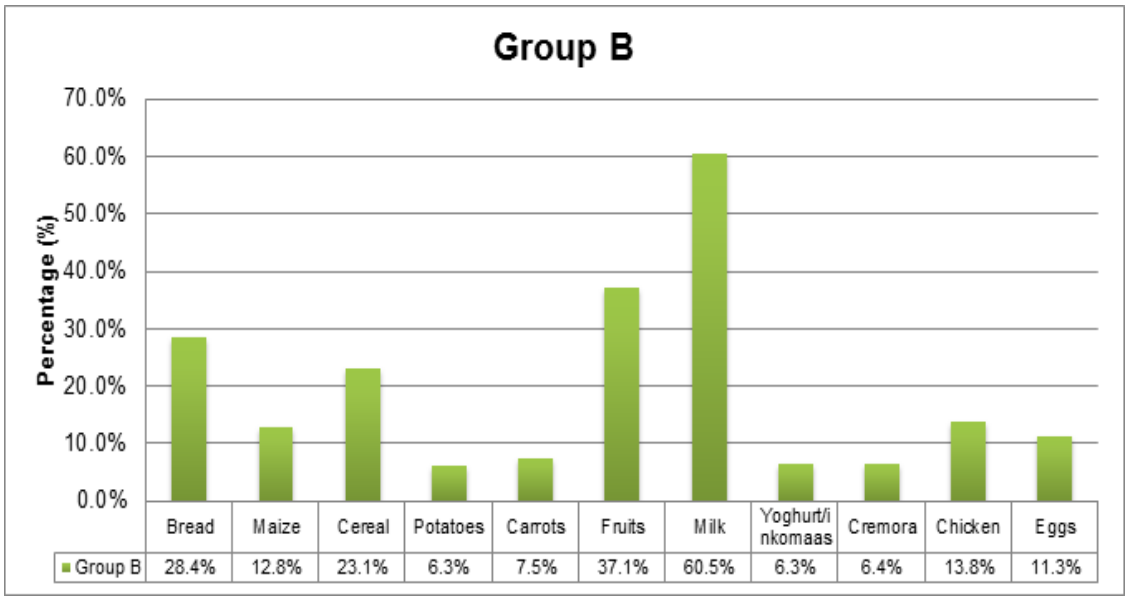
Figure 4-1 Most frequent food items consumed during the week as indicated by the majority of the study population

Similar patterns occurred for the two groups. When comparing the top ten food items consumed by Group A (Fig. 4–2a) versus Group B (Fig 4–2b), it is clear that milk (87.3%), chicken (87.3%), maize meal (85.7%) and bread (63.5%) are the most frequently consumed products on a daily basis within Group A. Similarly, milk was the most popular food item among Group B households, with 60.5% consuming it once or more per day, also illustrated in Figure 4–1. Furthermore, fruit (37.1%), bread (28.4%) and cereal (23.1%) were among the most popular items consumed by Group B respondents and were consumed on a daily basis. Most food items were consumed less frequently by Group B than by Group A. This could be attributed to the fact that respondents from Group A, typically from lower-income levels, have been found to rely on repetitive diets when money is restricted (Drimie *et al*., 2013:917), and generally maize meal makes up the bulk of their diets (McWilliams, 2011:260). Also, it could be an indication that respondents from Group B consumed a wider variety of foods, referring to Annexure 3A and seldom ate the same product every day of the week or more than once per day.

The two most consumed starches were bread and maize meal (Table 4–4). However, the frequency of consumption differs practical significantly between the groups, as indicated in Table 4–4 and also illustrated in Fig 4–2. (Detailed information is available in Annexure 3A). In order to attain the objectives of this study, the most popular staple food (i.e. starches) was chosen to be enriched with grain amaranth flour. Food consumption frequencies of all the food items are available in Annexure 3A.



a) Group A



b) Group B

Figure 4-2 Top ten food items consumed by Groups A and B on a daily basis

Bread consumption patterns of 144 respondents were analysed using cross-tabulations and a chi-square test to see if there would be a significant difference between the bread consumption patterns of Group A (f=63) and Group B (f=81) (Annexure 3A). Almost half of Group A (49.2%) indicated that they consume bread at least once per day, in contrast to 21% of Group B consuming bread on the same basis. However, Group B consumed bread on a regular basis, since 40.7% indicated that they consumed bread 2–4 days per week. A Chi-Square Test of Independence was performed to examine the relationship between the respondent groups and

their consumption frequency of bread. The relationship between these variables is significant, (χ^2 (5) =29.84, p≤.001). Thus, it could be concluded that a practical significant difference exists in bread consumption (p≤0.001; r=0.455). Group A consumed bread daily while Group B consumed bread more than four days a week (Fig 4–1a)(Table 4–4) (Annexure 3A).

In addition, maize meal remained the most consumed starch within Group A with 58.7% of the group consuming maize meal more than once per day. Conversely, only 7.7% of Group B consumed maize meal more than once per day. A statistical significant difference between the consumption of Group A and B was noted (χ^2 (5) =78.64, p=≤.001; r=0.747). Group A consumed maize meal daily or even more while Group B only consumed it once a week (Fig 4–2a). Even though bread consumption was also daily for Group A, it was more frequently consumed by Group B (more than 4 days a week) hence the choice for recipe enrichment with amaranth (Fig. 4–2b). It is clear that bread was consumed more regularly by both groups than maize meal. Viljoen *et al.* (2005:60) suggests that the increased consumption of bread could be because it is more convenient to prepare and could be consumed with more affordable condiments than maize meal.

According to the FBDG, it is recommended that starchy foods should be the basis of most meals, while a variety of fruit should be consumed daily (Vorster *et al.,* 2013:S6). Moreover, some source of milk should be consumed on a daily basis, while animal-based protein should also be consumed daily (Vorster *et al.,* 2013:S6). Food items from the recommended dietary groups are displayed in Figures 4–3.

The starchy food items with significant consumption differences were maize meal (Fig 4–3a), bread (Fig 4–3b) and *vetkoek* (Fig 4–3c), with a more frequent consumption among Group A than Group B. The median for maize meal (Median=6) and bread consumed (Median=5) by Group A, reflected that they consumed these items once per day or more than once per day, in contrast to Group B, where the median indicated they consumed bread on a less frequent basis. The vegetables that were identified with significant differences in consumption within the two groups are sweetcorn (Fig 4–3d), carrots (Fig 4–3e) and cabbage (Fig 4–3f).

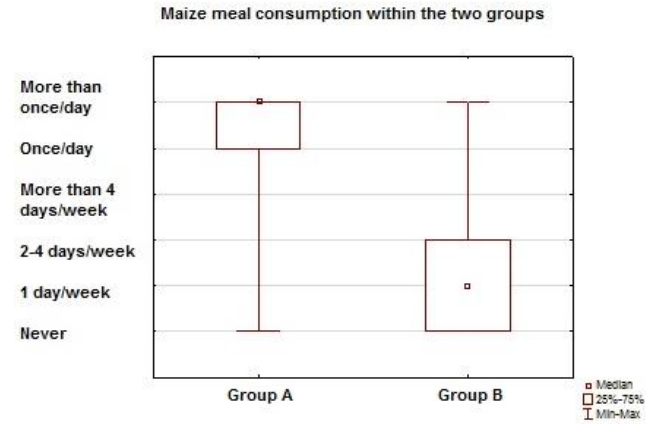
Table 4-4 Summary of most significant consumption of food items

Total consumption/item	Food item	Group	*N*	Cramer's V	Pearson Chi-Square
144	Bread	A	63	0.455*	0.000
		B	81		
141	Maize meal	A	63	0.747**	0.000
		B	78		
140	Vetkoek	A	63	0.437	0.000
		B	77		
117	Pronutro	A	62	0.375	0.001
		B	55		
143	Potatoes	A	63	0.442	0.000
		B	80		
139	Sweetcorn	A	63	0.430	0.000
		B	76		
16	Carrots	A	12	0.391	0.001
		B	4		
64	Sweet potatoes	A	37	0.320	0.006
		B	27		
143	Cabbage	A	63	0.436	0.000
		B	80		
143	Green beans	A	63	0.403	0.000
		B	80		
125	Fruit	A	63	0.445*	0.000
		B	62		
144	Fresh milk	A	63	0.410	0.000
		B	81		
101	Cremora	A	41	0.349	0.002
		B	60		
143	Chicken	A	63	0.759**	0.000
		B	80		
142	Liver	A	63	0.413	0.000
		B	79		
30	Beef mince	A	21	0.330	0.004
		B	9		
124	Chick peas	A	63	0.325	0.002
		B	61		
Effect size 0.1 small; 0.3* medium; 0.5** large					

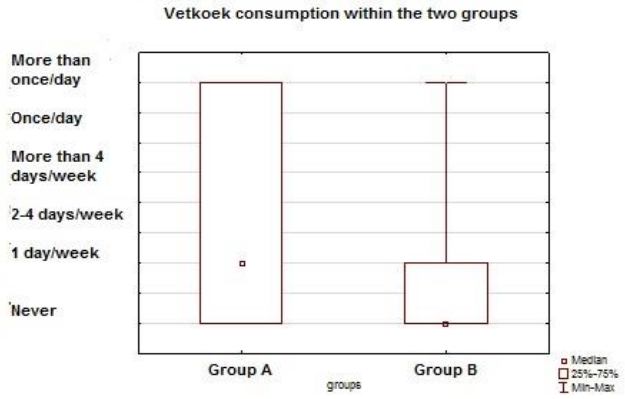
From these vegetable items, Group B consumed all these items more frequently than Group A, except for cabbage which was consumed on a more regular basis than by Group B. The less frequent consumption of vegetables by households from Group A could possibly be the result of decreased involvement in own food production and/or urbanisation as suggested by Puoane *et al.* (2006). With urbanisation an onset of a more westernised diet was adopted and a decrease in consuming of TLV was observed (Jansen van Rensburg *et al.,* 2007:324).

Milk (Fig 4–3g) was one of the items consumed most frequently from all the food items by both groups. The medians reflected this, where the majority of Group A consumed milk more than once a day (Median=6) while Group B's majority consumed milk once a day (Median=5), up to more than once every day. Although not dairy, most respondents used *Cremora* as an alternative to milk, especially in their coffee. The difference in consumption between the two groups were significant ($p \leq 0.05$) with a medium effect size ($r=0.349$), while more than 50% of Group A consumed *Cremora* once per day to never, contrasting to the majority of Group A never consuming *Cremora* (Fig 4–3h).

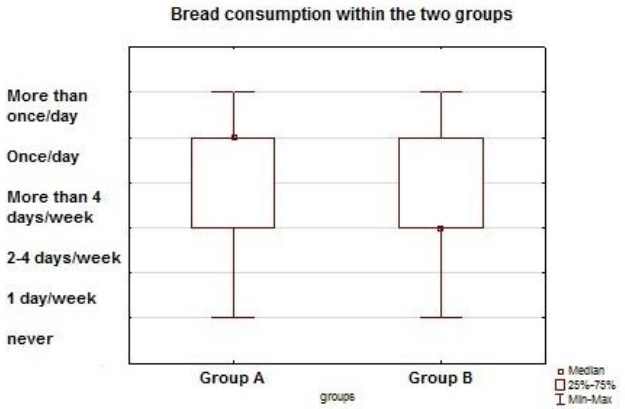
Furthermore, from animal protein sources, chicken (Fig 4–3i) was identified as having significant differences in consumption. Chicken, from all the protein sources however, was consumed most frequently by both groups,. The majority of Group A and the median were identified as once a day, while Group B consumed chicken between two to four days per week. The frequent chicken consumption was corroborated by the Department of Agriculture, Forestry and Fisheries (DoAFF) (2012:6) who determined the consumption of chicken meat was the most consumed animal protein source per person in SA, although it could be as a result of the perception that protein is consumed more frequently among a higher socio-economic class (Puoane *et al.,* 2006:92).



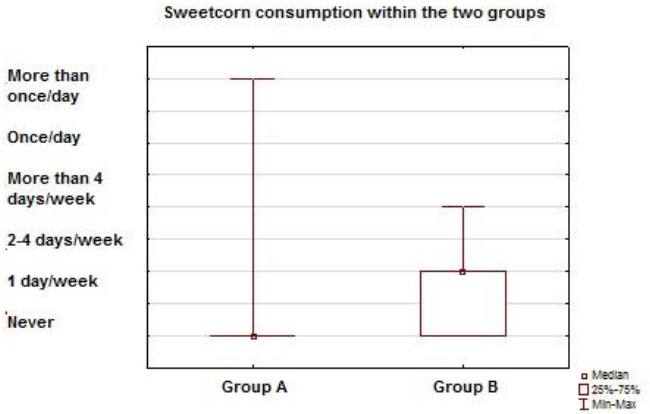
a)



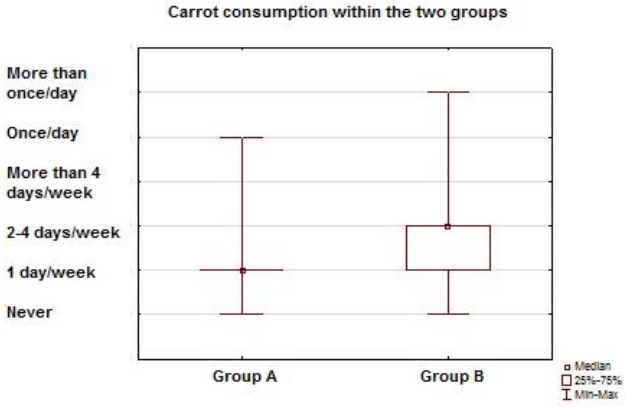
b)



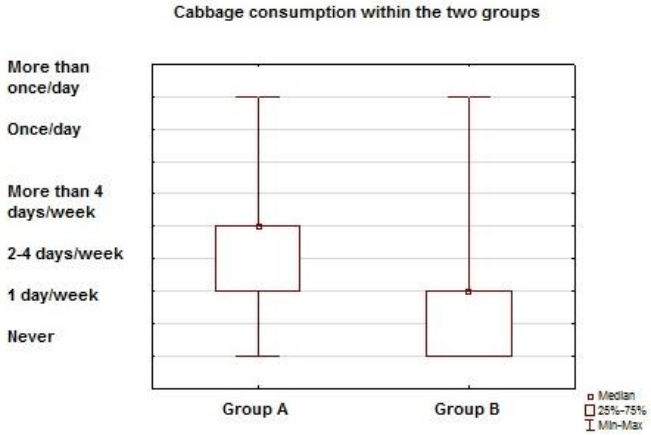
c)



d)

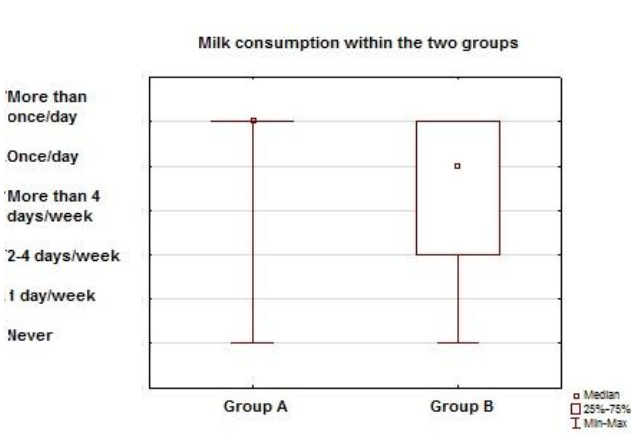


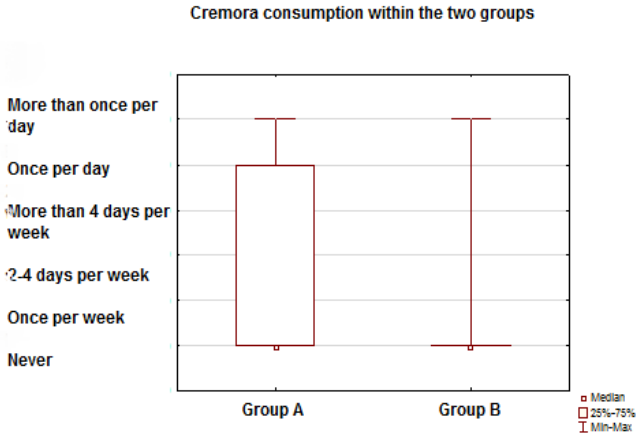
e)

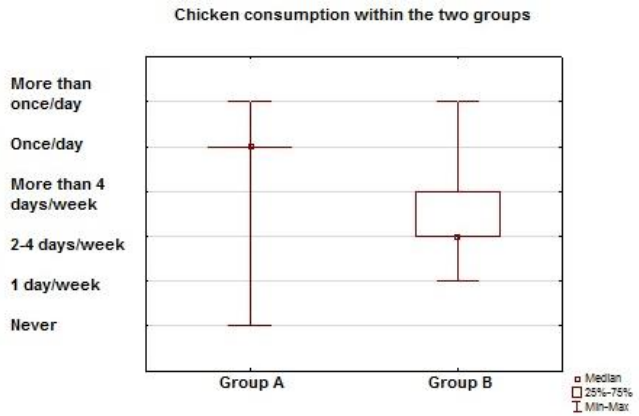


f)

Figure 4-3 Boxplots for food items with significant different consumption between Groups A and B ($p \leq 0.05$)







g) **h)** **i)**

Figure 4-3 Boxplots for food items with significant different consumption between Groups A and B ($p \leq 0.05$) (continued)

4.2.5 Household food security situation within the two groups

When considering the household food security situation of the two groups, it is evident that lower income households are more prone to food insecurity or at risk thereof within Group A. Figure 4–3 is a representation of the households' food security statuses. In the middle to higher income group (Group B) 66.7% of the households were food secure. Results clearly indicated an alarming high incidence of food insecure households from the lower income group (73%). This is supported by Ndhleve *et al.* (2013:19) in their study among rural communities in SA, where food insecurity was more prevalent among lower income households. Moreover, the demographic data (Table 4–1) indicated that Group A consists of black African respondents while Jansen *et al.* (2015:162) determined that black African individuals were more likely to be affected by poverty than other race groups. Furthermore, another 27.0% of the group's households were at risk while 24.7% of the households from Group B were at risk of becoming food insecure. The few food insecure households (*n*=7) from Group B had household sizes ranging from three to ten individuals per household, thus more occupants than in the food secure households, suggesting that larger household sizes could contribute to food insecurity (Sekhampu, 2013:547).

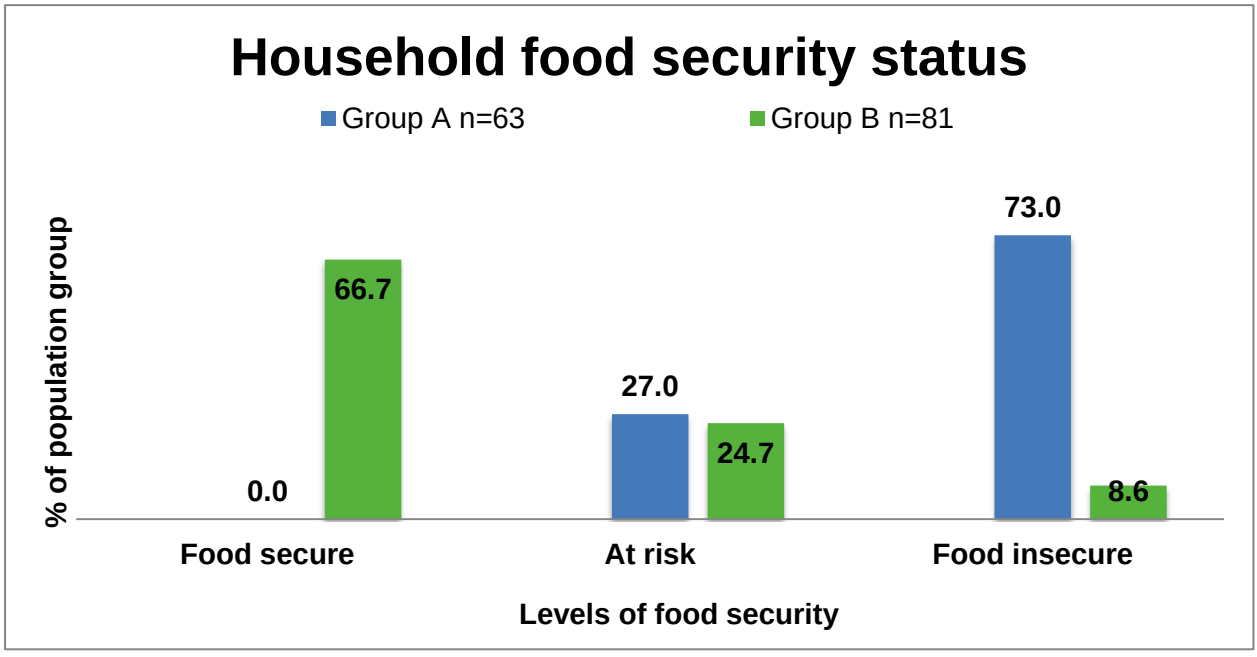


Figure 4-4 **Bar chart of households' food security statuses within the lower and middle to higher income groups**

Table 4-5 Household food security questions and frequency of occurrence

Question nr	Question	Yes				*p*-value*	Effect size (*r*)**
		Group A		Group B			
		n	*%*	*n*	*%*		
1	Does the respondent's household ever run out of money to buy food?	56	*88.9%*	14	*17.7%*	0.000*	0.707**
a	Has it happened in the past 30 days?	48	*76.2%*	10	*12.7%*	0.000*	0.642**
b	Has it happened 5 days or more in the past 30 days?	38	*60.3%*	4	*5.0%*	0.000*	0.603**
9	Do you ever eat less so that children will have enough to eat?	55	*88.7%*	19	*24.7%*	0.000*	0.638**
a	Has it happened in the past 30 days?	47	*75.8%*	6	*8.2%*	0.000*	0.690**
b	Has it happened 5 days or more in the past 30 days?	36	*58.1%*	4	*5.6%*	0.000*	0.572**

* *p*-value significant at levels $p < 0.001/p \leq 0.05$

** effect size interpreted as $r=0.1$ small effect; $r=0.3$ medium effect; $r=0.5$ large effect

Upon further examination of the food security questions, Question 1 (*Does the household ever run out of money to buy food?*) and Question 9 (*Do you ever eat less so that children will have enough to eat?*) were singled out as the two questions with the most affirmative responses (Table 4–5). Results for cross-tabulations on Questions two to eight is presented in Annexure 3B, Question 1 pertaining to the financial means to acquire food, and 9 regarding the adults of a household giving up their food to children of the household. Considering Question 1, the majority of Group A (88.9%), responded with affirmative answers for this question. Additionally, the severity of the situation was emphasised by the fact that it occurred in 60.3% of households from Group A, more than five days during the preceding month. Results of the question regarding enough money to purchase food showed that the incidence of the occurrence and severity among group B's households were practical significantly (p <0.001; r=0.707) less. Correspondingly results for the decreased food consumption by adults to enable children to consume enough food were experienced by 58.1% of Group A's households for more than five days per month compared to Group B's 5.6% (p <0.001; r=0.572).

This indicates that financial means to acquire food is a serious contributor to food insecurity (Sekhampu, 2013:547), while the adults in a household took on the responsibility to ensure the children would have sufficient food to eat. Thus, when considering a resolution for the households' food utilisation and food security situation, it is essential to take into account that such resolution should be financially feasible while enhancing a household's nutritional situation.

4.2.6 The relationship between household food security, education, income and money spent on food

The relationship between household food security levels and what the majority of income is spent on, money spent on food per month, household size, highest education levels and household income were calculated using cross-tabulations and represented in Table 4–6. The majority of households earned an income between R1 364–R3 137 per month; these households were also food insecure (66%). Additionally, the second largest group (51%) earned between R9 320–R32 511, and was food secure. Hence, it could be assumed that households with larger monthly incomes are more likely to be food secure, while the contrast is also true, and confirmed by statistical significance (p<0.001) and a large effect size (r=0.622). This finding is supported by similar conclusions by Sekhampu (2013:547) who determined among a study population in Bophelong, SA that larger household income contributed to their food security status in a positive manner.

It was also evident that food insecure households were more likely to spend most of their income on food. This relationship between food security levels and what the majority of income was spent on was indicated to be significant (p=0.002) with a medium practical significance (r=0.310). Moreover, households that spent between R100 to R500 and R501 to R1 500 on food every month, were mostly food insecure with only 24.1% being food secure.

Households with sizes between one and four, were largely evaluated as food secure (87%), while households with sizes between five and eight individuals (39.6%) were more food insecure. However, 7.6% of food insecure households had more than eight occupants in one household. Thus, the majority of the food secure households had smaller household sizes, while the food insecure households had increased household sizes. This was supported by statistical significance and a medium effects size (p<0.001; r=0.442). It could also be suggested that household size has an impact on the food security situation of a household since limited resources including food and household income in food insecure households would further decrease, having a negative impact on food security of the household (Sekhampu, 2013:547).

Additionally, levels of education were also confirmed to possibly affect food security levels. The largest group of respondents (62.3%) attained education levels between Grade 8 and 11, and this group was evaluated as experiencing food insecurity. Moreover, 2.8% of respondents indicated to be at risk of food security, only had a primary education, while 15.1% of the food insecure respondents also only had primary education. In contrast, 59.3% of respondents attained tertiary education levels and were food secure. Thus, respondents with higher levels of education were more likely to be food secure than those with lower levels of education (p<0.001, r=0.557), which was also confirmed in recent studies (De Cock *et al.*, 2013:280; Ndhleve *et al.,* 2013:17).

Figure 4–4 represents average scores on the factors contributing to food security levels. While the average scores each symbolises a different category, these categories can be explored in Annexure 1A from the pre-coded questionnaire. From Figure 4–4 it is apparent that household income, its size, education levels, what income is mostly spent on, and income spent on food have an effect on the level of food security a household experiences. Households that are food secure, have higher income and education levels and spend more money on food every month than households at risk of or already experiencing food insecurity. However, food secure households have an average household size of 2.9 individuals per household; this is less than that of the other two food security levels, with 4.31 and 5.21 respondents respectively per household in at risk and food insecure households (Fig 4–4). Furthermore, households experiencing food insecurity had the lowest average level of education (3.02 = Gr 8 – 11) (Annexure 1B), household income (3.17 = R1 929–R2 257) (Annexure 1B), and the largest average household size of 5.17 individuals per household.

Consequently recipe development commenced after concluding the food consumption patterns and food security levels. The bread samples were developed accordingly (See section 3.2.4) in order for sensory evaluation to take place. Hence, the sensory evaluation results will be discussed.

Table 4–6 Chi-square cross-tabulations for factors affecting food security

		n=54	Food secure		At risk		Food insecure	Pearson Chi-Square	Cramer's V
			%	*n*=37	%	*n*=53	%		
Household income (R)	< 1 363	0	*0.0*	2	*5.4*	4	*7.5*	0.000	0.622**
	1 364–3 137	2	*3.9*	16	*43.2*	35	*66.0*		
	3 138–9 319	10	*19.6*	12	*32.4*	14	*26.4*		
	9 320–32 511	26	*51.0*	6	*16.2*	0	*0.0*		
	> 32 522	13	*25.5*	1	*2.7*	0	*0.0*		
Income spent on	Food	26	*48.1*	24	*64.9*	37	*71.2*	0.002	0.310
	Clothes	0	*0.0*	0	*0.0*	5	*9.6*		
	Housing	24	*44.4*	11	*29.7*	4	*7.7*		
	Transport	1	*1.9*	1	*2.7*	3	*5.8*		
	School/ university fees	2	*3.7*	0	*0.0*	1	*1.9*		
	Other	1	*1.9*	1	*2.7*	2	*3.8*		
Amount of money spent on food (R)	100–500	1	*1.9*	3	*8.3*	16	*30.8*	0.000	0.518**
	501–1 500	12	*22.2*	21	*58.3*	34	*65.4*		
	1 501–2 500	18	*33.3*	9	*25.0*	2	*3.8*		
	2 501– >3 000	21	*38.9*	2	*5.6*	0	*0.0*		
	Do not know	*2*	*3.7*	1	*2.8*	0	*0.0*		
Household size	1–4	47	*87.0*	24	*64.9*	28	*52.8*	0.000	0.442
	5–8	7	*13.*	12	*32.4*	21	*39.6*		
	> 8	0	*0.*	1	*2.7*	4	*7.6*		
Highest level of education	None	0	*0.0*	0	*0.0*	1	*1.9*	0.000	0.557**
	Primary school	0	*0.0*	1	*2.8*	8	*15.1*		
	Gr. 8–Gr.11	1	*1.9*	11	*30.6*	33	*62.3*		
	Gr 12 (Matric)	16	*29.6*	16	*44.4*	11	*20.8*		
	Tertiary education	32	*59.3*	7	*19.4*	0	*0.0*		
	Diploma	5	*9.3*	1	*2.8*	0	*0.0*		

* *p*-value significant at levels $p<0.001$/$p\leq0.05$ ** effect size interpreted as $r=0.1$ small effect; $r=0.3$ medium effect; $r=0.5$ large effect

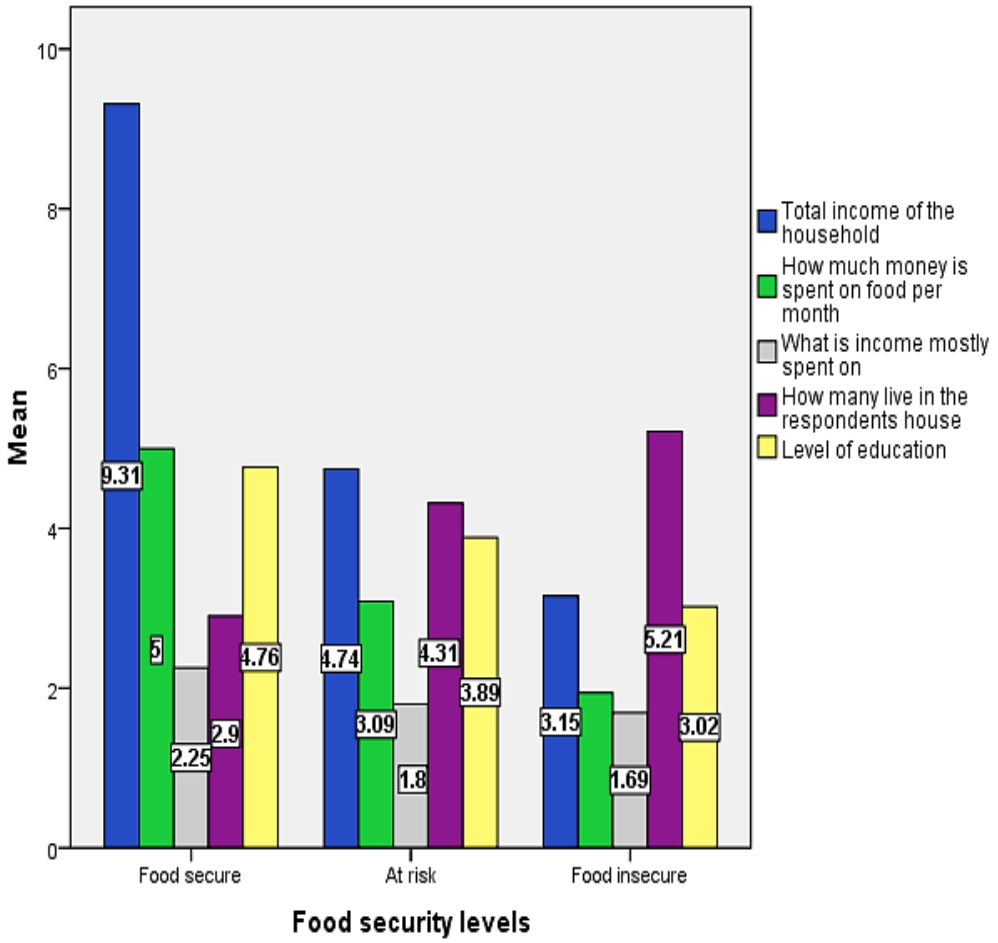


Figure 4-5 Mean scores of factors affecting household food security levels

4.3 Phase II: Sensory evaluation of amaranth enriched wheat bread

Respondents from the household survey were recruited for the sensory evaluation of the developed bread samples. A total of 90 respondents completed the sensory evaluation questionnaire and were divided into two groups with 48 respondents from Group A, and 43 respondents from Group B (Table 4–7). Group A consisted of respondents from the lower-income group, mainly black African females, while Group B respondents were from the middle- to higher-income group, consisting of white and black African, male and female respondents. As described in section 3.4.2. (*a*), a bread recipe was identified, standardised and supplemented with grain amaranth flour. Thereafter, sensory characteristics were evaluated by means of sensory panel tastings, assisted with a questionnaire and results were subsequently compared (Table 3–1). The samples were evaluated in the Consumer Sciences laboratory with a maximum of seven sessions per day, following the described procedure in section 3.4.2 (*b*). Furthermore, using a seven-point hedonic scale (Fig.3–5), respondents were required to indicate the degree of liking or disliking of the control bread and the two amaranth enriched wheat bread samples, *a* = control bread sample, *b* = 15% amaranth flour, and *c* = 25%

amaranth flour. The seven-point hedonic scale was divided into equal segments ranging from 1 “Dislike very much” to 7 “Like very much, with a neutral option 4 “neither like nor dislike” (Beinner *et al*. 2010).

Acceptance and preference of grain-enriched wheat bread within the two groups

When comparing the mean scores for all three samples in the two groups, it is evident that a practical difference can be perceived in Table 4–7. For the appearance of the bread samples, Group A preferred sample *B* (4.85±2.33), while Group B scored sample *B* 5.56±1.03, however, Group B preferred the appearance of sample *A* (5.76±1.12). Furthermore, the aroma of sample *A* was preferred by both Group A (4.61±2.29) and B (5.60±1.17), while Group B’s score was significantly higher (p=0.016, r=0.422). The texture of sample *B* was preferred by Group A (4.56±2.04), while Group B preferred the texture of sample *C* (5.23±1.39). Finally, considering the taste, Group A preferred the taste of sample *B* (4.51±2.23) and Group B preferred the taste of sample *A* (5.38±1.27).

When considering the average scores for the aroma and taste of all three samples for both groups, it is evident that the scores decrease as the percentage of grain amaranth increases. For Group A the average scores for aroma decreased from Mean=4.61 to Mean=3.87, while for Group B it decreased from Mean=5.60 to Mean=5.38 for samples *A* to *C* respectively. Also, the average scores for the taste of the samples decreased from Mean=4.26 to Mean=4.05 for Group A; for Group B (Mean=5.38 to Mean=5.16) it also decreased. The reduced average scores for the aroma and taste of the bread samples with more than 15% grain amaranth addition, could be attributed to the distinctive flavour and aroma of amaranth, as suggested by Mlakar *et al.* (2010).

This occurrence is similar to the results found by Ayo (2001:349), where the mean scores for taste and aroma also decreased as the percentage amaranth flour increased. Furthermore, Chlopicka *et al.* (2012:552) determined through sensory evaluation that the addition of 15% or more grain amaranth to wheat bread presented an unappealing aroma for the majority of the respondents. However, even considering the decreased average scores, none of them were evaluated as negative. Considering the average scores for Group A, it signified they “*neither liked/disliked to slightly liked”* (4/7 to 5/7) the appearance, aroma, texture and taste of all three samples, while for Group B, respondents “*slightly liked” to ‘liked*” (5/7 to 6/7) the appearance, aroma, texture and taste of all three samples.

Table 4-7 Mean scores and standard deviations for sensory characteristics for the two groups

Sensory characteristics	Bread sample	Group A *n*=48	Group B *n*=43	*p*-value	Effect size (*r)*
[+]Appearance	a	4.45±2.50	5.76±1.12	0.000	0.533
	b	4.85±2.33	5.56±1.03	0.000	0.547
	c	4.80±2.39	5.42±1.35	0.001	0.498
[+]Aroma	a	4.61±2.29	5.60±1.17	0.016	0.422
	b	4.28±2.12	5.49±1.08	0.002	0.496
	c	3.87±2.13	5.47±1.32	0.006	0.451
[+]Texture	a	4.34±2.24	5.09±1.36	0.003	0.480
	b	4.56±2.04	5.02±1.35	0.080	0.362
	c	4.41±2.31	5.23±1.39	0.011	0.432
[+]Taste	a	4.26±2.24	5.38±1.27	0.000	0.575
	b	4.51±2.23	4.91±1.36	0.001	0.519
	c	4.05±2.28	5.16±1.60	0.044	0.398
*Average sample preferred		1.93±0.81	1.98±0.87	0.105	0.617
**Sample consumption intent		3.62±3.061	4.05±1.306	0.001	0.515

[+]Hedonic scale: 1=dislike very much; 2=dislike; 3=dislike slightly; 4=neither dislike/like; 5=like slightly; 6=like; 7=like very much

*Sample preference: 1=sample a; 2=sample b; 3=sample c

**Sample consumption intent: 1=Never/Very seldom; 2=1day/week; 3=2-4 days/week; 4= > 4 days/week; 5=once/day; 6 = > once/day

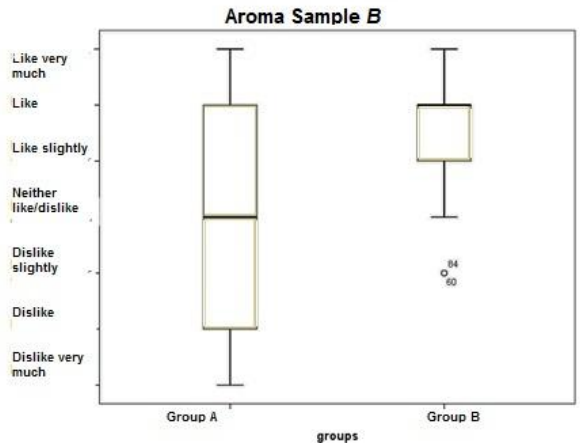
p-value significant ≤0.05; Effect size 0.1=small; 0.3=medium; 0.5=large

Lastly, considering the respondents' preference for the three different bread samples, respondents were required to indicate which bread sample they preferred (*a*=1; *b*=2; *c*=3), and how often they would consume this bread type. The average scores for each of the two groups were calculated to indicate which one of the three samples was preferred. The average score for Group A was 1.93 and for Group B, 1.98, hence, the average scores signify that for both groups, sample *B* was the preferred sample from the three bread samples (Table 4–7). In contrast to the study by Sanz-Penella *et al.* (2013:684) who found that their control wheat bread sample received higher preference than the bread samples with added amaranth flour, it appears that respondents from this study preferred bread samples enriched with 15% amaranth flour (Sample *B)*.

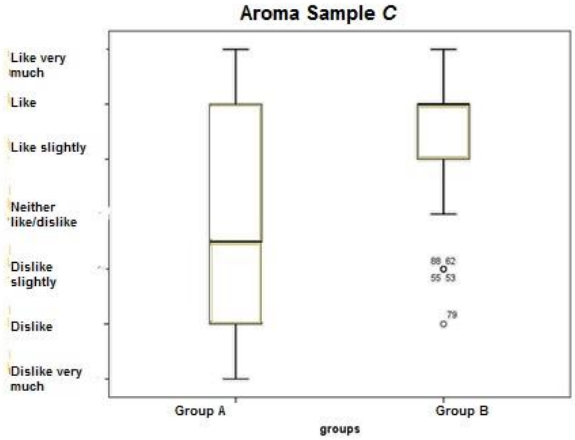
Respondents were further required to indicate their consumption intent towards the sample they preferred. The consumption intent for Group A (3.62±3.06) and Group B (4.05±1.31) both inclined towards four days in a given week (See Annexure 1B for pre-coded questionnaire). However, Figure 4–10e indicates that Group B would probably consume the preferred bread sample on a more regular basis than Group A, with 50% of Group B indicating they would consume the preferred sample between two to four days per week, to even once per day.

Additionally, statistically significant differences were evident between scores awarded by Group A and B to all sensory characteristics and samples, with the exception of the texture of sample *B (p*=0.080, *r*=0.362) and the taste of sample *C* (*p*=0.044; *r*=0.398). Further significant differences are illustrated in Figures 4–5a to e, determined with a Mann-Whitney U test. The median for aroma of sample *B* and sample *C*, indicated that Group A (Median=4) awarded lower scores for aroma of sample *B*, than Group B (Median=6) (Fig. 4–5a & b), signifying Group A "*neither like nor dislike" (*4/7) the aroma while Group B *"like" (6/7)* the aroma*.* Furthermore, regarding the taste of samples *A* and *C,* Group A awarded significantly lower scores compared to Group B. The median indicated that Group A "*neither like nor dislike"* (4/7) the taste of sample A, while the median for taste by Group B indicated they *'like"* (6/7) the taste of sample *A.* Similarly, the medians for the taste of sample *C,* also differed significantly, with Group A awarding lower scores than Group B. However, the median for the taste of sample *C* by Group B was lower than for sample *A (*5/7) (Fig. 4–5c & d). Respondents were required to indicate which of the three samples they preferred and it was evident that both groups preferred sample *B,* with an average of 1.93 and 1.98 for Group A and B respectively (Table 4–7). Respondents were further required to specify how often they would consume the preferred sample indicated as sample *B*. From Figure 4–5 e it is evident that Group B intended to consume the preferred sample on a more regular basis than Group A. The Median for Group A indicated that they would consume the bread sample "*2–4 days per week"* (3/6), while the median for Group B was 4.5/6, indicating their consumption intent as *"once per day".*

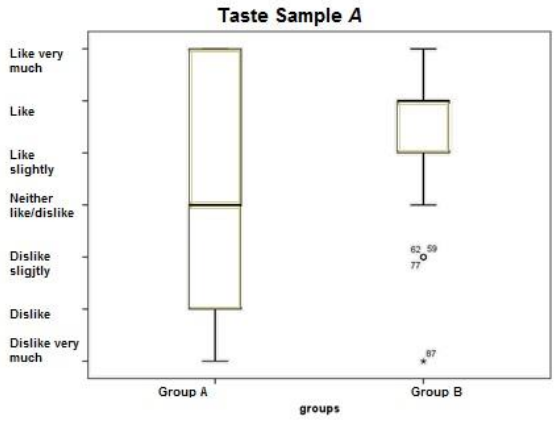
Thus it could be deduced that respondents from this study population had an overall positive acceptance of the amaranth enriched bread, contradicting the findings by Chlopicka *et al.* (2012:554) who recommend that the addition of amaranth is not advisable. Other research also showed that wheat bread enriched with 10 to 15% amaranth flour was acceptable to consumers in Nigeria (Ayo, 2001:350) and Siberia (Bodrož̌a-Solarov *et al.,* 2008:615).



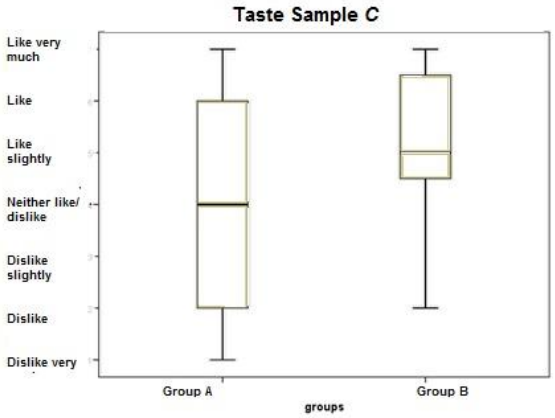
a) **Aroma Sample *B* (15%)**



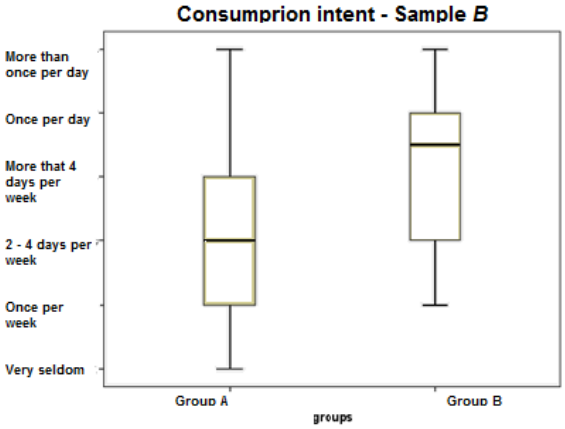
b) **Aroma Sample *C* (25%)**



c) **Taste Sample *A* (Control)**



d) **Taste Sample *C* (25%)**



e) **Consumption intent for sample *B***

Figure 4–6 **Box plot presentations of sensory characteristics for the three different bread samples as evaluated by the two different groups (Group A – Low income; Group B – Middle to higher income; Sample A – control bread; Sample B – 15% grain amaranth; Sample C – 25% grain amaranth)**

4.4 Conclusion

The study took place during two phases: the first entailing the data collection from the household survey, while the second phase encompassed the development of the bread samples and the sensory evaluation. The study population consisted of two groups from different socio-economic backgrounds, namely a lower-income Group A (*n*=63) and a middle- to higher-income Group B (*n*=81). A household survey was utilised to identify food consumption trends among the two groups and also to identify a frequently consumed staple food product, which could be enriched with grain amaranth flour in order to improve households' nutrition situation as well as contributing to dietary diversity. The most frequent food items consumed daily or several days during the week by all respondents were milk, chicken, bread, maize meal, potatoes, eggs and breakfast cereals. Vegetables and other meat were consumed mostly once a week. Among the middle- to higher-income group frequency of consumption was higher. Bread was identified as a suitable staple food item to be consumed by most respondents on a daily basis, since 63.5% of Group A and 28.3% of Group B consumed bread at least once per day.

Additionally, the survey evaluated the respondents' household food utilisation and food security status and the researcher was able to divide the respondents representing their households, into three categories: i) food secure, ii) at risk of becoming food insecure and iii) food insecure. It was determined that households from Group A were more likely to be at risk of or already experiencing food insecurity, while none of the Group B households were food insecure. An alarming 73.0% of households from the lower-income group were food insecure and another 24.7% were at risk thereof. The majority of the middle- to higher-income group were food secure (66.7%) but 27.0% of the group's households were at risk of becoming food insecure, while a minimal 8.6% were food insecure.

Additionally, various factors, including household income, money spent on food, household size and education levels were further analysed to identify whether these factors could contribute to food security. Statistical practical differences with very large effect sizes were evident for factors affecting household food security, including household income ($p<0.001$; $r=0.622$), money spent on food ($p<0.001$; $r=0.518$) and educational levels ($p<0.001$; $r=0.557$). Moreover, households with larger household sizes (Mean=5.21) were more likely to be food insecure than households with smaller sizes (Mean=2.9), suggesting that more individuals residing in a house could put strain on a household's resources.

After the commencement of the household survey data collection and analysis, bread recipes were tested with varying quantities of grain amaranth flour according to suggestions in literature. A standard brown bread recipe was utilised and served as the control bread (Sample *A*), while

two more bread samples were enriched with 15% (Sample *B*) and 25% (Sample *C*) grain amaranth flour respectively. The three different bread samples were evaluated by two groups, Group A (*n*=48) and B (*n*=43), both untrained consumer panels consisting of respondents that had taken part in the household survey.

They were required to evaluate the acceptance of the three bread samples according to four sensory characteristics (appearance, aroma, texture, taste), and to indicate their preference towards one sample, while also specifying how often they would consume the preferred sample. It was concluded that both groups positively evaluated all three samples. However; the middle- to higher-income group (Group B) awarded higher overall scores than the lower-income group (Group A). This was especially evident for the aroma of samples *B* and *C,* and for the taste of samples *A* and *C,* where statistically significant differences were evident and Group B awarded statistically higher scores than Group A. Additionally, both groups indicated a positive consumption intent to the preferred sample *B (15% amaranth enriched bread),* however from the median scores it was illustrated that Group A would consume the bread "*2–4 days per week*" while Group B would consume it "*once per day",* indicating Group B would consume it on a more regular basis. Furthermore, the taste of the enriched bread samples was not disliked by the respondents, thus indicating brown bread can successfully be enriched with 15 to 25% grain amaranth, hile still being acceptable to consumers from this sample population. It could contribute to households' nutritional quality and hopefully advance vulnerable households' food security situation.

4.5 References

Ayo, J.A. 2001. The effect of amaranth grain flour on the quality of bread. *International journal of food properties*, 4(2):341–351.

Beinner, M.A., Soares, A.D.N. & Barros, A.L.A. 2010. Sensory evaluation of rice fortified with iron. *Ciência e Tecnologia de Alimentos*, 30(2):516–519.

Blythe, J. 2008. Consumer Behaviour. London: Thomson.

Bodroža-Solarov, M., Filipčev, B., Kevrešan, Ž., Mandić, A. Šimurina, O. 2008. Quality of bread supplemented with popped *Amaranthus cruentus* grain. *Journal of food process engineering*, 31(5):602–618.

Brinkman, H., de Pee, S., Sanogo, I., Subran, L. & Blome, M.W. 2010. High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *Journal of nutrition*, 140(1):153–161.

Chlopicka, J., Pasko, P., Gorinstein, S., Jedryas, A. & Zagrodzki, P. 2012. Total phenolic and total flavonoid content, antioxidant activity and sensory evaluation of pseudocereal breads. *LWT-Food science and technology*, 46(2):548–555.

De Cock, N., D'Haese, M., Vink, N., Van Rooyen, C.J., Staelens, L., Schönfeldt, H.C. & D'Haese, L. 2013. Food security in rural areas of Limpopo province, South Africa. *Food security,* 5(2):269–282.

DoAFF ***See*** South Africa. Department of Agriculture, Forestry & Fisheries.

Drimie, S., Faber, M., Vearey, J. & Nunez, L. 2013. Dietary diversity of formal and informal residents in Johannesburg, South Africa. *BMC Public Health*, 13(1):911–919.

Hart, T.G.B. 2009. Exploring definitions of food insecurity and vulnerability: time to refocus assessments. *Agrekon: agricultural economics research, policy and practice in southern Africa*, 48(4):362–383.

Jansen, A., Moses, M., Mujuta, S. & Yu, D. 2015. Measurements and determinants of multifaceted poverty in South Africa. *Development southern Africa*, 32(2):151-169.

Jansen van Rensburg, W.S., Van Averbeke, W., Slabbert, R., Faber, M., Van Jaarsveld, P., Van Heerden, I., Wenhold, F. & Oelofse, A. 2007. African leafy vegetables in South Africa. *Water South Africa*, 33(3):317–326.

Matenge, S.T., Van der Merwe, D., Kruger, A. & De Beer, H. 2011. Utilisation of indigenous plant foods in the urban and rural communities. *Indilinga: African journal of indigenous knowledge systems*, 10(1):17–37.

McWilliams, M. 2011. Food around the world: a cultural perspective. 10th ed. Upper Saddle River, NJ: Pearson. p509.

Mlakar, G.S., Turinek, M., Jakop, M., Bavec, M. & Bavec, F. 2010. Grain amaranth as an alternative and perspective crop in temperate climate. *Journal for geography*, 5(1):135–145.

Ndhleve, S., Musemwa, L & Zhou, L. 2013. Household food security in a coastal rural community of South Africa: Status, causes and coping strategies. *African journal of food security,* 1(1):15–20.

Puoane, T., Matwa, P., Hughes, G. & Bradley, H.A. 2006. Socio-cultural factors influencing food consumption patterns in the black African population in an urban township in South Africa. *Human ecology*, 14:89–93.

Roos, J.A. 2012. Food system analysis and the development of a system dynamics approach to improve food security for a vulnerable community in the Breede river region, Western Cape Province, South Africa. Stellenbosch, SUN. (Thesis – Masters).

Sanz-Penella J.M., Wronkowska M., Soral-Smietana M. & Haros M. 2013. Effect of whole amaranth flour on bread properties and nutritive value. *Food science and technology*, 50(2):679–685.

Schiffman, L.G., Kanuk, L.L. & Wisenblit, J. 2010. Consumer behaviour: global edition. 10th ed. Upper Saddle River, NJ: Pearson. p591.

Sekhampu, T.J. 2013. Determination of factors affecting the food security status of households in Bophelong, South Africa. *International business and economics research journal*, 12(5):543–550.

South Africa. DoAFF (Department of Agriculture, Forestry and Fisheries). 2012. A profile of the South African broiler market value chain. http://www.nda.agric.za/docs/AMCP/Broiler2012-13.pdf Date of access: 26 Jan. 2015.

StatsSA (Statistics South Africa). 2011a. Census 2011 Municipal factsheet. https://www.statssa.gov.za /Census2011/Products/Census_2011_Municipal_fact_sheet.pdf Date of access: 2 Dec. 2014.

StatsSA (Statistics South Africa). 2011b. Tlokwe city council. http://beta2.statssa.gov.za/?page_id=993&id=tlokwe-city-council-municipality Date of access: 6 Feb. 2014.

Viljoen, A.T., Botha, P. & Boonzaaier, C. 2005. Factors contributing to changes in food practices of a black South African community. *Journal of family ecology and consumer sciences*, 33(1):46–62.

Vorster, H.H., Badham, J.B. & Venter, C. S. 2013. An introduction to the revised food-based dietary guidelines for South Africa. *South African journal of clinical nutrition*, 26(3):S5-S12.

Vorster, I.H.J., Jansen van Rensburg, W., Van Zijl, J.J.B. & Venter, S.L. 2007. The importance of Traditional Leafy Vegetables in South Africa. *African journal of food agriculture nutrition and development*, 7(4):1–13.

CHAPTER 5
CONCLUSION

5.1 Introduction

Food security remains an eminent problem in SA with a third of the households experiencing food insecurity, even though the country as a whole is considered food secure. Innovative ways of addressing household food security should be explored in an attempt to improve households' situation. This research study explored households' food security status among employees at the NWU, representing a lower-income (Group A) and middle- to higher-income group (Group B),during two phases. The researcher aimed to support household food security of lower-income households by enhancing the nutritional quality of a frequently consumed staple food product with grain amaranth. Consequently the degree of preference of the enriched food product was also evaluated to determine if consumers from the target population would find the enriched product acceptable.

5.2 Conclusion

The empirical findings are discussed in Chapter 4, with a synthesis provided henceforth. The study population for Phase I, the household survey, consisted of 144 respondents of whom the majority were female, with Group A and B consisting of *n*=63 and *n*=81 respondents, respectively. Most respondents from Group A were between the ages of 25 to 34 (41.3%) and were from the black African population group, while the majority of Group B were between 35 to 44 years old (27.2%) of whom the majority were from the white population group. Regarding education levels, the highest level of education for the majority of Group A (62.9%) was between Grade 8 and Grade 11, while 48.1% of Group B attained a tertiary qualification.

The majority of the respondents resided in formal dwellings, consisting of 74.6% of Group A and 100% of Group B with most structures including a kitchen and running water inside the house. Furthermore, more than half of the respondents from both groups (A=54.0%, B=80.2%) had a household size between one to four individuals while 3.5% of Group A had households with more than eight individuals.

However, considering the income and expenditure of the two groups, the largest part of Group A (50.8%) earned a household income of between R1 364 to R1 928 per month, while the average household income of Group B was more dispersed with the largest concentration of households (16.7%) earning between R9 320 to R13 209 per month, illustrating that Group A indeed earned a lower household income than Group B. Group A (85.7%) generally purchased household groceries once per month, while households from Group B purchased household groceries once every week (39.5%) and once per month (33.3%). Furthermore, the majority of

Group A (73.0%) purchased groceries at a *spaza* shop, contrasting to a small part (11.1%) of Group B who also made use of *spaza* shops. However, the total population from Group A also purchased groceries at supermarkets, while the majority (97.5%) of Group B purchased groceries at supermarkets. Food expenses are expected to be increased among the middle to higher income group; however, the results suggest differently. The majority of Group A (50.8%) spent between R501 and R1 000 on food items every month, while only 17.7% of Group B spent similar amounts. However, the largest group of respondents (19.0%) spent between R1 501 and R2 000. Moreover, 73.0% of Group A indicated the majority of their income was spent on food items, while significantly fewer households from Group B (51.3%) indicated food to be their largest expense. Considering that the majority of Group A only earned between R1 364–R1 928, their food expense amount presented a large part of their household income when compared to Group B. Hence, one can deduce that these households are most likely susceptible to food price fluctuations, and this could lead to decreased food purchases and increased risks of experiencing food insecurity.

Considering the food consumption patterns of the study population, the food items most frequently consumed daily or several days during the week consisted of milk, chicken, bread, maize meal, potatoes, eggs and breakfast cereals. Vegetables and other meats were consumed mostly once a week. Most food items were indicated to be consumed by Group B during the week while Group A indicated some items are seldom consumed, suggesting Group B consumed a wider variety of foods with less daily repetition.

For Group A it was evident that milk (87.3%), chicken (87.3%), maize meal (85.7%) and bread (63.5%) were consumed on a frequent basis by the majority of the group. Group B also consumed milk (60.5%), bread (28.4%), maize (12.8%) and chicken (13.8%) on a regular basis; however, the food consumption patterns of Group B were more dispersed than for Group A. Bread and maize meal were the two starches most often consumed by households from both groups; however, bread was identified as being consumed most often by the majority households from both groups. Maize meal was consumed by 58.7% of Group A more than once per day in contrast to 7.7% of Group B (p=<0.001; r=0.747). Contrasting to the frequent consumption of starches and animal proteins, plant proteins, vegetables and fruits were consumed far less frequently. Most vegetables were only consumed once per week whereas plant proteins were the least consumed food items. Moreover, fruit (37.1%) and cereal (23.1%) were also popular items used by Group B on a daily basis. The vegetables that were identified with significant differences in consumption within the two groups were sweetcorn, carrots and cabbage. Group B consumed sweetcorn and cabbage once during the week and carrots more frequently (2 – 4 days a week) while Group A consumed cabbage more frequently (2 – 4 days a week), carrots once a week and never sweetcorn. The use of *Cremora*, a milk substitute high in

plant fat was also popular in many households, but more from Group B.. Furthermore, from animal protein sources, chicken was identified as having significant differences in consumption. Chicken was the protein consumed mostly.. The majority of Group A ate chicken once a day contrasting to Group B, two to four days per week (p=<0.001; r=0.759).

The study population's dietary consumption patterns, for both groups were monotonous, maize meal, bread, fresh milk and chicken forming the daily diet for a large part of the population. Therefore in both Group A and B households' insufficient nutritional intake might be evident, contributing to increased risk for food insecurity. From the food consumption patterns it is evident that Group B made healthier food choices while consuming a wider variety of food , in contrast to Group A who consumed various food items on a frequent basis, indicative of a monotonous diet. This could be attributed to the fact that food prices can influence food choice, and that healthier food options would cost more, thus making it challenging to respondents from a lower income background. It was determined that bread would be a suitable food item to enhance with grain amaranth flour during Phase II, since it is a staple food consumed on a daily basis by a large portion of both groups.

One of the main objectives for this study was exploring the household food security status of the two groups. When reviewing the household food security situation for the two groups, it is clear Group B was less likely to experience food insecurity than Group A. Zero households from Group A were food secure while the majority of Group B (66.7%) were food secure. Although households in the *"at risk'* category were not yet experiencing household food insecurity on a regular basis, they were on the threshold of becoming food insecure. This was almost similar for both groups with 27% of Group A and 24.7% of Group B being regarded as "*at risk"* of becoming food insecure. Nonetheless, 24.7% of households from Group B, with higher incomes than Group A were at risk of becoming food insecure. This indicates that even though they earned higher incomes, they were not assured of food security. Alarming was that 73% of Group A experienced household food insecurity on a regular basis while only 8.6% of the middle- to higher-income group experienced these conditions.

From the household food security questions, two questions were selected that received the most affirmative responses (*Question 1: Does the household ever run out of money to buy food? and Question 9*: *Do you ever eat less so that children will have enough to eat?*). The majority of Group A (88.9%) indicated that they usually run out of money to buy food, while significantly less (p<0.001; r=0.707) respondents from Group B (17.7%) experienced the same circumstances. Similar to Question 1, the majority of Group A (88.7%) indicated they eat less to ensure their children have enough to eat, and that this occurred frequently during the month. Once again, the majority of Group B did not experience the same circumstances (24.7%), and significantly fewer (p<0.001; r=0.638) households from Group B had to consume less food for

their children to have sufficient, when compared to Group A, thus indicating that financial means to acquire sufficient quantities of food, have a significant impact on a household's food security situation.

In addition to the household food security levels, other factors contributing to food security were also explored. Household size was found to have a strong relation to the food security levels, since food insecurity was more prominent in households with increased household sizes (p<0.001; r=0.442). Education levels were also lower in households experiencing food insecurity (p<0.001, r=0.557). Furthermore, it was established that households with more affirmative answers signifying their proneness to food insecurity, were likely to be earning a lower household income. Thus, if food consumption could be improved while enabling households from a lower income group to purchase wholesome food items, or even produce and sell such items, their food security situation could be improved.

During Phase II recipe development commenced and the enhancement of brown bread with grain amaranth flour took place. Respondents that had taken part in the household survey (Phase I) were selected to take part in the sensory evaluation panel (n=90) that evaluated the bread samples enriched with grain amaranth flour, thus their demographic characteristics were the same as during Phase I. The three samples consisted of sample *A* – the control brown (wheat) bread, while in sample *B* – 15% grain amaranth flour and sample *C* – 25% grain amaranth flour was added respectively to wheat flour. Similar to Phase I, Group A (n=47) consisted of individuals from a lower-income, while Group B (n=43) consisted of respondents from a middle- to higher-income group.

Within Group A, the appearance, taste and texture of bread sample *B*, presented the highest average scores while the aroma of sample *A* was preferred. The average scores indicated that Group A "*slightly liked"* the appearance, texture and taste of sample *B, but* the aroma of sample *A.* Contrastingly, Group B preferred the texture of sample *C* while awarding the highest average scores to sample A for appearance, aroma and taste. The average scores for these samples indicated that Group B "*liked"* the appearance and aroma of sample *A,* while they "*slightly liked"* the taste of sample *A.* Furthermore, Group B *"slightly liked"* the texture of sample *C.* Both groups indicated that they preferred sample *B among* the three samples overall, and indicated the intention to consume this bread sample four days per week.

It was determined that significantly lower scores were awarded to most samples by Group A, than by Group B. However, even though this is true, the lowest scores awarded to the samples, were 3.87, indicating Group A were inclined to a neutral opinion (*neither like nor dislike*) regarding the aroma of sample *C.* Moreover, the majority of the scores for the bread samples by Group A, tended towards *"like slightly"* indicating that even with lower scores, the enriched

bread samples were positively evaluated by Group A. This is contradictory to literature that suggests addition of grain amaranth flour above 15% is unacceptable to consumers. What is more, none rated the 25% amaranth enriched bread sample as unacceptable.

Since the total population indicated a preference towards the 15% enriched bread sample (sample *B)* with the intent to consume this type of bread more than four days per week, the 15% amaranth enriched bread could be popular with a similar population. Thus, with improved awareness of the nutritional benefits of bread with added grain amaranth flour, a high possibility of acceptance among the study population exists. The acceptance of these bread samples was not only evident among respondents from a lower income group having TLV knowledge, but also among the middle to higher income group's respondents. In addition, households with access to agricultural land and kitchen facilities would easily be able to reproduce the enriched bread recipe, contributing to the household's nutritional status while also adding to their food security status. Moreover, since the bread product is acceptable among a middle- to higher-income group, respondents from lower income groups could utilise the recipe and market their produce among consumers from higher income groups. This has the potential for an additional income source, while further enhancing their food security status.

In conclusion it can be stated that the aim and objectives of this research study have been reached: It was ascertained that respondents from the cleaning service provider, consisting of lower income households, were more likely to be food insecure than their counterparts in the majority of the second group, consisting of employees from the NWU and earning a higher income than Group A. However, it was evident that a minimum amount of households from group B was nevertheless at risk of becoming food insecure or were already food insecure. This could be attributed to the number of household occupants, since the relevant households all had larger household sizes than the food secure households. Furthermore, the sensory evaluation to determine the acceptance and preference of the bread samples among the two groups was successful, with no negative responses from either group.

5.3 Contribution of the study

The most important contribution of this study is confirming the possibility to improve household food security in the sample population. This study revealed that households did not consume a sufficient variety of different foods as suggested by the dietary guidelines. Although it was not the intention to determine quantities, results indicated that several households consumed a few food items frequently and some eat a vegetable daily, implying that sufficient dietary needs most probably lack in many households. By developing a new, nutritious recipe supplementing frequently consumed food products with familiar traditional (leafy) vegetables, individuals' nutritional and health status could be improved. Furthermore, if individuals gained access to

plant cultivation, and was equipped with skills to prepare and promote new enriched products to a higher socio-economic market, generating income for the community may positively contribute to their general well-being. For further research, a sustainable, income-generating project could transpire from this study.

5.4 Recommendations for further research

This study identified various households that experienced food insecurity, with the majority from a lower income group. This raises the opportunity to further research the causes of food insecurity within these households and contribute to improving their situation. Additionally, the researcher has proposed a recipe and food product that could contribute to their food security situation. It is recommended that for further research, an income-generating project, utilising the proposed enriched bread recipe, could be developed among affected households and the acceptance thereof evaluated among a larger population. Furthermore, investigating if such a project would be feasible and yield the anticipated results of improving their household food security situation, it could provide a new solution to be implemented in other affected communities, while also being beneficial to all parties involved. Other traditionally acceptable recipes could also be explored and enriched with the grain amaranth flour, to further improve dietary diversity and increase products that could be produced and marketed by the affected communities. However, sensory evaluation would firstly have to commence to determine the acceptability of the newly developed products. Moreover, in order for the suggested projects to be successful, an effective information campaign should be initiated to introduce consumers to the amaranth plant and to inform consumers of the benefits of grain amaranth. This information campaign should be educational and should include healthy food options that could facilitate a behavioural change, to ultimately cultivate a healthier lifestyle. Together with the information campaign, it is recommended that TLV should be promoted among food insecure households, so that awareness of the benefits could be raised, and ultimately increase the consumption among vulnerable households.The researchers also recommend that further research should be conducted to determine the use of grain amaranth in South Africa, since data available was limited.

5.5 Limitations

The grain amaranth flour utilised during this study, was not available in South Africa and had to be imported from Kenya. Concerning the availability of raw materials, this was the only limitation. While this study made use of non-probability, purposive sampling to reach the appropriate respondents, these results could not be generalised. Thus it is proposed that future research on this topic should make use of random sampling in order to generalise the results to a wider population. Additionally, a quantitative method was employed to collect data among

respondents, while this allowed the researcher to collect valuable data; the opinions of the respondents were not recorded. Thus, a mixed method research design could be beneficial to acquire both quantitative and qualitative data to gather the maximum information from respondents.

Furthermore, as a result of safety precautions, data collection did not take place within households, and the interviewed respondents served as representatives of the households. This could have implications on the true food consumption patterns of the households. For future research it could prove valuable to obtain a secure study location easily accessible to the researcher and respondents, and acquire information from all members of the household.

Language barriers could also be a limitation since a large part of Group A indicated Setswana as their home language. Even though they were able to read and write English, some had lower educational levels, and could thus have influenced their ability to answer the questionnaires.

CHAPTER 6
RESEARCH ARTICLE

6.1 Title page

EXPLORING THE ACCEPTABILITY OF WHEAT BREAD ENRICHED WITH GRAIN AMARANTH FLOUR TO SUPPORT HOUSEHOLD FOOD SECURITY IN A COMMUNITY WITHIN SOUTH AFRICA.

(Article to be submitted to *Indilinga: African journal of indigenous knowledge systems)*

Lizelle Coetzee; Hanli de Beer; Annchen Mielmann;

North-West University, Potchefstroom Campus.

lizelle_pink@yahoo.com

6.2 ABSTRACT

Food insecurity affects a large part of the South African population's households, and agricultural means of addressing food insecurity has generally been explored, with success to some extent. This research study aimed to propose a different approach of addressing food security, by altering commonly consumed wheat bread, and enriching it with grain amaranth flour. The study was conducted during two phases to establish the study population's food security situation and their food consumption patterns, while sensory evaluation was conducted among an untrained consumer panel examining their acceptance, preference and purchase and consumption intent for the enriched bread samples (brown bread and 15% and 25% amaranth enriched bread samples). The household questionnaire illustrated that none of the low-income households were food secure, while almost similar amounts of households from both groups were at risk of becoming food insecure (Group A=27%; Group B=24.7%). Bread was the most consumed food product among both low and middle to higher income households. Both amaranth enriched bread samples were liked, showing potential to support nutritional enrichment of bread as staple food. If the nutritional intake of food-insecure households could be improved by enhancing a product that they would consume and is culturally acceptable, their food security situation could thus be improved.

Keywords: *Wheat bread; Grain amaranth; Acceptability; Household food security; Sensory evaluation; Food enrichment*

6.3 INTRODUCTION

Diminishing resources, climate changes and financial challenges result in 1.2 billion people affected by poverty globally (UNDP, 2014). South Africa is classified as a food secure country, but it is evident that 12.9% of the country's population has been recorded to experience food insecurity on a regular basis (StatsSA, 2013). Factors such as unemployment, low education levels, income (De Cock *et al.,* 2013; Sekhampu, 2013) and food price increases (Sommerville *et al.,* 2014) cause poor food and nutritional choices. This often result in unhealthy monotonous diets (Mavengahama *et al.,* 2013) that are less expensive, in order to feed the whole household, but is lacking nutritional adequacy. Poverty causes food insecurity. However, it is not clear if households with lower to middle incomes are food secure.

Food items mostly consumed by South Africans are maize, brown wheat bread and hard margarine, which is frequently consumed with milk, tea and sugar (Acham *et al,* 2012), and provide households with adequate amounts of energy, but is lacking sufficient micronutrients (Vorster, 2010) such as zinc (Zn), vitamin A, iodine (I), iron (Fe) and folate (Steyn & Ochse, 2013). Thus, households that revert to diets lacking diversity may be at risk of becoming food and nutrition insecure. Proper utilisation and knowledge of food resources could positively contribute to food security which highlights the importance of culture and traditional foods to meet the nutritional needs of all individuals in a household.

Indigenous vegetables including amaranth could considerably contribute to the dietary requirements of a household (Schönfeldt & Pretorius, 2011), especially considering the high amounts of crude fibre, protein and minerals present in these vegetables (Afolayan & Jimoh, 2009). Consumption of wild plant species' leaves, flowers or stems is common practice in South Africa and they are regarded as traditional vegetable sources by many African cultures (Mavengahama *et al.,* 2013:227). However, urbanisation causes decreased consumption of

these traditional food items. It could also be attributed to a lack of knowledge regarding the access and utilisation thereof (Taleni *et al.,* 2012).

In an attempt to support household's health and nutrition, reintroduction of traditional foods could be achieved through means of recipe development utilising traditional and staple food sources while considering households' cultural preferences. Thus, by changing a household's dietary pattern, subsequently initiating variety of food choices and health and nutrition, food security could be addressed, as proposed by Oldewage-Theron *&* Kruger (2011).

Cultivation of TLV in communal or home gardens could positively affect food security and decrease food expenditure. Matenge (2011) reported that amaranth leaves were very popular among communities in the North West Province although the grain amaranth is unfamiliar in SA. This nutritious grain is classified as a pseudo-cereal (Amicarelli & Camaggio, 2012), since the composition of the grain is similar to cereals regarding nutritional composition (Alvarez-Jubete, 2010). Cultivation of the amaranth grain species on a large scale is successfully implemented in Uganda, and although it is still regarded as novel, it has been indicated to successfully generate income (Ainebyona *et al.,* 2012). Alvarez-Jubete *et al*. (2010) indicated that amaranth has high nutritional value, Specifically being rich in protein (Mlakar *et al.,* 2010), Iron (Fe), Calcium (Ca) and fibre. It is also an excellent source of Vitamin C and it can be used to improve the diets of individuals, especially in the rural areas (Mnkeni *et al.,* 2007). Moreover Sanz-Penella *et al.* (2013) established that the addition of amaranth flour to wheat bread, improves the mineral and protein content of the bread. It was thus the purpose of this study to determine income-earning households' food utilisation and food security status and to further evaluate the acceptability of a 15% and 25% amaranth enriched wheat bread among consumers from different socio-economic and cultural backgrounds. With the addition of grain amaranth flour to wheat bread, the nutritional value of the bread will improve and hence it could contribute to improving the nutritional intake of households.

6.4 MATERIALS AND METHODS

6.4.1 Study Area

The study consisted of two phases and was conducted on the Potchefstroom campus of the NWU, in the North-West province of SA among 144 income-earning individuals. Respondents were recruited from staff employed by the university and contractors of the university.

6.4.2 Study procedure

Non-probability, purposive sampling was identified to be an appropriate sampling method to accommodate the inclusion criteria for respondents (Strydom, 2011). Inclusion criteria entailed that respondents need to be 18 years and older, be able to read and write Basic English and earn a salary. Moreover, no respondents should have had any food allergies as they were required to evaluate food samples.

The respondents were divided into two groups. The first group of respondents (Group A) comprised of lower income categories and were mainly from positions requiring lower skills. The second group of respondents (Group B) mainly consisted of administration and academic staff members and presented middle to higher income levels. Data were collected throughout two phases. Phase I consisted of the household survey to measure the respondents' basic demographic information, food consumption patterns and their household food security status. Household food security status was determined with the questionnaire of Labadarios *et al*. (2009), grouping households as: i) food secure; ii) at risk of being food secure; and iii) food insecure. Phases I and II of the study were conducted with 144 and 91 employees respectively. The statistical significance of the study population's sample size was verified with the assistance of the Statistical Consultation Services of the NWU (SCS).

Ethical approval for this study was acquired from the Health Research Ethical Committee (HREC) of the Faculty of Health Sciences of the NWU (Reference number: NWU-00040-13-A1).

6.4.3 Data collection and analysis

In order to accomplish dietary diversity and improved nutritional intake, bread as staple food consumed by the majority of all respondents was adapted to be nutritionally improved with amaranth. Bread recipes were adjusted before deciding on the one that would be easy to adapt in any household. The bread was enriched with grain amaranth flour and tested in order to standardise the recipe. Thereafter, sensory evaluation, encompassing Phase II, commenced and a consumer sensory test was utilised to evaluate respondents' acceptance of the bread samples (Lawless, 2013), with the use of a seven-point hedonic scale (Aniedu & Agugo, 2010).

Sensory characteristics were evaluated by means of consumer sensory panel tastings and a questionnaire developed to suit the study. Using a seven-point hedonic scale, respondents were required to indicate the degree of liking or disliking of three wheat bread samples, *a* = control pure wheat bread sample, *b* = containing 15% amaranth flour, and *c* = containing 25% amaranth flour. The seven-point hedonic scale was divided into equal segments ranging from 1 "Dislike very much" to 7 "Like very much", with a neutral option 4 "neither like nor dislike" (Beinner *et al*. 2010).

The data analysis for both questionnaires during the two phases was performed with the assistance of SCS, NWU. The pre-coded questions of the household survey were analysed by means of SPSS (Statistical Package for the Social Sciences), in addition to Microsoft Excel. Moreover, guidelines suggested by Labadarios *et al.* (2009), were used to evaluate the household food security questions. Furthermore, bar charts and box plots were used to highlight significant results and present summarised data in an illustrative manner.

Inferential statistics were used to draw conclusions from the study population's characteristics and enabled the researcher to test theories formulated from the descriptive data (Fouché & Bartley, 2011). Moreover, cross-tabulations were used to indicate significant relationships between variables using the Chi-square test, where significant relationships are indicated by $p<0.05$ and $p<0.001$. Additionally, significant relationships were tested for strength of associations between the variables and illustrated by using *Cramer's V* coefficient designated

by values between +1 and -1; where values closest to -1/+1 designate a perfect relationship (Mehta & Patel, 2012). Moreover, effect sizes were also calculated to indicate practical significance and *Cohen's d* and *r* were utilised to interpret the effect size between means and variables (Pietersen & Maree, 2010). The effect was considered small if *r*=0.1; medium if *r*=0.3 and a large effect if *r*=0.5 (Crano *et al.,* 2015).

6.5 RESULTS AND DISCUSSION

6.5.1 Phase I: Household survey – Demographic characteristics

The study population for Phase I, the household survey, consisted of 144 respondents of which the majority were female, with Group A and B consisting of *n*=63 and *n*=81 respondents, respectively. Most respondents from Group A were between the ages of 25 to 34 (41.3%) and were from the black African population group, while the largest part of Group B were between 35 to 44 years old (27.2%), the majority being from the white population group. Regarding education levels, the highest levels of education for the majority of Group A (62.9%) were between Grade 8 and Grade 11, while 48.1% of Group B attained a tertiary qualification.

However, considering the income and expenditure of the two groups, the largest part of Group A (50.8%) earned a household income of between R1 364 to R1 928 per month while the average household income of Group B was more dispersed, with the largest concentration of households (16.7%) earning between R9 320 to R13 209 per month, illustrating that Group A indeed earned a lower household income than Group B. Group A (85.7%) generally purchased household groceries once per month, while households from Group B purchased groceries once every week (39.5%) and once per month (33.3%).

Food expenses are expected to be increased among the higher income group. However, the results suggest differently. The majority of Group A (50.8%) spent between R501 and R1 000 on food items every month, while 17.7% of Group B spent similar amounts and the largest group of respondents (19.0%) spent between R1 501 and R2 000. Moreover, 73.0% of Group A indicated the majority of their income was spent on food items, while significantly fewer

households from Group B (51.3%) also indicated food to be their largest expense. Considering that the majority of Group A only earned between R1 364 toR1 928, their food expenses amount presented a large part of their household income, when compared to Group B. Hence, one can deduce that these households are most likely susceptible to food price fluctuations, and this could lead to decreased food purchases and increased risks of experiencing food insecurity.

Household food consumption patterns

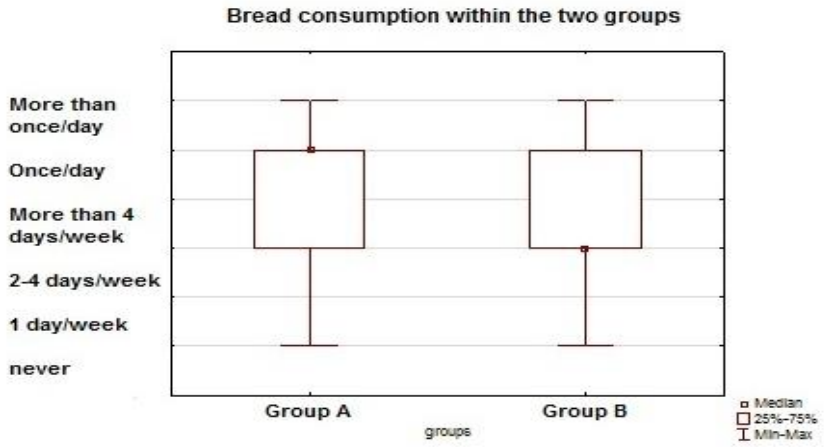
In view of the extensive food expenses incurred by the majority of the study population, it is important to consider the food consumption patterns of the respondents. The respondents were required to indicate from several food options their household consumption practices on a weekly basis. This provided the researchers with an indication of what was consumed on a daily basis and the dietary diversity within a household. Furthermore, it also gave an indication of what food products were rarely consumed.

The food items consumed daily and several days during the week were milk, chicken, bread, maize meal, potatoes, eggs and breakfast cereals. Vegetables and other meat items were consumed mostly once per week. Additionally, when comparing the top ten food items consumed by Group A versus Group B, it was clear that milk (87.3%), chicken (87.3%), maize meal (85.7%) and bread (63.5%) were the most frequently consumed products on a daily basis within Group A. Similarly, milk was the most popular food item among Group B households, with 60.5% consuming it once or more times per day.

Bread consumption patterns of 144 respondents were analysed using cross-tabulations and a chi-square test to see if there would be a significant difference between the bread consumption patterns of Group A (f=63) and B (f=81). A Chi-Square Test of Independence was performed to examine the relationship between the respondent groups and their consumption frequency of bread. A practical significant difference existed for bread consumption ($p \leq 0.001$; r=0.455). Group A consumed bread daily while Group B consumed bread more than four days a week (Fig 1).

It is clear that bread was consumed more frequently by both groups than maize meal, however, Group A consumed it on a more frequent basis than Group B. Viljoen *et al.* (2005) suggests that the increased consumption of bread could be because it is more convenient to prepare and could be consumed with more affordable condiments than maize meal.

Figure 1: Boxplot for bread with significant different consumption between Groups A and B ($p \leq 0.05$)



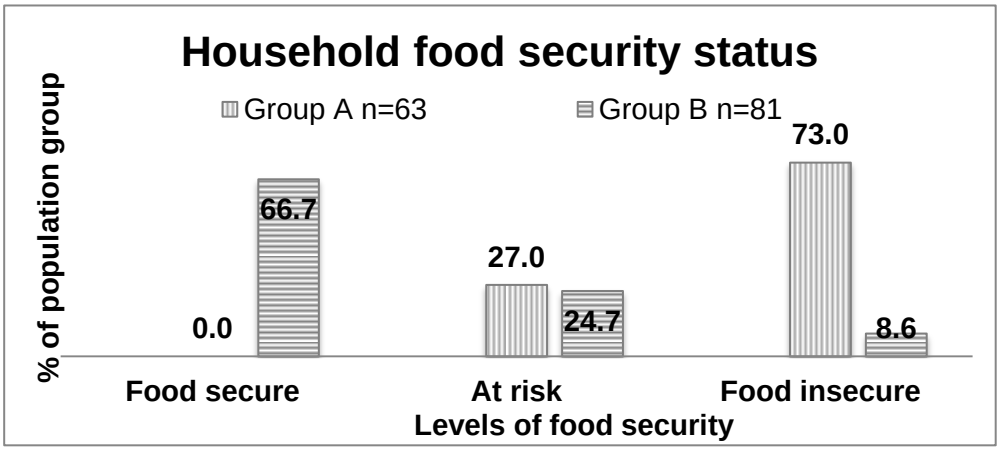
Additionally, according to the Food Based Dietary Guidelines (FBDG), it is recommended that starchy foods should be the basis of most meals, while a variety of fruit should be consumed daily (Vorster *et al.,* 2013). Since bread was frequently consumed among households from both groups, and it is recommended that starch should be the basis of most meals, the researchers chose to enhance wheat bread with grain amaranth flour.

Household food security status

The three categories of food security measured by the questionnaire included food secure households, households at risk of food insecurity and thirdly, households confirmed as food insecure or constantly experiencing hunger (Labadarios *et al.,* 2009). When considering the household food security situation of the two groups, it was evident that lower income households were more prone to food insecurity or at risk thereof within Group A. Figure 2 is a representation of the households' food security statuses. In the middle to higher income group (Group B) 66.7% of the households were food secure, while none of the households from Group

A were food secure. Furthermore, almost similar amounts of households from both groups, Group A: 27%; Group B: 24.7%, were evaluated as being at risk of becoming food insecure. Moreover, results clearly indicated an alarming high incidence of food insecure households among the lower income group (73%), compared to Group B (8.6%). This is supported by Ndhleve *et al.* (2013) in their study among rural communities in SA, where food insecurity was more prevalent among lower income households.

Figure 2: Bar chart of households' food security statuses within the lower and higher income groups



Upon further examination of the food security questions, Question 1 (*Does the household ever run out of money to buy food?*) and Question 9 (*Do you ever eat less so that children will have enough to eat?*) were singled out as the two questions with the most affirmative responses (Table 1). Considering Question 1, the majority of Group A (88.9%), responded with affirmative answers for this question. Additionally, the severity of the situation was emphasised by the fact that it occurred in 60.3% of households from Group A on more than five days during the preceding month. Results of the question regarding enough money to purchase food showed that the incidence of the occurrence and severity among group B's households were practical significantly (p <0.001; r=0.707) less.

Correspondingly results for the decreased food consumption by adults to enable children to consume enough food were experienced by 58.1% of Group A's households for more than five days per month compared to Group B's 5.6% (p <0.001; r=0.572).

Table 1: Household food security status

Question nr	Question	Yes				*p*-value*	Effect size (*r*)**
		Group A		Group B			
		n	%	*N*	%		
1	Does the respondent's household ever run out of money to buy food?	56	88.9%	14	17.7%	0.000*	0.707**
A	Has it happened in the past 30 days?	48	76.2%	10	12.7%	0.000*	0.642**
B	Has it happened 5 days or more in the past 30 days?	38	60.3%	4	5.0%	0.000*	0.603**
9	Do you ever eat less so that children will have enough to eat?	55	88.7%	19	24.7%	0.000*	0.638**
A	Has it happened in the past 30 days?	47	75.8%	6	8.2%	0.000*	0.690**
b	Has it happened 5 days or more in the past 30 days?	36	58.1%	4	5.6%	0.000*	0.572**

* *p*-value significant at levels $p < 0.001/p \leq 0.05$

** effect size interpreted as $r=0.1$ small effect; $r=0.3$ medium effect; $r=0.5$ large effect

This indicates that financial means to acquire food is a serious contributor to food insecurity (Sekhampu, 2013), while the adults in a household took on the responsibility to ensure the children would have sufficient food to eat. Thus, when considering a resolution for the households' food utilisation and food security situation, it is essential to take into account that such resolution should be financially feasible while enhancing a household's nutritional situation. Consequently, recipe development commenced after concluding the food consumption patterns and food security levels. The bread samples were developed accordingly in order for sensory evaluation to take place. Hence the sensory evaluation results will be discussed.

6.5.2 Phase II: Sensory evaluation of amaranth enriched wheat bread

A total of 91 respondents completed the sensory evaluation questionnaire and were divided into two groups with 48 respondents from Group A, and 43 respondents from Group B. Group A consisted of respondents from the lower income group, mainly black African females, while Group B were respondents from the middle to higher income group, consisting of white and black African male and female respondents

When comparing the mean scores for all three bread samples between the two groups, it is evident that a practical difference can be perceived in Table 2. For the appearance of the bread samples, Group A preferred sample *B* (4.85±2.33) while Group B preferred the appearance of sample *A* (5.76±1.12). Furthermore, the aroma of sample *A* was preferred by both Group A (4.61±2.29) and B (5.60±1.17), while Group B scored significantly higher scores (p=0.016, r=0.422). The texture of sample *B* was preferred by Group A (4.56±2.04) while Group B preferred the texture of sample *C* (5.23±1.39). Finally, considering the taste, Group A preferred the taste of sample *B* (4.51±2.23) and Group B preferred the taste of sample *A* (5.38±1.27).

When bearing in mind the average scores for the aroma and taste of all three samples for both groups, it is evident that the scores decrease as the percentage of grain amaranth increases. For Group A, the average scores for aroma decreased from Mean=4.61 to Mean=3.87, while for Group B it decreased from Mean=5.60 to Mean=5.38, for samples *A* to *C* respectively. Also, the average scores for the taste of the samples decreased from Mean=4.26 to Mean=4.05 for Group A, while for Group B (Mean=5.38 to Mean=5.16) it also decreased. The reduced average scores for the aroma and taste of the bread samples with more than 15% grain amaranth addition, could be attributed to the distinctive flavour and aroma of amaranth, as suggested by Mlakar *et al.* (2010). Lastly, respondents were required to indicate which bread sample they preferred (a=1; b=2; c=3). The average score for each of the two groups was calculated to indicate which one of the three samples was preferred.

The average score for Group A was 1.93 and for Group B, 1.98, hence, the average scores signify that for both groups, sample *B* (2), was the preferred sample from the three bread

samples (Table 2). In contrast to the study by Sanz-Penella *et al.* (2013) who found that their control wheat bread sample received higher preference than the bread samples with added amaranth flour, it appears that respondents from this study preferred bread samples enriched with 15% amaranth flour (Sample *B)*.

Table 2: Mean scores and standard deviations for sensory characteristics for the two groups

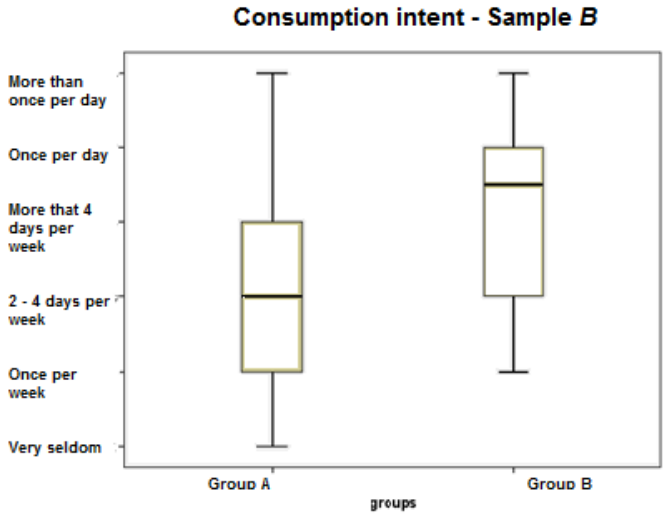
Sensory characteristics	Bread sample	Group A *n*=48	Group B *n*=43	*p*-value	Effect size (*r)*
+Appearance	a	4.45±2.50	5.76±1.12	0.000	0.533
	b	4.85±2.33	5.56±1.03	0.000	0.547
	c	4.80±2.39	5.42±1.35	0.001	0.498
+Aroma	a	4.61±2.29	5.60±1.17	0.016	0.422
	b	4.28±2.12	5.49±1.08	0.002	0.496
	c	3.87±2.13	5.47±1.32	0.006	0.451
+Texture	a	4.34±2.24	5.09±1.36	0.003	0.480
	b	4.56±2.04	5.02±1.35	0.080	0.362
	c	4.41±2.31	5.23±1.39	0.011	0.432
+Taste	a	4.26±2.24	5.38±1.27	0.000	0.575
	b	4.51±2.23	4.91±1.36	0.001	0.519
	c	4.05±2.28	5.16±1.60	0.044	0.398
*Average sample preferred		1.93±0.81	1.98±0.87	0.105	0.617
**Sample consumption intent		3.62±3.061	4.05±1.306	0.001	0.515

+Hedonic scale: 1=dislike very much; 2=dislike; 3=dislike slightly; 4=neither dislike/like; 5=like slightly; 6=like; 7=like very much
*Sample preference: 1=sample a; 2=sample b; 3=sample c
**Sample consumption intent: 1=Never/very seldom; 2=1day/week; 3=2-4 days/week; 4= > 4 days/week; 5=once/day; 6 = > once/day
p-value significant $p \leq 0.05$; Effect size 0.1=small; 0.3=medium; 0.5=large

Respondents were further required to indicate their consumption intent towards the sample they preferred. The consumption intent for Group A (3.62±3.06) and Group B (4.05±1.31) both inclined towards four days in a given week *(See Table 2 **sample consumption intent).* However Figure 3 indicates that Group B would probably consume the preferred bread sample on a more regular basis than Group A, with 50% of Group B indicating they would consume the preferred sample between two to four days per week, to even once per day.

It could be deduced that respondents from this study population had an overall positive acceptance of the amaranth enriched bread, contradicting the findings by Chlopicka *et al.* (2012) who recommend that the addition of amaranth is not advisable. Other research, however, showed that wheat bread enriched with 10 to 15% amaranth flour, was acceptable to consumers in Nigeria (Ayo, 2001) and Siberia (Bodrože-Solarov *et al.,* 2008).

Figure 3: Box plot presentations of consumption intent for Sample *B,* by the two different groups (Group A – Lower-income; Group B – Middle to higher-income; Sample B – 15% grain amaranth)



6.6 CONCLUSION

Food security remains an eminent problem in SA even though the country as a whole is considered food secure. Innovative ways of addressing household food security, including recipe enhancement, should be explored in an attempt to improve households' situation. This research study set out to explore households' food security status among employees at the NWU from a lower- (Group A, *n*=63) and a middle- to higher-income group (Group B, *n*=81), during two phases. Additionally the researcher aimed to enhance the nutritional quality of bread (identified during the household survey as a frequently consumed staple) with grain amaranth flour, in order to propose an alternative method to improve household food and nutrition security. The acceptance and preference of the enhanced food product were evaluated to determine if consumers from the target population would find the enhanced product acceptable.

The survey also evaluated the respondents' household food utilisation and food security status and the researcher was able to divide the respondents representing their households into three categories: i) food secure, ii) at risk of becoming food insecure and iii) food insecure. It was determined that households from Group A were more likely to be at risk of or already experiencing food insecurity, while none of the Group B households were food insecure. Seventy three percent of households from the lower income group were food insecure and another 24.7% were at risk thereof. The majority of the higher income group were food secure (66.7%), although 27.0% of the group's households were at risk of becoming food insecure, while a small percentage (8.6%) were food insecure. Moreover, various factors including household income, money spent on food, household size and education levels were further analysed to identify whether these factors could contribute to food security.

A standard brown bread recipe was utilised and served as the control bread (Sample *A*), while two more bread samples were enriched with 15% (Sample *B*) and 25% (Sample *C*) grain amaranth flour. The three different bread samples were evaluated by two groups, Group A (n=48) and B (n=43), of untrained consumer panels consisting of respondents that had taken part in the household survey. They were required to evaluate the acceptance of the three bread samples according to four sensory characteristics (appearance, aroma, texture, taste) and to indicate their preference towards one sample while also specifying how often they would consume the preferred sample.

It was concluded that both groups positively evaluated all three samples, however, the higher income group (Group B) awarded higher overall scores than the lower income group (Group A). This was especially evident for the aroma of samples *B* and *C,* and for the taste of samples *A* and *C,* where statistically significant differences were evident and Group B awarded statistically higher scores than Group A. Additionally, both groups indicated a positive consumption intent to the preferred sample *B (15% amaranth enriched bread).* From the median scores it was illustrated that Group B would consume the bread on a more frequent basis

Furthermore, the taste of the enriched bread samples was not disliked by the panels, thus indicating brown bread can successfully be enriched with 15–25% grain amaranth while still being acceptable to consumers, thus contributing to households' nutritional quality and hopefully advancing vulnerable households' food security situation. Offering an acceptable food product with improved nutritional qualities, while being culturally acceptable, households' food security situation could be improved.

The researchers recommend the utilisation of the enriched bread recipe and initiate an income generating product. Together with the income generating project, awareness regarding the benefits of grain amaranth could be created through an educational programme. This could improve their behaviour towards a healthier lifestyle and ultimately improve their household food insecury situation. It is also recommended that a mixed method research design could be beneficial for future research on this subject, to acquire both quantitative and qualitative data to gather the maximum information from respondents.

6.7 REFERENCES

Acham, H., Oldewage-Theron, W.H. and Egal, A.A. (2012). Dietary diversity, micronutrient intake and their variation among black women in informal settlements in South Africa: A cross-sectional study. *International journal of nutrition and metabolism,* 4(2):24–39.

Afolayan, A.J. and Jimoh, F.O. (2009). Nutritional quality of some wild leafy vegetables in South Africa. *International journal of food sciences and nutrition*, 60(5):424–431.

Ainebyona, R., Mugisha, J., Kwikiriza, N., Nakimbugwe, D., Masinde, D. and Nyankanga, R.O. (2012). Economic evaluation of grain amaranth production in Kamuli District, Uganda. *Journal of agricultural science and technology,* 2(2):178–190.

Alvarez-Jubete L., Arendt E.K. and Gallagher E. (2010). Nutritive value of pseudo cereals and their increasing use as functional gluten free ingredients. Trends in food science and technology, 21(2):106–113.

Amicarelli, V. and Camaggio, G. (2012). Amaranthus: a crop to rediscover. *Forum ware international,* 2:4–11.

Aniedu, C. and Agugo, U.A. (2010). Acceptability of bread produced from Hausa-potato and sweet potato composite flours. *Journal of agriculture and social research,* 10(2):162–166.

Ayo J.A. (2001). The effect of amaranth grain flour on the quality of bread. *International journal of food properties*, 4(2):341–351.

Beinner, M.A., Soares, A.D.N. and Barros, A.L.A. (2010). Sensory evaluation of rice fortified with iron. *Ciência e Tecnologia de Alimentos*, 30(2):516–519.

Bodroža-Solarov M., Filipčev B., Kevrešan Ž., Mandić A. and Šimurina O. (2008). Quality of bread supplemented with popped *Amaranthus cruentus* grain. Journal of food process engineering, 31(5):602–618.

Chlopicka, J., Pasko, P., Gorinstein, S., Jedryas, A. and Zagrodzki, P. (2012). Total phenolic and total flavonoid content, antioxidant activity and sensory evaluation of pseudocereal breads. *LWT-Food science and technology*, 46(2):548–555.

Crano, W.D., Brewer, M.B and Lac, A. (2015). Principles and methods of social research. 3rd ed. New York: Routledge.

De Cock, N., D'Haese, M., Vink, N., Van Rooyen, C.J., Staelens, L., Schönfeldt, H.C. and D'Haese, L. (2013). Food security in rural areas of Limpopo province, South Africa. *Food security,* 5(2):269–282.

Fouché, C.B. and Bartley, A. (2011). Quantitative data analysis and interpretation. (*In* de Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C.S.L. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p248–294).

Labadarios D., Davids Y.K., Mchiza Z. and Weir-Smith G. (2009). The assessment of food insecurity in South Africa. Pretoria: Centre for poverty, employment and growth. Human Sciences Research Council.

Lawless, H.T. (2013). Laboratory exercises for sensory evaluation. Ithaca, NY: Springer.

Matenge, S.T.P. (2011). Utilisation of traditional and indigenous foods in the North West Province of South Africa. Potchefstroom: NWU. (Thesis – PhD).

Mavengahama, S., McLachlan, M. and De Clercq, W. (2013). The role of wild vegetable species in household food security in maize based subsistence cropping systems. *Food security*, 5(2):227–233.

Mehta, C.R. and Patel, N.R. (2012). IBM SPSS exact test statistics. Available at: http://www.sussex.ac.uk/its/pdfs/SPSS_Exact_Tests_21.pdf. Accessed on: 25 Jun. 2015

Mlakar, G.S., Turinek, M., Jakop, M., Bavec, M. and Bavec, F. (2010). Grain amaranth as an alternative and perspective crop in temperate climate. *Journal for geography*, 5(1):135–145.

Mnkeni A.P., Masika P. and Maphaha M. (2007). Nutritional quality of vegetable and seed from different accessions of Amaranthus in South Africa. Water South Africa, 33(3):377–380.

Ndhleve, S., Musemwa, L. and Zhou, L. (2013). Household food security in a coastal rural community of South Africa: Status, causes and coping strategies. *African journal of food security,* 1(1):15–20.

Oldewage-Theron, W.H. and Kruger, R. (2011). Dietary diversity and adequacy of women caregivers in a peri-urban informal settlement in South Africa. *Nutrition*, 27(4):420–427.

Pietersen, J. and Maree, K. (2010). Statistical analysis II: inferential statistics. (*In* Maree, K. *ed.* First steps in research. Pretoria: Van Schaik. p198–213).

Sanz-Penella J.M., Wronkowska M., Soral-Smietana M. and Haros M. (2013). Effect of whole amaranth flour on bread properties and nutritive value. Food Science and Technology, 50(2):679–685.

Schönfeldt, H.C. and Pretorius, B. (2011). The nutrient content of five traditional South African dark green leafy vegetables: A preliminary study. *Journal of food composition and analysis*, 24(8): 1141–1146.

Sekhampu, T.J. (2013). Determination of factors affecting the food security status of households in Bophelong, South Africa. *International business and economics research journal*, 12(5):543–550.

Sommerville, M., Essex, J. and Le Billon, P. (2014). The 'global food crisis' and the geopolitics of food security. *Geopolitics*, 19(2):239–265.

StatsSA (Statistics South Africa). (2013). Millennium Development Goals, Country Report 2013. South Africa: Pretoria. Available at: http://www.statssa.gov.za/wp-content/uploads/2014/02/MDGR_Report_2013_Final.pdf. Accessed on: 23 Apr. 2014.

Steyn, N.P. and Ochse, R. (2013). "Enjoy a variety of foods": as a food-based dietary guideline for South Africa. *South African journal of clinical nutrition,* 26(3):13–17.

Strydom, H. (2011). Sampling in the Quantitative paradigm. (*In* de Vos, A.S., Strydom, H., Fouché, C.B. and Delport, C.S.L. *ed.* Research at grassroots: for the social sciences and human service professions. Pretoria: Van Schaik. p222–235).

Taleni, V., Nyoni, P. and Goduka, N. (2012). People's perceptions on indigenous leafy vegetables: A case study of *Mantusini* Location of the Port St Johns Local Municipality, in the Eastern Cape, South Africa. Paper presented at the Strategies to overcome poverty and inequality: towards Carnegie III conference, University of Cape Town, CT, 3–7 September. Available at: http://carnegie3.org.za/docs/papers/260_Taleni_People's%20perceptions%20on%20indig

enous%20leafy%20vegetables%20%20a%20case%20study%20of%20Mantusini%20location%20of%20the%20Port%20St%20JOhns%20Local%20MUnicipality.pdf. Accessed on 13 May 2015.

UNDP (United Nations Development Programme). (2014). The Millennium Development Goals Report 2014. Available at: http://www.undp.org/content/undp/en/home/librarypage/mdg/the-millennium-development-goals-report-2014.html. Accessed on 22 Jun. 2015.

Viljoen, A.T., Botha, P. and Boonzaaier, C. (2005). Factors contributing to changes in food practices of a black South African community. *Journal of family ecology and consumer sciences*, 33(1):46–62.

Vorster, H.H. (2010). The link between poverty and malnutrition: A South African perspective. *Health SA Gesondheid,* 15(1):1–6.

Vorster H.H., Badham J.B. and Venter C.S. (2013). An introduction to the revised food-based dietary guidelines for South Africa. *South African journal of clinical nutrition*, 26(3): 5-12.

ANNEXURES

ANNEXURE 1A: CONSENT FORM

QUESTIONNAIRE REGARDING ASPECTS OF HOUSEHOLD FOOD SECURITY

VRAELYS AANGAANDE ASPEKTE VAN HUISHOUDELIKE VOEDSELSEKURITEIT

THE AIM AND NATURE OF THE RESEARCH STUDY/ *DOELWIT EN AARD VAN DIE NAVORSINGSTUDIE*

The questionnaire will consist of questions regarding food utilisation and knowledge, food security and demographic information. After data analysis, informational material will be presented to respondents to improve their household food security status.

Die vraelys sal uit vrae aangaande voedselbenutting, kennis, voedselsekuriteit en demografiese inligting bestaan. Na data-analise sal inligtingsmateriaal aan die respondente bekend gemaak word om hul huishoudelike voedselsekuriteitstatus te verbeter.

RESEARCH PROCEDURE / *NAVORSINGSPROSEDURE*

1) You are requested to participate in the questionnaire that will be completed by the researcher.
2) The questionnaire will take approximately 20 minutes to complete.
3) All data gathered during this study will be handled and stored confidentially and only the members of the research team will have access to the data. Data published in the thesis or journals will not contain any information that may result in the identification of respondents.
4) **Your anonymity will be assured at all times.** We, however, request your personnel number to label the questionnaire and to ensure traceability for follow-up procedures.
5) It is possible that you will not derive any benefit personally from your participation in the study, although the knowledge gained by means of the study may benefit other individuals or communities.
6) By agreeing to take part in the study, you are also giving consent that data gathered be used by the researchers for scientific purposes as they see fit. Confidentiality will further be assured, as your name will not be recorded.
    1) *U word versoek om die vraelys te voltooi deur die vrae te beantwoord wat deur die navorser gevra word.*
    2) *Die vraelys sal ongeveer 20 minute neem om te voltooi.*
    3) *Alle data wat gedurende hierdie studie ingesamel word, sal deurentyd vertroulik hanteer word en slegs lede van die navorsingspan sal toegang tot die data hê. Enige data wat in tesisse of joernale gepubliseer word, sal geen inligting bevat wat tot die herkenning van enige respondent kan lei nie.*

4) ***U anonimiteit sal deurentyd verseker word****. Ons versoek wel u personeelnommer sodat die vraelyste genommer kan word en om te verseker dat u vir opvolgprosedures opgespoor kan word indien nodig.*
5) *Dit is moontlik dat u geen persoonlike baat mag vind na u deelname aan die studie nie, maar ander individue en gemeenskappe mag moontlik voordeel trek uit die kennis wat deur hierdie studie verkry sal word.*
6) *Deur in te stem om aan die studie deel te neem, gee u ook toestemming dat enige inligting wat in die studie verkry word deur die navorsers, volgens hulle oordeel, vir wetenskaplike doeleindes gebruik kan word. Vertroulikheid word verder verseker deurdat u naam nêrens verskyn nie.*

POSSIBLE BENEFITS OF THE STUDY / *MOONTLIKE VOORDELE VAN DIE STUDIE*

The present study shall provide knowledge regarding household food utilisation, and food security status. The knowledge gained will then be utilised to introduce educational information based on areas with shortcomings in food knowledge, handling and storage practices. The aim is to enhance household food security by optimal utilisation of available resources. Results will be used to improve problem areas. Feedback will be presented to the concerned parties at the end of the study.

Die huidige studie sal kennis aangaande huishoudelike voedselbenutting, voedselhanteringpraktyke en voedselsekuriteit verskaf. Die kennis verkry vanuit die studie sal gebruik word om opvoedkundige inligting aangaande voedselkennis, hantering en bergingspraktyke, bekend te stel. Die doelwit is om huishoudelike voedselsekuriteit te verbeter deur optimale benutting van beskikbare bronne. Terugvoer sal aan die betrokke partye na afloop van die studie voorgestel word.

INFORMATION / *INLIGTING*

Should you require more information, please do not hesitate to contact Lizelle Coetzee, (Masters Degree student) at 21189536@nwu.ac.za or Dr Hanli de Beer (study leader) at 018 299 2483.

Indien u enige verdere inligting benodig, moet asseblief nie huiwer om (Meestersgraad student) Lizelle Coetzee*, te kontak by* 21189536@nwu.ac.za *of Dr. Hanli de Beer (studieleier) by 0182992483*.

WITHDRAWAL OF PARTICIPATION / *ONTTREKKING VAN DEELNAME*

Participation in the study is completely voluntary and you have the right to withdraw from the study at any given time, should you wish to do so. However, you are kindly requested not to withdraw from the study without careful consideration.

Deelname aan die studie is heeltemal vrywillig en u het die reg om te eniger tyd van die studie te onttrek. Ons rig egter 'n versoek aan u dat u nie van die studie onttrek sonder sorgvuldige oorweging nie.

DECLARATION OF CONSENT / *TOESTEMMINGSVERKLARING*

I declare that I willingly participate in this study by completing the questionnaire. The purpose of this research study was explained to me and I declare that I fully understand the content thereof. I was given the opportunity (if so preferred) to discuss any aspects of the study with the researcher and hereby voluntarily agree to participate in the study. I would hereby like to exempt the University or any employee or any student of the University from any liability that I might incur during this study.

I furthermore waive my right to institute any claims whatsoever against the University that may arise during the study or from the conduct of any person involved in the study, except for claims arising from proven negligent conduct of the University or its employees or students.

Ek verklaar dat ek vrywilliglik deelneem aan die studie deur die vraelys te voltooi. Die doel van die navorsingstudie is aan my verduidelik en ek verklaar dat ek die inhoud ten volle verstaan. Ek is die geleentheid gegun (indien verkies) om enige aspekte van die studie met die navorser te bespreek en hiermee stem ek vrywilliglik in om aan die studie deel te neem. Hiermee stel ek die universiteit of enige werknemer of student van die universiteit, vry van enige aanspreeklikheid wat gepaard gaan met deelname aan die studie. Ek verbeur die reg om enige eise teen die universiteit of individue betrokke by die studie in te stel, wat gedurende die loop van die studie mag voorkom behalwe in die geval van bewese nalatige optrede deur die universiteit of hul werknemers en studente.

Signature of the respondent:_____

Signed at_____on this _____day of _____2012.

*Handtekening van die deelnemer*_____

Geteken te _____ op hierdie_____ dag van_____2012.

ANNEXURE1B: HOUSEHOLD SURVEY

a) What is your highest level of education? (*Wat is u hoogste vlak van opleiding?*)

None, did not have the opportunity to attend school *(Geen, het nie die geleentheid gehad om skool by te woon nie)*	1
Primary School *(Laerskool)*	2
Secondary school (Gr. 8 to Gr. 11) *(Hoërskool – (Gr. 8 tot Gr. 11)*	3
Matric / (Grade 12) *(Matriek / Graad 12)*	4
Tertiary education/ training / *(Tersiêre onderig /opleiding)*	5
Diploma	6

b) What is your race? *(Wat is u ras?)*

White (Blank)	1
Black (Swart)	2
Asian (Indiër)	3
Coloured (Kleurling)	4
Other (Ander)	5

c) Do you have any health-related conditions e.g. Diabetes

(Het u enige gesondheidsverwante toestande bv. Diabetes)

Yes / *Ja*	1
No / *Nee*	2
If yes, specify / *Indien ja, spesifiseer*_____	

Section A FOOD PRODUCTION AND CONSUMPTION *(Tick the best option)*

Afdeling A VOEDSELPRODUKSIE EN -VERBRUIK *(Merk die beste opsie)*

1. Do you have a vegetable garden?

(Het u 'n groentetuin?)

Yes (*Ja*)	1
No (*Nee*)	2

NOTE: If yes, go to question1.1. If no, go to question1.2

(NOTA: Indien ja, gaan na vraag 1.1. Indien nee, gaan na vraag 1.2)

1.1 If yes, what do you use your vegetables for? *(Indien 'Ja', waarvoor gebruik u die groente?)*	**YES***JA*	**NO***NEE*
1.1.1 Household consumption (*Huishoudelike gebruik*)		
1.1.2 Selling (*Verkoop*)		
1.1.3 Preserving for the future (*Preserveer vir die toekoms*)		
1.1.4 Giving away to family/friends (*Skenk aan familie/ vriende*)		

1.2 If 'No', why do you not have a vegetable garden? *(Indien 'Nee', hoekom het u nie 'n groentetuin nie?)*	
1.2.1 Not enough money (*Nie genoeg geld nie*)	
1.2.2 Not enough time (*Nie genoeg tyd nie*)	
1.2.3 Not enough space (*Nie genoeg plek nie*)	
1.2.4 Buy all vegetables (*Koop alle groente*)	
1.2.5 Not interested in a vegetable garden (*Stel nie belang in 'n groentetuin nie*)	

1.3 Would you like to have a vegetable garden?

(*Sal u daarvan hou om 'n groentetuin te hê?)*

Yes (*Ja)*	1
No (*Nee*)	2

1.4 Do you keep any animals for food purposes e.g. Chickens, sheep, pigs, cattle etc.?

(Hou u enige diere aan vir kosdoeleindes bv. hoenders, skape, varke, beeste ens?)

Yes (Ja)	1
No (Nee)	2

NOTE: If yes, go to question 1.5. If no, go to question 2.

Indien ja, gaan na vraag 1.5. Indien nee, gaan na vraag 2.

1.5 If yes, for what do you use your animals? *(Indien 'Ja', waarvoor gebruik u die diere?)*	**YES/***JA*	**NO/***NEE*
1.5.1 Food for the household (*Kos vir die huishouding)*		
1.5.2 Selling (*Verkoop*)		
1.5.3 Preserving for the future (*Preserveer vir die toekoms*)		
1.5.4 Giving away to family/friends (*Skenk aan familie/ vriende*)		
1.5.5 Other *(Ander)*_____		

2. How often do you eat the following food products?

(*Hoe gereeld eet u die volgende kosprodukte?*)

(Tick one block only for every question) *(Merk slegs een blokkie vir elke vraag)*	**Never / Very seldom** *(Nooit / Baie selde)*	**1 day/week** *(1 dag/week)*	**2 – 4 days / week** *(2- 4 dae / week)*	**More than 4 days/week** *(Meer as 4 dae/week)*	**1 x/day** *(1 x/dag)*	**More than once a day** *(Meer as een keerper dag)*
Starch *(Stysel)*						
2.1.1 Bread (*Brood*)	1	2	3	4	5	6
2.1.2 Maize Meal (*Mieliemeel*)	1	2	3	4	5	6
2.1.3 Sorghum/ Maltabella	1	2	3	4	5	6

	Never / Very seldom *(Nooit / Baie selde)*	**1 day/week** *(1 dag/week)*	**2 – 4 days / week** *(2- 4 dae / week)*	**More than 4 days/week** *(Meer as 4 dae/week)*	**1 x/day** *(1 x/dag)*	**More than once a day** *(Meer as eenkeer per dag)*
2.1.4 Samp (*Stampmielies*)	1	2	3	4	5	6
2.1.5 Rice (*Rys*)	1	2	3	4	5	6
2.1.6 Vetkoek	1	2	3	4	5	6
2.1.7 Instant breakfast cereal: Corn flakes / Weet-Bix (*Ontbytgraanvlokkies: Corn flakes / Weet-Bix*)	1	2	3	4	5	6
2.1.8 ProNutro	1	2	3	4	5	6
2.1.9 Other *(Ander)*_____	1	2	3	4	5	6
Vegetables *(Groente)*						
2.2.1 Morogo: green leafy vegetables (*Marog: groen blaargroente*)	1	2	3	4	5	6
2.2.2 Sweet corn (*Suikermielies*)	1	2	3	4	5	6
2.2.3 Potatoes (*Aartappels)*	1	2	3	4	5	6
2.2.4 Carrots (*Wortels*)	1	2	3	4	5	6
2.2.5 Sweet Potatoes (P*atats*)	1	2	3	4	5	6
2.2.6 Pumpkin (*Pampoen*)	1	2	3	4	5	6
2.2.7 Cabbage *(Kool)*	1	2	3	4	5	6
2.2.8 Green beans, peas (*Groenbone, ertjies*)	1	2	3	4	5	6
2.2.9 Other *(Ander)*_____	1	2	3	4	5	6
2.3 Fruit *(Vrugte)*	1	2	3	4	5	6
Dairy *(Suiwel)*						
2.4.1 Milk (*Melk*)	1	2	3	4	5	6
2.4.2 Inkomaas/ Amazi/ Yoghurt (*Inkomaas/ Amazi/ Joghurt*)	1	2	3	4	5	6
2.4.3 Powdered milk: *Nespray, Elite* (*Poeiermelk: Nespray, Elite*)	1	2	3	4	5	6

	Never / Very seldom *(Nooit / Baie selde)*	**1 day/week** *(1 dag/week)*	**2 – 4 days / week** *(2- 4 dae / week)*	**More than 4 days/week** *(Meer as 4 dae/week)*	**1 x/day** *(1 x/dag)*	**More than once a day** *(Meer as eenkeer per*
2.4.4 Powdered coffee creamer: Cremora (*Koffieverromer: Cremora*)	1	2	3	4	5	6
2.4.5 Other *(Ander)*_____	1	2	3	4	5	6
Meat *(Vleis)*						
2.5.1 Chicken (*Hoender*)	1	2	3	4	5	6
2.5.2 Pilchards: Lucky star *(Pilchards sardyne: Lucky star)*	1	2	3	4	5	6
2.5.3 Fish *(Vis)*						
2.5.4 Liver *(Lewer)*	1	2	3	4	5	6
2.5.5 Bully beef *(Boeliebief)*	1	2	3	4	5	6
2.5.6 Beef stew (Gestoofde beesvleis)	1	2	3	4	5	6
2.5.7 Beef mince (*Maalvleis*)	1	2	3	4	5	6
2.5.8 Pork (Vark)						
2.5.9 Eggs (*Eiers*)	1	2	3	4	5	6
2.5.10 Other *(Ander)*_____	1	2	3	4	5	6
Plant proteins *(Plantaardige proteïene)*						
2.6.1 Beans: red, white, black (*Bone: rooi, wit, swart*)	1	2	3	4	5	6
2.6.2 Lentils (*Lensies*)	1	2	3	4	5	6
2.6.3 Chick peas (*Keker-ertjies*)	1	2	3	4	5	6
2.6.4 Nuts, Peanuts (*Neute, Grondboontjies*)	1	2	3	4	5	6

3. **Where do you buy food**? (*Waar koop u kos?)*	**YES/**JA	**NO/**NEE

3.1 Spaza Shop		
3.2 Street Vendor *(Straatverkoper)*		
3.3 Supermarket *(Supermark)*		
3.4 Other, specify *(Ander, spesifiseer)*		

Section B FOOD PREPARATION
Afdeling B VOEDSELVOORBEREIDING

4. (Tick one block only for every question) *(Merk een blokkie vir elke vraag)*	**Myself** *(Ekself)*	**Someone else** *(Iemand anders)*	**Me and someone else** *(Ek en iemand anders)*	**Notes** *(Notas)*
4.1 Who is mainly responsible for making food in your house? (*Wie is hoofsaaklik verantwoordelik om kos te maak in u huis?)*	1	2	3	
4.2 Who decides what food to buy for the household? (*Wie besluit watter kos vir die huishouding gekoop moet word?)*	1	2	3	
4.3 Who decides how much money is spent on food? (*Wie besluit hoeveel geld op kos spandeer word?)*	1	2	3	

5. Who is the head of the household? (*Wie is die hoof van die huishouding?*)

Specify *(Spesifiseer)*_____

6. Do you use the following to cook food? *(Gebruik u die volgende om kos gaar te maak?)*	**YES***/JA*	**NO***/NEE*
6.1 Fire *(Vuur)*		
6.2 Paraffin *(Paraffien)*		
6.3 Electricity *(Elektrisiteit)*		

6.4 Gas		
6.5 Other *(Ander)*		

7. Do you use the following equipment in your house? *(Gebruik u die volgende apparate in die huis?)*	**YES/**JA	**NO/**NEE
7.1 Refrigerator *(Yskas)*		
7.2 Freezer *(Vrieskas)*		
7.3 Pots / pans *(Potte / panne)*		
7.4 Kettle *(Ketel)*		
7.5 Cooking utensils other than knives, spoons and forks (e.g. peeler/ whisk etc.) *(Kookapparate anders as messe, lepels, vurke (bv skiller/ eierklitser ens.)*		
7.6 Electric appliances etc.: toaster, mixer *(Elektriese toestelle ens.: broodrooster, klitser)*		
7.7 Stove *(Stoof)*		
7.8 Microwave *(Mikrogolf)*		
7.9 Table *(Tafel)*		
7.10 Electrical frying pan *(Elektriese braaipan)*		

Section C FOOD SECURITY
Afdeling C VOEDSELSEKURITEIT

	YES/JA	NO/NEE
8. Are you single with no children? *(Is u enkellopend met geen kinders?)*		
Does your household ever run out of money to buy food? *(Het u huishouding ooit te min geld om kos te koop?)*		
1a. Has it happened in the past 30 days? (*Het dit in die afgelope 30 dae gebeur?)*		
1b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do you ever rely on a limited quantity of food to feed your children		

because you are running out of money? *(Maak u ooit staat op 'n beperkte hoeveelheid kos om u kinders te voed, omdat u te min geld het?)* 2a. Has it happened in the past 30 days? (*Het dit in die afgelope 30 dae gebeur?)* 2b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do you ever cut the size of your household's meals because there is not enough food in the house? *(Verminder u ooit die grootte van u huishouding se maaltye omdat daar nie genoeg kos in die huis is nie?)* 3a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 3b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do you ever eat less than you should because there is not enough money for food? *(Eet u ooit minder as wat u moet, omdat daar nie genoeg geld vir kos is nie?)* 4a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 4b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do your children ever eat less than you feel they should because there is not enough money for food? *(Eet u kinders ooit minder as wat u voel hul moet omdat daar nie genoeg geld vir kos is nie?)* 5a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 5b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do your children ever say they are hungry because there is not enough food in the house? *(Sê u kinders ooit dat hulle honger is, omdat daar nie genoeg kos in die huis is nie?)* 6a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 6b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		

Do your children ever skip meals because there is not enough food in the house? *(Slaan u kinders ooit maaltye oor omdat daar nie genoeg kos in die huis is nie?)* 7a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 7b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do any of your children ever go to bed hungry because there is not enough money to buy food? (*Gaan enige van u kinders honger bed toe omdat daar nie genoeg geld is om kos te koop nie?)* 8a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 8b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		
Do you ever eat less so that your children will have enough to eat? *(Eet u ooit minder sodat u kinders genoeg sal hê om te eet?)* 9a. Has it happened in the past 30 days? *(Het dit in die afgelope 30 dae gebeur?)* 9b. Has it happened 5 or more days in the past 30 days? *(Het dit al 5 of meer dae in die afgelope 30 dae gebeur?)*		

Section F Demographic information
Afdeling F DEMOGRAFIESE INLIGTING

9. Gender (*Geslag)*

Male (*Manlik*)	1
Female (*Vroulik*)	2

10. Age *(Ouderdom)*

18-24	25-34	35-44	45-54	55-64	65 +
1	2	3	4	5	6

11. Home language *(Huistaal)*	**YES/**JA	**NO/**NEE
11.1 Setswana		
11.2 IsiXhosa		
11.3 Sepedi		
11.4 isiZulu		
11.5 Sesotho		
11.6 Tshivenda		
11.7 isiNdebele		
11.8 Xitsonga		
11.9 siSwati		
11.10 English		
11.11 Afrikaans		

Section G LIVING ENVIRONMENT
Afdeling G LEEFOMGEWING

12. What type of house do you live in?

(In watter tipe huis woon u?)

House built with bricks: permanent structure *(Huis gebou met bakstene: permanente struktuur*)	1
Permanent structure as part of a complex: flat (*Permanente struktuur as deel van 'n kompleks: woonstel*)	2
Semi-permanent structure - House made from building materials other than bricks: corrugated iron / wood *(Semi-permanente struktuur - Huis gebou van materiale anders as bakstene: sinkplaat / hout*)	3

13. Is there a kitchen in your house?

(Is daar 'n kombuis in u huis?)

Yes (*Ja)*	1
No (*Nee*)	2

13.1 Is the kitchen a separate room in the house?

(Is die kombuis 'n aparte vertrek in die huis?)

Yes *(Ja*)	1
No (*Nee*)	2

14. Where do you get water?

(*Waar kry u water vandaan?)*

Tap in the house (Kraanwater in die huis)	1
Tap outside the house: in yard (Kraanwater buite die huis: in erf)	2
Borehole (Boorgat)	3
Spring / river / dam water (Fontein/ rivier / damwater)	4
Fetch water from elsewhere_____ (Kry water op 'n ander plek) _____	5

15. How many people live in your house?

(Hoeveel mense woon in u huis?)

1	2	3	4	5	6	7	8	9	>9
1	2	3	4	5	6	7	8	9	10

Section H INCOME & FOOD EXPENDITURE
Afdeling H INKOMSTE & VOEDSELUITGAWES

16. Do the following members of the household contribute to the total household income? (Dra die volgende *lede van die huishouding by tot die totale huishoudelike inkomste?)*	**YES/**JA	**NO/**NEE
16.1 Mother (*Ma*)		
16.2 Father (*Pa*)		
16.3 Son (*Seun*)		
16.4 Daughter (*Dogter)*		
16.5 Grandparents (*Oupa/ Ouma*)		
16.6 Uncle/ Aunt (*Oom/ Tannie*)		
16.7 Fiancée (*Verloofde*)		
16.8 Friend (*Vriend*)		
16.9 Other (*Ander*)		
16.10 Only myself *(Net ek*)		

17. What is the total income of the household PER MONTH? [Tick only one]
(Wat is die totale inkomste van die huishouding PER MAAND?) [Merk slegs een]

< R 1 363	1
R 1 364 - R 1 928	2
R 1 929 - R 2 257	3
R 2 258 - R 3 137	4
R 3 138 - R 4 164	5
R 4 165 - R 6 321	6
R 6 322 – R 9 319	7
R 9 320 - R 13 209	8
R 13 210 - R 17 987	9
R 17 988 - R 26 705	10
R 26 706 - R 32 521	11
>R 32 522	12

18. How often do you do grocery shopping for food? *[Tick only one]*
(Hoe gereeld doen u kosinkopies?) [*Merk slegs een*]

18.1 Every day (*Elke dag)*	
18.2 Once a week (*Eenkeer 'n week*)	
18.3 Once a month (*Eenkeer 'n maand*)	

18.4 More than once a month (Meer as eenkeer per maand)	
18.5 Other, specify (*Ander, spesifiseer*) _____	

19. How much money is spent on food PER MONTH, by the household? [*Tick only one]*

(Hoeveel geld word aan kos, PER MAAND,spandeer, deur die huishouding?) [Merk slegs een]

R 100 – R 500	1
R 501 – R 1000	2
R 1001 – R 1500	3
R 1501 – R 2000	4
R 2001 – R 2500	5
R 2501 – R 3000	6
> R 3000	7
Do not know *(Ek weet nie)*	8

20. On which one of the following do you MAINLY spend your income?

(Op watter een van die volgende spandeer u die MEESTE van u inkomste?)

Food *(Kos)*	1
Clothes *(Klere)*	2
Housing/ household aspects e.g. Rent, furniture, appliances *(Behuising/huishoudelike aspekte bv. Huurgeld, meubels, toestelle)*	3
Transport *(Vervoer)*	4
School-/ University fees *(Skoolfonds/ Universiteitsgelde)*	5
Other *(Ander)*	6

Thank you for your willingness to participate in this research study. It is highly appreciated!

(Dankie vir u bereidwilligheid om aan die navorsingstudie deel te neem. Dit word opreg waardeer)

ANNEXURE 2A: CONSENT FORM–SENSORY EVALUATION

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

Private Bag X6001, Potchefstroom
South-Africa, 2520

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

School for Physiology, Nutrition and Consumer Sciences

Tel/Fax: (018) 299-2470

TOESTEMMING TOT DEELNAME AAN NAVORSING/

CONSENT TO PARTICIPATE IN RESEARCH

Sensoriese evaluering van verrykte stapelvoedsel met Amarant. / ***Sensory evaluation of Amaranth enriched staple food.***

Verkenning van huishoudelike voedselsekerheid en die aanvaarding van Amarantverrykte brood / ***Exploring household food security and the acceptance of an amaranth enriched food product***

- U is versoek om aan ‘n navorsingstudie deel te neem./ *You have been asked to participate in a research study.*
- U is oor die studie ingelig deur:/ *You have been informed about the study by:* Lizelle Coetzee*.*
- U kan Lizelle Coetzee enige tyd kontak by 072 418 1147 indien u vrae oor die navorsingstudie het./ *You may contact Lizelle Coetzee at 072 418 1147 any time if you have questions about the research study.*
- U kan die Navorsing Etiese Komitee van die Noord-Wes-Universiteit kontak by 018 299 4849 indien u enige vrae het oor u regte as ‘n deelnemer./ *You may contact the Research Ethics Committee (REC) of the North West University at* 018 299 4849 *if you have questions about your rights as a research subject.*
- U deelname aan hierdie navorsing is vrywillig, en u sal nie gepenaliseer word of voordele verbeur as u weier om deel te neem of besluit om deelname te staak nie./ *Your participation in this research is voluntary, and you will not be penalised or lose benefits if you refuse to participate or decide to terminate participation.*
- Die navorsingstudie, insluitend die bogenoemde inligting is verbaal aan my beskryf. Ek begryp wat my betrokkenheid by die studie beteken en ek stem vrywillig in om deel te neem./ *The research study, including the above mentioned has been verbally described to me. I understand what my involvement in the study means and I voluntarily agree to participate.*
- U is bewus daarvan dat u onder geen omstandighede mag deelneem aan die navorsingstudie indien u enige voedselallergene het nie./ *You are aware that you are not allowed to participate under any circumstances in this research study if you have any food allergies.*

_____ _____

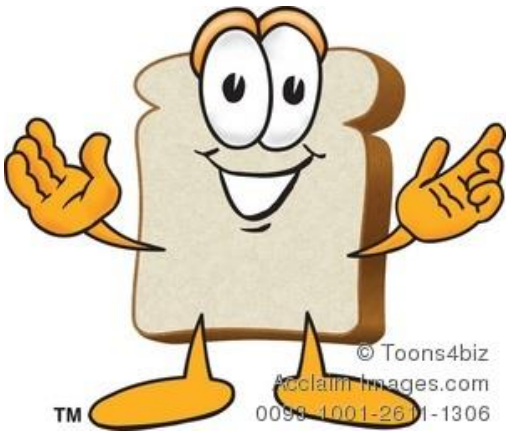
Handtekening van deelnemer/ **Datum/** ***Date***
Signature of participant

ANNEXURE 2B: SENSORY EVALUATION QUESTIONNAIRE

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

Welcome at Consumer Sciences!

Thank you for your willingness to participate in the sensory consumer panel.



Instructions:

During the evaluation you will be expected to follow the instructions carefully and answer the questions as honestly as possible. Three samples that should each be tasted and evaluated separately will be provided. Water and carrots are provided to neutralise the palate before and between evaluations of each sample. Before evaluating a sample, take a sip of water and wait 30 seconds before evaluating the next sample. **Please make sure you fill in all the sections.**

You are provided with three coded bread samples in front of you.

Evaluate all three samples, starting from the left, according to the characteristics (Appearance etc.) provided.

Please make a tick ☑ for every bread sample at each characteristic, according to the level of acceptance most appropriate to you.

Example:

Criteria	Sample codes	1 Dislike Very much	2 Dislike	3 Dislike slightly	4 Neither like nor dislike	5 Like slightly	6 Like	7 Like Very much
Taste	143						☑	

SENSORY EVALUATION OF BREAD SAMPLES

SECTION A: ACCEPTABILITY

Please evaluate each sample according to the characteristics provided, starting with the sample on the left

Sample codes: ☐ ☐ ☐

	Extent of acceptability							
Criteria	Sample codes	1 Dislike Very much	2 Dislike	3 Dislike slightly	4 Neither like nor dislike	5 Like slightly	6 Like	7 Like Very much
1. Appearance								
2. Aroma (Smell)								
3. Taste								
4. Texture (Feeling in mouth)								

5. Which sample did you like best? Fill in the sample code.

☐

5.1 What do you like most about the bread? Give your opinion.

_____

5.2 What do you like least about the bread? Give your opinion.

_____

6. How often would you eat a slice of this bread?

Very seldom/ Never	1
1 day/week	2
2 – 4 days / week	3
More than 4 days/week	4
1 x/day	5
More than once a day	6

7. Do you prefer white or brown bread? Choose one.

White bread	1
Brown bread	2

8. Do <u>YOU</u> usually eat a slice of bread?

Yes	1
No	2

8.1 If yes, how often do you eat brown bread?

Very seldom / Never	1
1 day/week	2
2 – 4 days / week	3
More than 4 days/week	4
1 x/day	5
More than once a day	6

SECTION B: DEMOGRAPHIC INFORMATION

9. Gender

Male	1
Female	2

10. Age

18-24	25-34	35-44	45-54	55-64	65 +
1	2	3	4	5	6

11. Race

White	1
Black	2
Asian	3
Coloured	4
Other	5

12. Home language

12.1	Setswana	
12.2	IsiXhosa	
12.3	Sepedi	
12.4	isiZulu	
12.5	Sesotho	
12.6	Tshivenda	
12.7	isiNdebele	
12.8	isiTsonga	
12.9	isiSwati	
12.10	English	
12.11	Afrikaans	

13. What is your highest level of education?

None (did not have the opportunity to attend school)	1
Primary School	2
Secondary school (Gr 8 to Gr 11)	3
Matric / (Grade 12)	4
Tertiary education/ training	5
Diploma	6

14. Occupation

Cleaning	1
Administrative	2
Academic	3
Other	4

Thank you for your time.

It is highly appreciated!

ANNEXURE 3: ADDITIONAL RESULTS

ANNEXURE 3A: FOOD CONSUMPTION PATTERNS

Annexure 3A: Food consumption patterns for the study population

Total consumption /item	Food item	Group	n	%	Never (n)	%	One day per week (n)	%	2-4 days per week (n)	%	> 4 days per week (n)	%	Once per day (n)	%	More than once per day (n)	Phi / Cramer's V	Pearson Chi-Square
144	Bread	A	63	*7.9*	5	*9.5*	6	*19.0*	12	*0.0*	0	*49.2*	31	*14.3*	9	0.455	0.000
		B	81	*1.2*	1	*13.6*	11	*40.7*	33	*16.0*	13	*21.0*	17	*7.4*	6		
141	Maize meal	A	63	*1.6*	1	*3.2*	2	*0.0*	6	*9.5*	0	*27.0*	17	*58.7*	37	0.747	0.000
		B	78	*26.9*	21	*33.3*	26	*17.9*	14	*9.0*	7	*5.1*	4	*7.7*	6		
139	Sorghum/ Maltabella	A	63	*63.5*	40	*7.9*	5	*6.3*	4	*0.0*	0	*22.2*	14	*0.0*	14	0.352	0.002
		B	76	*75.0*	57	*15.8*	12	*6.6*	5	*1.3*	1	*0.0*	1	*0.0*	0		
141	Samp	A	62	*72.6*	45	*22.6*	14	*4.8*	3	*0.0*	0	*0.0*	0	*0.0*	0	0.029	0.941
		B	79	*72.2*	57	*24.1*	19	*3.8*	3	*0.0*	0	*0.0*	0	*0.0*	0		
144	Rice	A	63	*0.0*	0	*61.9*	19	*30.2*	2	*3.2*	3	*4.8*	0	*0.0*	0	0.349	0.001
		B	81	*4.9*	4	*35.8*	40	*49.4*	8	*9.9*	0	*0.0*	0	*0.0*	0		
140	Vetkoek	A	63	*42.9*	27	*12.7*	8	*9.5*	6	*0.0*	0	*34.9*	22	*0.0*	0	0.437	0.000
		B	77	*67.5*	52	*19.5*	15	*5.2*	4	*3.9*	3	*3.9*	3	*0.0*	0		
140	Cereals	A	62	*40.3*	25	*11.3*	7	*14.5*	9	*3.2*	2	*30.6*	19	*0.0*	0	0.243	0.144
		B	78	*32.1*	25	*16.7*	13	*17.9*	14	*10.3*	8	*19.2*	15	*3.8*	3		
141	Pronutro	A	63	*98.4*	62	*0.0*	0	*0.0*	0	*0.0*	0	*1.6*	1	*0.0*	0	0.375	0.001
		B	78	*70.5*	55	*15.4*	12	*6.4*	5	*2.6*	2	*5.1*	4	*0.0*	0		
143	Potatoes	A	63	*4.8*	3	*15.9*	10	*44.4*	28	*3.2*	2	*31.7*	20	*0.0*	0	0.442	0.000
		B	80	*5.0*	4	*20.0*	16	*53.8*	43	*15.0*	12	*2.5*	2	*3.8*	3		
139	Morogo/ Spinach	A	63	*27.0*	17	*46.0*	29	*25.4*	16	*0.0*	0	*0.0*	0	*1.6*	1	0.264	0.084

Total consumption /item	Food item	Group	n	%	Never (n)	%	One day per week (n)	%	2-4 days per week (n)	%	> 4 days per week (n)	%	Once per day (n)	%	More than once per day (n)	Phi / Cramer's V	Pearson Chi-Square
		B	76	*40.8*	31	*25.0*	19	*27.6*	21	*3.9*	3	*1.3*	1	*1.3*	1		
139	Sweetcorn	A	63	*82.5*	52	*11.1*	7	*4.8*	3	*0.0*	0	*1.6*	1	*0.0*	0	0.430	0.000
		B	76	*43.4*	33	*48.7*	37	*7.9*	6	*0.0*	0	*0.0*	0	*0.0*	0.0		
143	Carrots	A	63	*19.0*	12	*57.1*	36	*20.6*	13	*0.0*	0	*3.2*	2	*0.0*	0	0.391	0.001
		B	80	*5.0*	4	*37.5*	30	*37.5*	30	*12.5*	10	*6.2*	5	*1.2*	1		
142	Sweet potatoes	A	63	*58.7*	37	*38.1*	24	*3.2*	2	*0.0*	0	*0.0*	0	*0.0*	0	0.320	0.006
		B	79	*34.2*	27	*43.0*	34	*20.3*	16	*1.3*	1	*1.3*	1	*0.0*	0		
143	Pumpkin	A	63	*17.5*	11	*66.7*	42	*14.3*	9	*0.0*	0	*1.6*	1	*0.0*	0	0.221	0.135
		B	80	*17.5*	14	*48.8*	39	*28.8*	23	*2.5*	2	*2.5*	2	*0.0*	0		
143	Cabbage	A	63	*12.7*	8	*33.3*	21	*36.5*	23	*1.6*	1	*15.9*	10	*0.0*	0	0.436	0.000
		B	80	*36.2*	29	*46.2*	37	*11.2*	9	*3.8*	3	*2.5*	2	*0.0*	0		
143	Green beans	A	63	*39.7*	25	*47.6*	30	*11.1*	7	*0.0*	0	*1.6*	1	*0.0*	0	0.403	0.000
		B	80	*10.0*	8	*55.0*	44	*21.2*	17	*10.0*	8	*2.5*	2	*1.2*	1		
125	Fruit	A	63	*22.2*	14	*12.7*	8	*11.1*	7	*0.0*	0	*27.0*	17	*27.0*	17	0.445	0.000
		B	62	*4.8*	3	*11.3*	7	*32.3*	20	*14.5*	9	*21.0*	13	*16.1*	10		
144	Fresh milk	A	63	*6.3*	4	*0.0*	0	*4.8*	3	*1.6*	1	*6.3*	4	*81.0*	51	0.410	0.000
		B	81	*4.9*	4	*6.2*	5	*14.8*	12	*13.6*	11	*16.0*	13	*44.4*	36		
142	Inkomaas/ amazi/ yoghurt consumption	A	63	*27.0*	17	*31.7*	20	*23.8*	15	*0.0*	0	*9.5*	6	*7.9*	5	0.312	0.017
		B	79	*24.1*	19	*29.1*	23	*30.4*	24	*0.0*	8	*10.1*	5	*6.3*	0		
142	Powdered	A	62	*98.4*	61	*0.0*	0	*1.6*	1	*0.0*	0	*0.0*		*0.0*	0	0.198	0.135

Total consumption /item	Food item	Group	n	%	Never (n)	%	One day per week (n)	%	2-4 days per week (n)	%	> 4 days per week (n)	%	Once per day (n)	%	More than once per day (n)	Phi / Cramer's V	Pearson Chi-Square
	milk																
		B	80	*88.8*	71	*6.2*	5	*3.8*	3	*1.2*	1	*0.0*		*0.0*	0		
141	Cremora	A	63	*65.1*	41	*3.2*	2	*1.6*	1	*0.0*	0	*12.7*	8	*17.5*	11	0.349	0.002
		B	78	*76.9*	60	*12.8*	10	*3.8*	3	*0.0*	0	*1.3*	1	*5.1*	4		
143	Chicken	A	63	*1.6*	1	*1.6*	1	*7.9*	5	*1.6*	1	*81.0*	51	*6.3*	4	0.759	0.000
		B	80	*0.0*	0	*17.5*	14	*48.8*	39	*20.0*	16	*10.0*	8	*3.8*	3		
142	Pilchards	A	62	*56.5*	35	*25.8*	16	*17.7*	11	*0.0*	0	*0.0*	0	*0.0*	0.0	0.182	0.196
		B	80	*58.8*	47	*28.8*	23	*8.8*	7	*3.8*	3	*0.0*	0	*0.0*	0.0		
135	Fish	A	63	*61.9*	39	*28.6*	18	*9.5*	6	*0.0*	0	*0.0*	0	*0.0*	0.0	0.348	0.001
		B	72	*29.2*	21	*48.6*	35	*16.7*	12	*5.6*	4	*0.0*	0	*0.0*	0.0		
142	Liver	A	63	*34.9*	22	*28.6*	18	*28.6*	18	*0.0*	0	*7.9*	5	*0.0*	0	0.413	0.000
		B	79	*54.4*	43	*38.0*	30	*5.1*	4	*1.3*	1	*0.0*	0	*1.3*	1		
139	Bully beef	A	61	*72.1*	44	*21.3*	13	*6.6*	4	*0.0*	0	*0.0*	0	*0.0*	0.0	0.083	0.810
		B	78	*70.5*	55	*23.1*	18	*5.1*	4	*1.3*	1	*0.0*	0	*0.0*	0.0		
139	Beef stew	A	60	*51.7*	31	*36.7*	22	*10.0*	6	*0.0*	0	*1.7*	1	*0.0*	0.0	0.228	0.124
		B	79	*30.4*	24	*50.6*	40	*16.5*	13	*1.3*	1	*1.3*	1	*0.0*	0.0		
140	Mince	A	60	*35.0*	21	*43.3*	26	*20.0*	12	*0.0*	0	*1.7*	1	*0.0*	0.0	0.330	0.004
		B	80	*11.2*	9	*50.0*	40	*36.2*	29	*2.5*	2	*0.0*	0	*0.0*	0.0		
132	Pork	A	60	*55.0*	33	*20.0*	12	*18.3*	11	*1.7*	1	*5.0*	3	*0.0*	0.0	0.343	0.004
		B	72	*31.9*	23	*45.8*	33	*22.2*	16	*0.0*	0	*0.0*	0	*0.0*	0.0		
140	Eggs	A	60	*18.3*	11	*23.3*	14	*25.0*	15	*1.7*	1	*31.7*	19	*0.0*	0	0.303	0.024
		B	80	*13.8*	11	*35.0*	28	*37.5*	30	*2.5*	2	*10.0*	8	*1.2*	1		
141	Beans	A	63	*33.3*	21	*52.4*	33	*9.5*	6	*1.6*	1	*3.2*	2	*0.0*	0.0	0.091	0.884
		B	78	*41.0*	32	*46.2*	36	*7.7*	6	*2.6*	2	*2.6*	2	*0.0*	0.0		

Total consumption /item	Food item	Group	n	%	Never (n)	%	One day per week (n)	%	2-4 days per week (n)	%	> 4 days per week (n)	%	Once per day (n)	%	More than once per day (n)	Phi / Cramer's V	Pearson Chi-Square
141	Lentils	A	63	*82.5*	52	*14.3*	9	*0.0*	0	*0.0*	0	*3.2*	2	*0.0*	0.0	0.184	0.311
		B	78	*73.1*	57	*17.9*	14	*3.8*	3	*2.6*	2	*2.6*	2	*0.0*	0.0		
140	Chickpeas	A	63	*100.0*	63	*0.0*	0	*0.0*	0	*0.0*	0	*0.0*	0	*0.0*	0.0	0.325	0.002
		B	77	*79.2*	61	*16.9*	13	*2.6*	2	*0.0*	0	*1.3*	1	*0.0*	0.0		
143	Nuts/ peanuts	A	63	*47.6*	30	*19.0*	12	*19.0*	12	*0.0*	0	*14.3*	9	*0.0*	0.0	0.302	0.011
		B	80	*38.8*	31	*31.2*	25	*21.2*	17	*6.2*	5	*2.5*	2	*0.0*	0.0		

ANNEXURE 3B: HOUSEHOLD FOOD SECURITY QUESTIONS

Annexure 3B: Household food security levels for the study population

Q nr	Question	Yes				No				Cramer's V	Pearson Chi-Square
		Group A		Group B		Group A		Group B			
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
1	Does the respondent's household ever run out of money to buy food	56	*88.9*	14	*17.7*	7	*11.1*	65	*82.3*	0.000	0.707
a	Has it happened in the past 30 days	48	*76.2*	10	*12.7*	15	*23.8*	69	*87.3*	0.000	0.642
b	Has it happened 5 days or more in the past 30 days	38	*60.3*	4	*5.0*	25	*39.7*	76	*95.0*	0.000	0.603
2	Does the respondent ever rely on limited quantities of food to feed children	49	*77.8*	11	*14.1*	14	*22.2*	67	*85.9*	0.000	0.640
a	Has it happened in the past 30 days	45	*71.4*	6	*7.7*	18	*28.6*	72	*92.3*	0.000	0.659
b	Has it happened 5 days or more in the past 30 days	34	*54.0*	3	*3.9*	29	*46.0*	74	*96.1*	0.000	0.659
3	Does the respondent ever cut the size of the household’s meals	50	*79.4*	16	*20.3*	13	*20.6*	63	*79.7*	0.000	0.589
a	Has it happened in the past 30 days	50	*79.4*	5	*6.3*	13	*20.6*	74	*93.7*	0.000	0.589
b	Has it happened 5 days or more in the past 30 days	40	*63.5*	3	*3.8*	23	*36.5*	76	*96.2*	0.000	0.645
4	Does the respondent ever eat less because there is not enough money for food	47	*74.6*	11	*13.9*	16	*25.4*	68	*86.1*	0.000	0.613
a	Has it happened in the past 30 days	46	*73.0*	6	*7.6*	17	*27.0*	72	*91.1*	0.000	0.675
b	Has it happened 5 days or more in the past 30 days	37	*59.7*	6	*7.6*	25	*40.3*	73	*92.4*	0.000	0.562

Q nr	Question	Yes				No				Cramer's V	Pearson Chi-Square
		Group A		Group B		Group A		Group B			
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
5	Does the respondent's children ever eat less than they feel they should	43	*69.4*	4	*5.2*	19	*30.6*	73	*94.8*	0.000	0.674
a	Has it happened in the past 30 days	43	*69.4*	2	*2.6*	19	*30.6*	76	*97.4*	0.000	0.710
b	Has it happened 5 days or more in the past 30 days	40	*64.5*	1	*1.3*	22	*35.5*	76	*98.7*	0.000	0.689
6	Does the respondent's children ever say they are hungry because there is not enough food	42	*67.7*	2	*2.6*	20	*32.3*	76	*97.4*	0.000	0.697
a	Has it happened in the past 30 days	41	*67.2*	1	*1.3*	20	*32.8*	77	*98.7*	0.000	0.713
b	Has it happened 5 days or more in the past 30 days	34	*56.7*	2	*2.6*	26	*43.3*	76	*97.4*	0.000	0.611
7	Does the respondent's children ever skip meals because there is not enough food	21	*33.9*	4	*5.1*	41	*66.1*	74	*94.9*	0.000	0.373
a	Has it happened in the past 30 days	21	*35.0*	1	*1.3*	39	*65.0*	76	*98.7*	0.000	0.455
b	Has it happened 5 days or more in the past 30 days	19	*31.7*	1	*1.3*	41	*68.3*	76	*98.7*	0.000	0.427
8	Does the respondent's children go to bed hungry	11	*17.7*	1	*1.3*	51	*82.3*	77	*98.7*	0.001	0.292
a	Has it happened in the past 30 days	11	*18.3*	0	*0.0*	49	*81.7*	78	*100.0*	0.000	0.336
b	Has it happened 5 days or more in the past 30 days	8	*13.3*	0	*0.0*	52	*86.7*	78	*100.0*	0.001	0.283
9	Do you ever eat less so that children will have enough to eat	55	*88.7*	19	*24.7*	7	*11.3*	58	*75.3*	0.000	0.638
a	Has it happened in the past 30 days	47	*75.8*	6	*8.2*	15	*24.2*	67	*91.8*	0.000	0.690

Q nr	Question	Yes				No				Cramer's V	Pearson Chi-Square
		Group A		Group B		Group A		Group B			
		n	*%*	*n*	*%*	*n*	*%*	*n*	*%*		
b	Has it happened 5 days or more in the past 30 days	36	*58.1*	4	*5.6*	26	*41.9*	68	*94.4*	0.000	0.572

ANNEXURE 4: INDILINGA JOURNAL AUTHORS' GUIDELINES

GUIDE FOR AUTHORS

Books for review

These should be sent to the Editors-in-Chief (see above details).

Submitting articles for publication

Length
Articles should not normally exceed 15 pages long (4000-4500 words); shorter articles such as research reports or comment are welcome. A manuscript should include a cover sheet indicating a name and address of the author(s) followed by a separate title sheet.

Number of Copies
Send three hard copies and a disk to the Editor-in- Chief. The title of the article should be on the first page of the article and a separate page should show title, name(s) of authors, and an abstract of no more than 200 words. The disk should be 3.5" and labelled with the filename, operating platform (IBM compatible or Mac) and the software version, e.g. Microsoft Word.

Editorial
All Contributions are refereed or reviewed, and all are edited or revised for publication. The Editors reserve the right to make alterations without consulting the author(s) that do not result in substantive changes. Proofs will be returned to authors if time permits; they must be returned within four days and no substantial changes can be made at this stage. The Editors' decisions about acceptance are final.

Copyright
Publication is conditional upon authors giving copyright to the Indilinga : African Journal of Indigenous Knowledge Systems. Requests to copy all or substantial parts of an article must be made to the Editors.

Layout
Text should be double-line spaced on one side of A4 paper with at least 30mm margins on all edges.

Writing Style
The journal encourages various and different styles of writing. Main criteria for publishable texts are academic rigour as well as dialogic qualities that open up for conversations with readers. Different kinds of narratives as well as more traditional academic accounts are welcomed.

Language Medium
English, or an African language. All articles will be submitted to referees. If an article is submitted in a language for which it is difficult to find suitable referees the author can be requested to submit a translated version of the article (in English) for purposes of refereeing.Notes:These should be avoided where possible; when they have to be used, list them at the end of the manuscript.

Referencing
List of references
Only sources cited in the text are listed in the references. Bibliographic information should be in the language of the source (therefore not necessarily in the language of the manuscript).

Capital letters are used only where they are necessary for linguistic reasons. Entries are in alphabetical order.

Source references are given by surnames and initials of all authors, followed by year, title of article, unabbreviated title of journal, volume, number, and applicable pages, e.g. Brown P. & Brown T. B. (1993). Early Childhood Education. Educational Psychology, 28(6)L : 23-24.

In book references, the surnames and initials of all the authors, followed by the year of publication, as well as the title, volume, edition, place of publication, and publisher, e. g. Luthuli P. C. (1998). Philosophical Foundations of Education. Durban: Kagiso Publishers.

In the case of official reports and those of corporate authors the references must be as detailed as possible, e. g. Department of National Education 1991. Report of Teacher Education. Pretoria: Government Printer. RP 173/1991:122.

For unpublished theses and dissertations follow this example:Mtetwa D. 2001. From policy to practice: The South African Schools Act. MEd dissertation. KwaDlangezwa: University of Zululand. South Africa

Anonymous references from newspapers are indicated thus: Sunday Times, 25 March 2001: 11. Leadership in education.

Personal communications are not included in the reference list as they are not retrievable.

Submitting articles for publication

Should be addressed to:

The Editor -in-Chief
Indilinga : African Journal of Indigenous Knowledge Systems
PO Box 13789
Cascades
Pietermaritzburg
SOUTH AFRICA
3202

Email: Queeneth Mkabela

ANNEXURE 5: ETHICAL APPROVAL

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

To whom it may concern

Faculty of Health Sciences
Tel: 018 2992092
Fax: 018 2992088
Email: Minrie.Greeff@nwu.ac.za

9 September 2013

Dear Dr. de Beer

Additional Request - Ethics Application: NWU-00040-13-A1

"Sustainable livelihoods, health and well-being in rural communities in South Africa – a transdisciplinary multi-level approach (WIN Project)"

Your request to include the sub-study, entitled "Amaranth enrichment of traditional recipes to address household food security in Potchefstroom" under the above mentioned umbrella project has been approved retrospectively.

Yours sincerely

Prof. Minrie Greeff
Ethics Sub-committee Vice Chairperson

Original details: Prof. Minrie Greeff(10187308) C:\Users\13210572\Documents\ETIEK\2013 ETHICS\NWU-00040-13-A1 Additional request 5.docm
9 September 2013

File reference: NWU-00040-13-A1

ANNEXURE6: LETTER OF AFFIRMATION

LETTER OF AFFIRMATION

I, Matilda Juliana Kruger, registered by SATI to edit and translate documents in both Afrikaans and English hereby affirm that I have edited the dissertation

Exploring household food security and the acceptance of an amaranth enriched food product

submitted in fulfilment of the requirements for the degree *Magister Scientiae* in Consumer Sciences at the Potchefstroom Campus of the North-West University

by

Lizelle Coetzee 21189536

MJ Kruger

SATI registration number 1000787

Date: 26 September 2015

E-mail address: julianakrugermj@gmail.com