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Dietary analysis of South African indigenous vegetables and traditional foods

Assumptions made by nutritionists and the
impact on public health outcomes

Joelaine Meryll Chetty
11 February 2013

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University of Cape Town

PART 0

PREAMBLE

**DIETARY ANALYSIS OF SOUTH AFRICAN INDIGENOUS VEGETABLES AND TRADITIONAL
FOODS – ASSUMPTIONS MADE BY NUTRITIONISTS AND THE IMPACT ON PUBLIC
HEALTH OUTCOMES**

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STUDENT NUMBER: HMPJOE001

A minor dissertation submitted in partial fulfillment of the requirements for the degree of
Master of Public Health: General, in the Department of Public Health, Faculty of Health Sciences of
the University of Cape Town

Cape Town, 2013

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CO-SUPERVISOR: DR PETRO WOLMARANS (MRC)

SUBMITTED: 11 FEBRUARY 2013

DECLARATION

I Joelaine Meryll Chetty, student number HMPJOE001, declare that *Dietary analysis of South African indigenous vegetables and traditional foods – assumptions made by nutritionists and the impact on public health outcomes* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full name: _____

Date: _____

Signed: _____

University of Cape Town

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- My family, for their unending patience, understanding and assistance during this challenging year.

DEDICATION

I dedicate this thesis to my loving husband, Donovan Chetty, my beautiful children Callum and Jordan. Thank you for your endless support and encouragement during this trying time. To my parents who I am blessed to have around and who have taught me to live up to the motto of “nothing but the best”, I love you all dearly!

University of Cape Town

THESIS ABSTRACT

A food composition database needs to be reflective of the commonly consumed foods eaten by the population, in order for it to be comprehensive. The South African Food Data System (SAFOODS) is one of a few food composition databases used amongst nutrition researchers and academia nationally for dietary intake analysis of South Africans. The SAFOODS comprises of 37% truly analysed South African nutrient values, which provides for an improved analysis when using this food composition database to analyse dietary intake data of South Africans.

Indigenous vegetables and traditional recipe foods are limited within the current SAFOODS, resulting in nutrition researchers making assumptions when coding dietary records comprising of these foods eaten in selected study areas.

The aim of this cross-sectional descriptive study was to collect and evaluate the different assumptions made by researchers when analysing food intake data inclusive of indigenous vegetables and traditional recipe foods, when utilising the South African food composition database for dietary analysis. In addition, it aims to record how these assumptions could possibly over or under report on actual dietary intake.

Forty (40) nutrition researchers, actively engaged in dietary intake studies across the nine provinces of South Africa, were conveniently selected for this study. These researchers were all linked to an academic institution and consisted of dietitians and nutritionists. A questionnaire was completed, assumptions recorded by the nutrition researchers for indigenous vegetables and traditional recipe foods not found within SAFOODS. The study investigator further entered assumptions reported by participants of the study into a sample menu dataset. Information received from participants' were compared to a reference meal analysis report and analysed results compared for energy and macronutrients (carbohydrate, fat, protein) and micronutrients (vitamin A and C, iron, magnesium and sodium).

Assumptions made when entering dietary intake data into a dietary analysis software program shows variation within the analyses and influences the resultant outcomes of dietary analysis studies.

The results of the study recommends that the addition of laboratory analysed and recorded data for indigenous vegetables and traditional recipe foods consumed in South Africa, to the country-specific food composition database will improve the nutrient analysis of food consumption studies in South Africa considerably. It should eliminate assumptions which nutrition researchers make for dietary analysis of indigenous vegetables and traditional recipe foods and impact significantly on dietary analysis outcomes, especially those of rural communities.

Keywords: indigenous, vegetables, traditional, nutrients, food composition, recipes



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PART A

PROTOCOL

Dietary analysis of South African indigenous vegetables and traditional foods – assumptions made by nutritionists and the impact on public health outcomes

1. Problem statement

Information on nutrient composition for indigenous vegetables and traditional recipe foods are limited in the South African Food Data System (SAFOODS), making the analysis of dietary intake data heavily dependent on researcher assumptions, which could hypothetically lead to either an over or under-reporting of actual dietary intake data. This poses a limitation / challenge to nutrition researchers coding dietary intake data.

Overall Aim: This study aims to explore: (a) the gaps which exist within the South African food composition database, when coding indigenous vegetables and traditional South African recipe foods commonly consumed in research study areas and (b) how the assumptions made by researchers possibly over or under report on actual dietary intake.

2. Research justification

SAFOODS comprises of 1472 food items grouped into 16 food groups with approximately 37% of these food items having a main reference source of South African origin, the rest being borrowed nutrient sources from the United States Department of Agriculture (USDA) and United Kingdom (UK). Within the South African food composition database, 21 indigenous vegetables are listed for 12 species of leaves. Rural and urban South African diets include a combination of traditional recipe foods and indigenous vegetables of varying cultivars, e.g. *amaranthus hybridus* or *cleome gynandra* (spider flower), to name but a few, which are collectively grouped and recorded as African leafy vegetables (ALV). The nutrient content of traditional recipe foods which are often localised to a province, are less frequently found in the South African food composition database. Assumptions made for these food items by nutrition researchers often entails substituting with the “next best” food item options, found within food databases which are generally of an international origin. Whilst recording and examining the assumptions made by nutrition researchers, this study will attempt to identify the shortcomings found within SAFOODS for further exploration. The ultimate intention is to generate nutrient information for indigenous vegetables and traditional recipe foods consumed by studied populations across South Africa for inclusion into SAFOODS. The information collected by this study serves as a baseline “indigenous and traditional recipe foods” needs assessment to further generate and access, chemically analysed nutrient information of indigenous vegetables and traditional recipe foods. This would be highly beneficial for inclusion into SAFOODS and to report on the biodiversity of species of indigenous vegetables, to produce a more comprehensive South African food database.

3. Specific objectives:

- a. Identify the top five (5) frequently consumed indigenous vegetables and top five (5) traditional recipe foods per province/area;
- b. Determine the food item options researchers select for “next best” food items when entering nutrient data for analysis, when faced with traditional recipe foods and indigenous vegetables;
- c. Perform an analytical exercise based on researcher selections of “next best” food items, by comparing assumptions made per researcher to that of a “gold standard”¹ menu ;
- d. Compare the dietary analysis from researcher selections, of nutrient data for macronutrients (energy, carbohydrates, fat and protein) and micronutrients (vitamins A and C, iron, magnesium and sodium), to that of a “gold standard” menu analysed.

¹ For the rest of the Thesis, the “gold standard” terminology used in the Protocol section will be replaced with the words reference menu

4. Abbreviations and definition section for whole thesis

AIDS	Acquired Immune Deficiency Syndrome
ALV	African leafy vegetables
FAO	Food and Agriculture Organization
FF3	FoodFinder3™ dietary analysis software program
HIV	Human Immunodeficiency Virus
Indigenous vegetables	Defined as vegetables having their origin in South Africa
MDG	Millenium Development Goal
MRC	Medical Research Council
SAFOODS	South African Food Data System
Traditional recipe foods	Defined as recipe foods genuinely native to a particular region or that has been present in that region long enough to have evolved through generations
UCT	University of Cape Town
UK	United Kingdom
USA	United States of America
USDA	United States Department of Agriculture

1. Project title

Dietary analysis of South African indigenous vegetables and traditional foods – assumptions made by nutrition researchers and the impact on public health outcomes.

2. Purpose of study / Overall Aim

This study aims to explore: (a) the gaps which exist within the South African food composition database, when coding² indigenous vegetables and traditional South African recipe foods commonly consumed in research study areas and (b) how the assumptions made by researchers possibly over or under reports on actual dietary intake.

Hypothesis

Assumptions made by researchers, when selecting “next best” food items for indigenous vegetables and traditional recipe foods consumed within a study population, but does not exist in the South African food composition database, over predicts on nutrient values when analysed.

3. Background and Rationale

Indigenous vegetables³ and traditional recipe foods⁴ of South Africa have been widely researched and many studies show the importance these food items have on household food security (Kaschula, 2008; Flyman & Afolayan, 2006; Faber et al., 2010; Jansen van Rensburg et al., 2007). The South African food composition database is regarded as the main reference database for many nutrient intake or consumption studies in South Africa (SAFOODS, 2000). This database houses nutrient information for approximately 1472 food items, 37% of foods having nutrient data of South African origin. Information on the

² Definition Coding: Is the method of matching food items reported in a diet record (e.g. food diary) with a food code on an electronic database.

³ Definition Indigenous vegetables: vegetables having their origin in South Africa.

⁴ Definition Traditional recipe foods: recipe foods genuinely native to a particular region or that has been present in that region long enough to have evolved through generations.

biodiversity of indigenous vegetables and traditional recipe foods are currently lacking in this database, as the initial intention for this database was aimed at nutrient intake studies which focused mainly on western/urbanised diets, excluding mainly those consuming indigenous vegetables and traditional recipe foods. Currently, a total of 21 indigenous leafy vegetable food items are listed for 12 species of leaves are found within the South African food composition database (Kruger et al., 1998:136).

Presently, researchers have to make assumptions for indigenous vegetables and traditional recipe foods consumed in rural communities as limited nutrient data are available in food databases for this food group and could thus have an impact on the assessment of nutritional status which influences public health outcomes of rural communities.

4. Introduction

Indigenous South African food crops are defined as having their origin in South Africa. Added to these crops are those that were introduced into the country and are now recognised as naturalised or traditional crops (“Department of Agriculture, Forestry and Fisheries”, 2000). Studies in different areas of South Africa indicate differences in cultural practices for different traditional foods and the practice of mixing traditional foods into dishes is something common (Nesamvuni, 2000). In the Eastern Cape province, for instance, common traditional recipe foods consist of *umbona* (maize), goat meat, milk that is often drunk in its sour form and *umngqusho*, which combines honey corn with sugar beans (Shava, 2000).

It is important to clarify the definitions of traditional recipe foods per province, as in some provinces “offal” refers to all the intestines, head, feet, stomach of the animal, whilst in another province, “offal” is regarded as only the stomach (tripe) and trotters of the animal. Nutrient information based on the definition of the food item “offal” in this case, would

influence the food item choice the nutrition researcher coding the dietary intake data makes and influences the nutrient analysis of the individual consuming the traditional recipe food item. A food database is regarded as being representative and comprehensive if it houses nutrient information of foods typically eaten amongst a population. In South Africa we experience a wide range of dietary consumption patterns across a myriad of cultures, and ideally a country-specific food composition database should be reflective of the country's consumption patterns (Greenfield & Southgate, 2003:33). Many indigenous vegetables and traditional recipe foods are absent from the current SAFOODS, hence this investigation as to food items for future inclusion. Continually increasing the number of foods (specifically indigenous vegetables and traditional foods) included in SAFOODS will result in an improved nutrient analysis nationally when large scale food consumption surveys are planned.

Public health nutrition intervention strategies, such as the vitamin A supplementation programme of the Department of Health (Provincial Department of Health, Western Cape, 2005), targets communities where marginal vitamin A consumption patterns have been identified. The resultant blanket Vitamin A supplementation programme continues in communities, but is there a need for this programme in areas where high vitamin A intake is observed in our under 5years target groups? Where there is a high intake of indigenous vegetables and/or traditional recipe foods the blanket supplementation programme might be regarded as futile, as communities utilise their surroundings to achieve optimal vitamin A intake. Stuijvenberg et al., (2011) challenges the national supplementation programme in their Northern Cape study, by highlighting certain pockets of communities who may not benefit from the blanket supplementation provided by the South African Department of Health, but who utilise the surrounding abattoirs in the area to achieve the required daily allowance of vitamin A from an increased organ meat, specifically liver, consumption. In this community, organ meats were classified as traditional foods, as they are genuinely

native to a particular region and evolved through many generations by frequent consumption.

Laboratory analysed and recorded nutrient data for indigenous vegetables and traditional recipe foods consumed in South Africa, will improve the country-specific food composition database and the nutrient analysis of food consumption studies in South Africa considerably. It should eliminate assumptions which nutrition researchers make for dietary intake analysis of indigenous vegetables and traditional recipe foods and impact significantly on dietary analysis outcomes.

5. Review of literature

A quote from McCance & Widdowson made in 1940 still holds true today, as it did seventy years ago: “*A knowledge of the chemical composition of foods is the first essential in dietary treatment of disease or in any quantitative study of human nutrition*”. When studying populations, the food database should be representative of commonly consumed food items eaten in households of the general population being studied or researched. This would provide with a complete analysis of nutrient intakes of populations being investigated.

A Zimbabwean study described nutrient content of amaranth to provide adequate nutrients after undergoing different processing and preservation methods, showing that the nutrient levels meet the daily required intake regardless of the losses caused by drying and blanching (Makobo, Shoko & Mtaita, 2010). Freshly harvested *Amaranthus cruentus* at plant age of 3 weeks had the highest calcium value (2 693 mg Ca per 100 g of plant) followed by the frozen state (2 515 mg per 100 g). Dried and blanched levels of calcium for the same plant species were 681 mg per 100 g and 1 040 mg per 100 g respectively.

Similarly, Uusiku et al., (2010) reviewed the literature on African leafy vegetables (ALV) consumed in sub-Saharan Africa and found that many ALVs are good sources of

micronutrients, especially *Manihot esculenta* and *Chenopodium album*. Species which are high in fibre include *Arachis hypogea* and *Bidens pilosa*. Final conclusions from this study indicated that consumption, cultivation and promotion of these species should be promoted in groups who consume these ALVs.

Faber et al., (2010) highlighted the dominant ALV in rural areas of Kwa-Zulu Natal as being amaranth (*Amaranthus spp*) and blackjack (*Bidens spinosa*), whilst in rural Limpopo, spider plant (*Cleome gynandra*), amaranth (*Amaranthus spp*) and wild watermelon leaves (*Citrullus lanatus*) were most frequently consumed. This study also revealed that ALV are still commonly consumed in these areas, because they are considered a free source of nutritious food which could be easily accessed and harvested during the growing season. Janse van Rensburg et al., (2007) identified eight groups of vegetable species that are of particular importance in South Africa. These include: amaranth (*Amaranthus spp*), spider flower (*Cleome gynandra*), Chinese cabbage (*Brassica rapa* subsp. *chinensis*), nightshade (*Solanum retroflexum*), Jew's mallow (*Corchorus olitorius* and *C.tridens*), cowpeas (*Vigna inguiculata*) and pumpkins (*Curcubita pepo*), melons (*Citrullus lanatus*) and selected other indigenous curcurbits, such as balsam pear (*Momordica balsamina*). The crops are located across South Africa, ranging from the Bushbuckridge area in the Limpopo province, Mpumalanga, Transkei, across the Eastern Cape and Kwa-Zulu Natal areas. The popularity of these species listed, include factors such as ease of availability, taste and ease of preparation.

Twine & Hunter (2007) observed in their study that the use of wild natural resources, especially wild foods, had a very important role in food security among Human Immunodeficiency Virus (HIV) impacted households compared to non-HIV impacted households. Households used wild vegetables and wild fruit more than once a week. Findings point to the general importance of wild indigenous foods, such as wild vegetables,

fruit and insects in the local diet. In times of death or stress, communities resorted to increasing the consumption of wild vegetables. The authors found that the use of natural resources is seen as an all important component of dietary coping strategies when death occurs. There is a strong association between mortality experience and use of natural resources, specifically to save money. Kaschula (2008) reported that wild foods offer unique benefits to households afflicted by the Acquired Immune Deficiency Syndrome (AIDS) in that it provides a nutritious and freely available food source at minimal labour and financial implication, i.e. households using wild foods are more economically resilient. However, this study found that households affected by HIV might reduce their use of wild foods due to stigma and household labour shortages.

A study by Aletor, Oshodi & Ipinmoroti (2002) performed in Nigeria, showed that chemical analyses of four common leafy vegetables, i.e. bitter leaf (*Vernonia amygdalina*), green tete (*Solanum Africana*, *Amaranthus hybridus*) and fluted pumpkins (*Telfaria occidentalis*) revealed that protein values of the leafy plant were relatively high. Subject to high level intake and amino acid supplementation, a large proportion of animal protein requirement could be met by consumption of these vegetable protein species.

Food security

A South African study performed by Aphane, Chadha & Oluoch (2003) showed that the major health problem in developing countries is micronutrient deficiencies, which has far reaching consequences on development, growth and health among children. Dietary intakes of socially and economically deprived communities in developing countries usually consist of plant based staple foods which are monotonous with minimal variation. Vitamin A shortages usually exist in these communities as fruits, vegetables and animal products are seldomly consumed.

According to the National Food Consumption Survey of 1999, one in four children under the age of six years is stunted due to chronic malnutrition (Labadarios, 2000). Vitamin A and iron deficiencies lead to an imbalance in children's growth and development. Indigenous leafy vegetables are an important part of farming and consumption systems throughout Africa (Faber et al., 2010). They are also important sources of micronutrients like vitamin A and C, iron and others. Indigenous vegetables are of extreme importance to food security, especially during times of famine and natural disasters (Habwe, Walingo & Onyango, 2008).

In 2006, Flyman and Afolayan reviewed the importance of wild vegetables to address dietary deficiencies and also showed how drying of wild vegetables affected their micronutrient content. Blanching of wild vegetables prior to drying prolongs the shelf life of the vegetable, especially as it is a seasonal crop which is highly perishable. Traditional practices of blanching before drying decreased micronutrient content for vitamin C, riboflavin and thiamine, with substantial losses in beta-carotene. No significant changes were reported for losses in calcium and zinc in this study. This study shows a strong request for further analytical studies to find out more on the nutritive content of wild vegetables. A database of traditional knowledge and information on the distribution and use of wild vegetables in rural communities could be of significant value.

Mbhenyane et al., (2005) completed a study on the nutrient intake and consumption of indigenous foods among college students in Limpopo province and found that 22% of students consumed indigenous fruits and 89% consumed indigenous vegetables, specifically pumpkin leaves and tendrils and dried cowpea leaves. Vegetables, including indigenous vegetables, were consumed on a daily basis yet these were grouped together with spinach intake for analysis purposes. A total of 28 indigenous foods (46.7%) of a total of 60 foods consumed, were included in the diet of college students. The study

recommended that chemical analysis of indigenous vegetables should be undertaken to report more accurately on the nutrient composition of these foods and thus nutrient intakes amongst this group. The study further emphasized the importance of inclusion amongst habitual diets of college students.

Many studies have shown the importance of indigenous vegetables and traditional recipe foods amongst certain population groups (Faber et al., 2010; Janse van Rensburg et al., 2007; Uusiki et al., 2010; Twine & Hunter 2009). Despite some cultures showing a decline in intake of traditional recipe foods, largely due to unavailability of indigenous vegetables in some communities and areas, others are still continuing the practise. Some organisations/research institutes have the nutrient analyses of indigenous vegetables and traditional recipe foods available, yet it needs to be accessed and jointly stored in a database for optimal use by all researchers engaged in dietary intake studies. Pooled resources for nutrient information of indigenous vegetables and traditional recipe foods should be initiated. There is a growing need to access and chemically analyse indigenous vegetables and traditional recipe foods for inclusion into the South African food composition database, with a resultant improved analysis of actual dietary intake of communities, when future food consumption studies are planned.

6. Project description

6.1 Problem statement

Nutrient composition of indigenous vegetables and traditional recipe foods from South Africa are limited in the South African Food Data System (SAFOODS), making the analysis of dietary intake data heavily dependent on researcher assumptions, which could hypothetically lead to either an over or under-reporting of actual dietary intake data. Nutrition researchers coding dietary records where indigenous vegetables and traditional recipe foods are

consumed will face the challenge of making assumptions for food items not found within the South African food composition database.

6.2 Project objectives

Specific objectives:

- 6.2.1 Identify the top five (5) frequently consumed indigenous vegetables and top five (5) traditional recipe foods per province/area;
- 6.2.2 Determine the food item options researchers select for “next best” food items when entering nutrient data for analysis, when faced with indigenous vegetables and traditional recipe foods;
- 6.2.3 Perform an analytical exercise based on researcher selections of “next best” food items, by comparing assumptions made per researcher to that of a “gold standard” menu;
- 6.2.4 Compare the resultant analysis from researcher selections, of nutrient data for macronutrients (energy, carbohydrates, fat and protein) and micronutrients (vitamins A and C, iron, magnesium and sodium).

7 Methodology

7.1 Study design

This research will be a cross-sectional study.

7.2 Selection criteria of study population

- Nutrition researchers and/or dietitians from all nine provinces, linked to an academic facility or research institution.
- Nutrition researchers and/or dietitians who are actively engaged in dietary analysis of food intake studies on populations.
- Number of participants amounts to a total of 40 participants across the nine provinces in South Africa. Sampled from nine (9) Universities and two (2)

Universities of Technology, totalling 11 academic institutions and dietitians across the province. (outlined in Table 1 below).

- Inclusion and exclusion criteria: Only nutrition researchers who use products of the South African food composition database for analysing food intake data will be selected for this study.
- Participants will be excluded if they are not involved in food intake surveys of communities.
- Location of research: questionnaires will be sent to participants via email/fax, who will complete the information electronically or via fax return. Study will be done from the Medical Research Council office.

Table 1: Characteristics of study population

Province		Institution – Details	Nr	Total
1	Western Cape	University of Cape Town	2	8
		University of the Western Cape	2	
		University of Stellenbosch	2	
		Cape Peninsula University of Technology	2	
2	Northern Cape	Dietitians	2	2
3	Eastern Cape	Dietitians	2	2
4	Gauteng	University of Pretoria	2	4
		Dietitians	2	
5	Kwa-Zulu Natal	University of Kwa-Zulu Natal	2	4
		Durban University of Technology	2	
6	Free State	University of the Free State	2	4
		Dietitians	2	
7	Limpopo	University of Limpopo – Turfloop campus	2	6
		University of Limpopo – Medunsa campus	2	
		University of Venda	2	
8	North West	North West University	2	4
		Dietitians	2	
9	Mpumalanga	Dietitians	2	2
	Other	Agricultural Research Council	2	2
		Human Sciences Research Council	2	2
TOTAL			n=40	

7.3 Recruitment and enrolment

Telephonic communication with the head of Nutrition Departments from academic institutions indicated that not more than two researchers were actively involved in research on indigenous vegetables and traditional food practices in South Africa. As specialists in this area of research are severely limited, it was decided to include community dietitians/nutritionists from the Department of Health in the provinces where researchers in the field of indigenous vegetables and traditional foods were minimal.

7.3.1 Informed consent process

Participants will be invited via an email communication letter sent out for participation describing the purpose of the study. Signed consent letters (scanned pdf files or faxes) will be returned to the researcher for inclusion into this study. (Appendix B)

7.3.2 Privacy and confidentiality

Any information that is obtained in this study and identified with the participant will remain confidential and will be disclosed only with the participant's permission. Completed questionnaires obtained will be recorded anonymously and kept in the strictest confidence by the principal investigator/researcher. Aggregate data will be presented using averages or generalisations about the responses as a whole. No identifiable responses will be presented in the final form of the study. All data will be stored in a secure location accessible only to the researcher. The researcher retains the right to use and publish non-identifiable data. Any reports of this study sent to a scientific journal for publication will contain information that reflects group results and not information about specific individuals.

7.4 Research procedures and data collection methods

7.4.1 Questionnaire

- Open ended questions will form part of the qualitative data that will be collected and serve as baseline information.

- Development of the questionnaire:
 - This was developed following gaps identified in the South African food composition database, when coding for indigenous vegetables and traditional recipe foods. Many assumptions needed to be made when analysing dietary intake data using the South African food composition database as information for indigenous vegetables and traditional recipe foods are limited.
 - The questionnaire will include information on the following aspects: to determine definitions for indigenous vegetables and traditional recipe foods; to identify the most frequently consumed indigenous vegetables (listed by species) to improve on the biodiversity of the food database; identify commonly consumed traditional recipe foods per province, for inclusion into this database; products of South African food composition database most commonly used for dietary analysis surveys; challenges experienced with these products of the South African food composition database; assumptions made for a pre-populated food list provided .
 - The questionnaire is targeted specifically at individuals who are active in the nutrition field, who have background knowledge of the products of the South African food composition database for coding purposes and who can identify limitations with the database for future improvements in the indigenous vegetable and traditional recipe food section.
 - The information received from the questionnaire will serve as a baseline needs assessment tool, for the generation of the additional food group “Indigenous and Traditional South African foods”.
- Piloting of the questionnaire
 - The questionnaire will be piloted within the Nutritional Intervention Research Unit of the MRC.
 - Three individuals will complete the questionnaire to determine if any challenges are experienced when completing the questionnaire. Any problems encountered

or refinements identified for the questionnaires will be addressed prior to the implementation of the survey.

- Distribution of the questionnaire
 - The questionnaire will be emailed to the participants and followed up telephonically for the successful return thereof to the study investigator.

7.4.2 Data analysis

- Commonly consumed indigenous vegetables, listed by scientific genus/species and traditional recipe foods will be listed per province, and form the basis of important food items, to be further researched, i.e. analysed in future and included into the South African food composition database. This will be presented in tabular form, linked per province, highlighting the top 5 food items.
- Categorical data will be reported as percentages.
- Spearman's correlation coefficients will be used to test for correlations between continuous variables.
- *P* values below 0.05 are considered to be statistically significant.
- Data manipulation following receipt of participants information:
 - A further analytical exercise will be performed by the study investigator, based on the responses received from participants via the questionnaire.
 - Assumptions for various food items from the participants will be incorporated into a meal analysis report. A dataset which comprises of both indigenous vegetables and traditional recipe foods will be completed by the study investigator. This will be regarded as the reference menu when compared to participant information.
 - Meal analysis reports will be completed using the FoodFinder3TM dietary analysis software program. Further statistical analysis will be done using Microsoft Excel and statistical package Stata version 12.

- A comparison of the dietary analysis of a prescribed dataset (“gold standard” menu analysis), stratified according to energy intake, macronutrients/ proximates (carbohydrate, protein, fat) and micronutrients (vitamin A, vitamin C, iron, magnesium and sodium) outputs. Data will be presented in the form of scatter plots and bar graphs for all the nutrients identified for analysis.
- The assessment of consistency or reproducibility of quantitative measurements made by different observers/participants of this study will be addressed with inter-class correlations.
- The Bland-Altman plot will compare measuring techniques to a “gold standard” and will be used to compare participant’s selection of “next best” food items for a prescribed dataset, to that of a reference menu analysis, as completed by the study investigator.

8 Project deliverables

8.1 Layout

Chapter 1 - Introduction

Chapter 2 – Background Literature Review

Chapter 3 – Research methodology

Chapter 4 – Results and Discussion

Chapter 5 – Conclusion and Recommendations

8.2 Project plan

	2012										
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Protocol submission											
Ethics submission											
Data collection											
Data analysis											
Thesis write up											
Proof reading and thesis finalisation											
Final thesis submission											

9 Limitations or constraints

Constraint - Amount of time available to do the study.

Limitation of the study could include the possible low response rate of participants. This could be counteracted via email reminders being sent to participants to encourage responses at set time intervals.

10 What happens at end of study?

Once the research is complete a brief report explaining the findings of this study will be available for those interested. Date when results are available: March 2013.

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PART B

STRUCTURED LITERATURE REVIEW

1.1 Introduction

In South Africa, the term “African leafy vegetables” was adopted to refer to the collective plant species of the *morogo* or *imifino* leafy vegetable family (Jansen van Rensburg et al., 2007). When studying populations, the food database of a country should be representative of commonly consumed food items eaten in households of the general population being studied. Factors known to affect nutrient content of foods include climate, geography, agricultural practices such as fertilization and the genetic composition of the food species.

The research question posed: “What happens when food items consumed in communities, are not available in the food composition database?” formed the underlying basis of this research and the overall aim to explore the gaps which exist within the South African food composition database, when coding commonly consumed South African indigenous vegetables and traditional recipe foods. Alternative or “next best” food item choices are made by researchers and provide a biased viewpoint for intake studies and analysis. Researcher assumptions when selecting alternative food items, when actual consumption of food items are not available in the South African food composition database, might be one of the causal factors for misinterpretation of nutritional status of communities.

1.2 Objectives

This literature review aims to:

- Define indigenous vegetables and traditional recipe foods and their importance to public health nutrition;
- Review the biodiversity and consumption patterns of indigenous vegetable species available in South Africa and how to capture this in the South African Food Data System (SAFOODS);

- Provide an overview of the available sources of nutrient information for indigenous vegetables and traditional foods consumed in South Africa specifically and to further identify the limitations and strengths of the research.

1.3 Search strategy

A search was conducted on ScienceDirect, <http://www.sciencedirect.com/> and Google, www.google.co.za search engines using the search terms: indigenous, vegetables, traditional, nutrients, food composition, recipes, biodiversity, South Africa. Additional articles were hand searched and traced from the reference lists and bibliographies of both peer reviewed and non-peer reviewed articles and from personal communication with researchers working in the indigenous vegetables area of research. Published theses on the subject matter were consulted for this review (Nesamvuni, 2000; Shava, 2000).

1.4 Quality and relevance criteria

A review of indigenous vegetables and traditional foods in literature published in South Africa and other countries was undertaken. Studies reporting on nutrient content, biodiversity and methods of analysis of indigenous vegetables were included for this review. The intention was to initially exclude work prior to the year 2000 on the basis that analytical methodologies have significantly changed since then for inclusion of nutrients into a food composition database (Greenfield & Southgate, 2003:Chapter 6). Research in this field is very limited, therefore it was decided to include work done in the area of indigenous vegetables and traditional food research, even if the data was outdated and analytical methods may have changed since these studies were undertaken.

1.5 Summary and interpretation of literature

1.5.1 Definitions and indigenous food consumption

Indigenous South African food crops are defined as having their origin in South Africa (Department of Agriculture, Forestry and Fisheries, 2000). Added to these crops are those that were introduced

into the country and are now recognised as naturalised or traditional crops. Indigenous vegetables are edible plants that are biologically indigenous to an area whilst indigenised vegetables have adapted to local conditions after their introduction, and considered local. Examples of indigenised vegetables are maize, pumpkins and sweet potatoes (Nesamvuni, 2000:14).

Quin (1964) identified local food habits in the Pedi tribe of South Africa. Twenty (20) indigenous plant species, 9 varieties of fruits, 14 insect species and 9 domestic animals were identified by the researcher, and provides with a baseline needs assessment for future chemical analyses of the identified indigenous food items. Similarly, Kirsten in 1974 identified the consumption patterns of a group of Xhosas living in the Mount Ayliff district of rural Eastern Cape (Transkei). Results from this study showed dietary intake information for males, females, children and the aged and how food intakes differed amongst these groups. The Transition, Health and Urbanisation in South Africa project (THUSA study, MacIntyre et al., 2001) was a community cross-sectional study during 1996-1998, which described intakes of the African population of the North West province and the transitions observed in the diets. Fruit and vegetable consumption was low in the THUSA study, a trend in contrast to other traditional African diets reported (Shava, 2000; Nesumvuni, 2000; Flyman & Afolayan, 2006; Janse van Rensburg et al., 2007) where a variety of indigenous and cultivated vegetables and fruit made a considerable contribution to the diet. The reasons for lowered consumption in the rural areas of the THUSA study were linked to climatic changes, poor soil, low rainfall, migration of men to urban areas making the cultivation of vegetables difficult, whilst indigenous vegetables did not grow readily in the urban areas and limited space was available to do so.

Clarifying the definitions of traditional recipe foods per province, is important as in certain provinces “offal” refers to all the intestines, head, feet and stomach of the animal (Struijvenberg et al., 2011) whilst in another province, “offal” is regarded as only the stomach (tripe) and trotters of the animal (Mbhenyane, Venter & Steyn, 2005). This has direct implications on the analysis of the

dietary intake data, as the contribution from various organ meats differs in nutrient content, with a resultant effect on the nutrient information. The Oxford dictionary definition of the term “offal” is listed as “entrails and internal organs of an animal used for food” (<http://oxforddictionaries.com/definition/english/offal>), whilst the Merriam Webster dictionary defines the term “offal” as “the by-products and organs e.g. liver or kidney of an animal that are used for food”, (<http://www.merriam-webster.com/dictionary/offal>). In SAFOODS (2010) offal is defined as the nutrient analysis of tripe, brawn, brain and tongue of the animal. It is with this basis in mind, that the correct understanding of a traditional recipe food should mean exactly the same to all people across a country. If the definition of a traditional food item differs, the nutrient content will differ and impact on the calculation of nutrient content of the recipe calculations in different population groups.

Definitions and understanding of indigenous vegetables and traditional South African recipe foods differ per province, as depicted in studies in the Northern Cape (Struijvenberg et al., 2011) where offal was defined as all the entrails, organs and trotters of an animal consumed in one meal and prepared traditionally. In the Limpopo province study on college students performed by Mbhenyane, Venter & Steyn (2005), the offal eaten was beef/ox tripe and liver, usually consumed individually. It is with these examples in mind that one has to be clear of the term used in communities and identify the traditional recipe and preparation methods before performing any nutritional analysis of foods consumed and nutrient composition tables should make provision for this.

The importance of indigenous vegetables lies in their high nutritional value and their ability to thrive under adverse conditions (Nesamvuni, 2001; Jansen van Rensburg et al., 2007). These crops grow well during drought periods and in areas with low rainfall, which is the case in many parts of South Africa. A policy brief published by Rhodes University researchers in 2009 (Skackleton et al., 2009) recommends that by promoting indigenous vegetables in urban

agriculture it will improve dietary diversity considerably and provide sustainability of the local heritage of plant species. Shackleton et al., (2009) further recommends the importance of compiling an inventory of edible plants in order to promote specific species of indigenous vegetables to be consumed for nutritional deficiencies which occur in our communities. Studies in different provinces of South Africa indicate differences in cultural practices for different traditional foods and the practice of including indigenous vegetables into dishes is common (Nesamvuni, 2000). In the Eastern Cape province, for instance, common traditional recipe foods consist of *umbona* (maize), goat meat, milk that is often drunk in its sour form and *umngqusho*, which combines yellow maize with sugar beans (Shava, 2000).

Schönfeldt & Pretorius (2011) chemically analysed five traditional dark leafy vegetables commonly consumed in South Africa, and grew these in a localised area, in similar soil and harvested and collected from Roodeplaat, Gauteng. The vegetables under observation included: misbredie (*Amaranthus tricolor*), pumpkin leaves (*Curcubita maxima*), cat's whiskers (*Cleome gynandra*), cowpea leaves (*Vigna unguiculata*) and wild Jute (*Corchorus olitorius*). The motivation for their study was that soil and climatic conditions of different regions result in a significant difference in food composition of foods being produced (Greenfield & Southgate, 2003) and therefore data cannot simply be borrowed between countries. Due to financial limitations of this study the sample size of fresh plants were small and only nutrient information for protein, fat, ash, moisture, vitamin B₂, β -carotene, iron, zinc, magnesium, calcium and phosphorous were reported on. Although limitations exist, the nutrient analyses of the traditional South African dark green leafy vegetables of this study revealed that it is a good source of protein, minerals (iron, calcium, phosphorous and magnesium) and β -carotene. Cooking affected nutrient content as anticipated and β -carotene levels were higher in the cooked than in the raw leaves. Conclusions for this study were that both raw and cooked leafy vegetables contained high levels of β -carotene (range 796 to 6 134 μg per 100 g) and that cowpea leaves was the poorest source of minerals compared to misbredie, pumpkin leaves, cat's whiskers and wild jute.

A Zimbabwean study (Makobo, Shoko & Mtaita, 2010), described the nutrient content of amaranth to provide adequate nutrients after undergoing different processing and preservation methods, showing that the nutrient levels meet the daily required intake of adults regardless of the losses caused by drying and blanching. Freshly harvested *Amaranthus cruentus* at plant age of 3 weeks and frozen state, had the highest calcium value (2 693 mg and 2 515 mg Ca per 100 g of plant, respectively). Dried and blanched levels of calcium for the same plant species were 681 mg per 100 g and 1 040 mg per 100 g, respectively. Similarly, Uusiku et al., (2010) reviewed the literature on African leafy vegetables (ALV) consumed in sub-Saharan Africa and found that many ALVs are good sources of micronutrients, especially *Manihot esculenta* and *Chenopodium album*. Species which are high in fibre include *Arachis hypogea* and *Bidens pilosa*. Final conclusions drawn from this study indicated that consumption, cultivation and promotion of these species should be promoted in groups who consume these ALVs.

African leafy vegetables form part of the daily staple diet of South Africans and are rich in nutrients, e.g. vitamin A and iron (Faber et al., 2010). Currently, the Agricultural Research Council promotes the cultivation and utilization of these vegetables by farmers, especially women and other vulnerable groups. The indigenous vegetables sub-programme of this Research Council aims to promote the development of improved cultivation methods, promotion, marketing and commercialization of African leafy vegetables and develop a database with nutrient information of the indigenous vegetables (Agricultural Research Council, n.d). Similarly, Faber et al., (2010) highlighted the dominant ALVs in rural areas of Kwa-Zulu Natal as being amaranth (*Amaranthus spp*) and blackjack (*Bidens spinosa*), whilst in rural Limpopo, spider plant (*Cleome gynandra*), amaranth (*Amaranthus spp*) and wild watermelon leaves (*Citrullus lanatus*) were most frequently consumed. This study also revealed that ALV are still commonly consumed in these areas, because they are considered a free source of nutritious food which could be easily accessed and harvested during the growing season.

Jansen van Rensburg et al., 2007, identified eight groups of vegetable species that are of particular importance in South Africa. These included: amaranth (*Amaranthus spp*), spider flower (*Cleome gynandra*), Chinese cabbage (*Brassica rapa* subsp. *chinensis*), nightshade (*Solanum retroflexum*), Jew's mallow (*Corchorus olitorius* and *C.tridens*), cowpeas (*Vigna inguiculata*) and pumpkins (*Curcubita pepo*), melons (*Citrullus lanatus*) and selected other indigenous cucurbits, such as balsam pear (*Momordica balsamina*). The crops are located across South Africa, ranging from the Bushbuckridge area in the Limpopo province, Mpumalanga, rural Eastern Cape and KwaZulu-Natal areas. Nutrient information for the 8 groups of vegetable species identified, still need to be acquired.

1.5.2 Indigenous food and HIV

The Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome (HIV/AIDS) pandemic in South Africa has impacted severely on rural life and family life. Food security to the household is challenged, as the ill person would require care and assistance. Family members of the affected individual automatically aid and assist in caring for the ill, which have implications on their food security (Kaschula, 2008).

Twine & Hunter (2007) observed in their South African study that the use of wild natural resources especially wild foods had a very important role in food security among HIV impacted households compared to non-HIV impacted households. Households used wild vegetables and wild fruit more than once a week. Findings point to the general importance of wild indigenous foods, such as wild vegetables, fruit and insects in the local diet. In times of death or stress, regardless of the cause of death, communities resorted to increasing the consumption of wild vegetables. The authors found that the use of natural resources is seen as an all important component of dietary coping strategies for the family when death occurs. There is a strong association between mortality experience and use of natural resources, specifically to save money.

Similarly, Kaschula (2008), reports that wild foods offer unique benefits to households afflicted by AIDS in that it provides a nutritious and freely available food source at minimal labour and financial implication, i.e. households using wild foods are more economically resilient. However, this study found that households affected by HIV might reduce their use of wild foods due to stigma and household labour shortages.

1.5.3 Indigenous food and Food security

Food security exists: “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”, as defined by the World Food Summit of 1996 in Rome. Food security is built on three pillars, viz. (1) food availability: having sufficient quantities of food available on a consistent basis, (2) food access: having sufficient resources to obtain appropriate foods for a nutritious diet and (3) food use: based on knowledge of basic nutrition and care, including adequate water and sanitation.

The South African government in their attempt to adapt this definition from the World Summit of 1996, projected the vision for South Africa to ensure food security as follows: “to attain universal physical, social, economic access to sufficient, safe and nutritious food by all South Africans at all times to meet their dietary and food preferences for an active and healthy lifestyle”. The South African government is attempting to ensure that the Millenium Development Goal (MDG) aiming to eradicate hunger, malnutrition and food insecurity is achieved by 2015 (FAO, 2006).

A South African study performed by Aphane, Chadha & Oluoch (2003), showed the major health problem in developing countries is micronutrient deficiencies, which has far reaching consequences on development, growth and health among children. Dietary intakes of socially and economically deprived communities in developing countries usually consist of plant based staple foods which are monotonous with minimal variation. Vitamin A shortages usually exist in these communities as fruits, vegetables and animal products are seldomly consumed. According to the National Food Consumption Survey of 1999, one in four children under the age of six years are stunted due to chronic malnutrition (Labadarios et al., 2000). Vitamin A and iron deficiencies lead

to an imbalance in children's growth and development. Commonly consumed food items at the national level included maize, white sugar, tea, whole milk and brown bread, whilst green leaf consumption ranked 16th on the list (Labadarios et al., 2000). By identifying these food items, food fortification projects could be addressed using these foods as vehicles, as it reflects the most commonly consumed food items across South Africa.

Indigenous leafy vegetables are an important part of farming and consumption systems throughout Africa. They are also important sources of micronutrients like vitamin A and C, iron and others (Faber et al., 2010). Indigenous vegetables are of extreme importance to food security, especially during times of famine and natural disasters (Habwe, Walingo & Onyango, 2008).

A study by Aletor, Oshodi & Ipinmoroti in 2002, performed in Nigeria, showed that chemical analysis of four commonly consumed leafy vegetables, i.e. bitter leaf (*Vernonia amygdalina*), green tete (*Solanum Africana*, *Amaranthus hybridus*) and fluted pumpkins (*Telfaria occidentalis*) revealed that protein values of the leaf protein extracts were relatively high, subject to high level intake and amino acid supplementation, a large proportion of animal protein requirement could be met by consumption of these vegetable protein species.

In 2006, Flyman & Afolayan described the importance of the consumption of wild vegetables to address dietary deficiencies and also showed how processing of wild vegetables affected their micronutrient content. Certain processing and storage techniques are demonstrated in this study, to conserve the micronutrient content of wild vegetables, as these vegetables are seasonally available and highly perishable. The nutrient content of wild vegetables may be preserved by blanching before consumption. Blanching is a process of heating vegetables to a temperature high enough to destroy enzymes present in leaf tissues, to prevent enzymatic induced colour changes and shorten their drying and dehydration times. This process, carried out in hot water reduces the bitterness and acid components common in leafy vegetables as a first step in preserving the crop, before drying and storage results. This study indicated the potential of traditionally cooked green

leafy vegetables to supply bioavailable iron, β carotene, riboflavin, thiamine, folic acid, vitamin C, zinc and copper. This study showed a strong need for further analytical studies to find out more about the nutrient content of wild vegetables. These researchers recommended a database of traditional knowledge and information on the distribution and use of wild vegetables in rural communities.

Mbhenyane et al., (2005) completed a study on the nutrient intake and consumption of indigenous foods among college students in Limpopo province and found that 22% of students consumed indigenous fruits and 89% consumed indigenous vegetables, specifically pumpkin leaves and tendrils and dried cowpea leaves. Vegetables, including indigenous vegetables, were consumed on a daily basis yet these were grouped together with spinach intake for analysis purposes. A total of 28 indigenous foods of 60 commonly consumed foods in total were included in the diet of college students. The study also recommended that chemical analysis of indigenous vegetables is to be undertaken to report more accurately on intake amongst this group and also further enhance the importance of inclusion of pumpkin tendrils and leaves and dried cowpea leaves in the habitual diets of college students.

1.5.4 Biodiversity and indigenous vegetables

What is biodiversity? This is defined as the diversity among and within plant and animal species in an environment (“Biodiversity and nutrition a common path”, n.d.). Biodiversity is found at three levels and covers the diversity within species, between species and of ecosystems, as defined by the Food and Agriculture Organization of the United Nations (“Biodiversity and nutrition a common path”, n.d.). A “species” is further defined as a group of organisms with similar features; and is one of the basic units of biological classification and a taxonomic rank (<http://www.fao.org/biodiversity/components/plants/en/>); A “cultivar”, is defined as the basic independent category used for organisms in agriculture, forestry, and horticulture and defined and regulated in the *International Code of Nomenclature for Cultivated Plants*; A “variety”, is classed a rank below species (<http://www.iapt-taxon.org/nomen/main.php?page=art6>).

Indigenous vegetable varieties will have different nutrient contents linked to the species. Biodiversity plays a key role in ensuring dietary diversity because nutrient composition between foods and among varieties/cultivars/breeds of the same food can differ dramatically. It is important that the food databases include data on these variations in order to provide with a more comprehensive nutrient database. For example, as described in “Biodiversity and nutrition a common path”, n.d. publication of the FAO, the protein content of rice varieties can range from 5 percent to 14 percent by weight; similarly, the carotenoid content of sweet potato cultivars differs by a factor of 200 or more. This implies that the intake and consumption of one variety rather than another can make the difference between micronutrient deficiency and micronutrient adequacy in populations. When nutrient intake studies are performed, identifying the correct variety/species of the food item consumed will be of utmost importance as a thin line between deficiency and adequacy exists. Countries who house nutrient information of food items in a database, should consider incorporating biodiversity information as well, to provide with a more accurate analysis of actual food consumption of a country per se.

Botanists across the world agree in unison that any study of plants should use botanical names, consisting of a Latin genus and species which conforms to the International Code of Botanical nomenclature. This is regarded as a unique identifier similar to being the “plant’s passport” to which information could be attached, data shared across scientific disciplines and electronic retrieval systems (Nesbitt et al., 2010:487). Wild and locally cultivated wild food species provides with challenges to botanists for accurate naming and identification.

1.6 Identification of gaps for further research

Table 1, summarises the literature which provided nutrient information for this review and indicates the areas and countries where research was executed. Very few studies have explored the indigenous vegetables and traditional foods in South Africa. Indigenous foods are still being consumed in our communities across South Africa today (Mbhenyane, Venter & Vorster, 2005; Jansen van Rensburg et al., 2007; Faber et al., 2010). The absence of accurate researcher

identification of vegetable species consumed, when dietary intake studies are performed, will lead to massive over or under reporting of nutrients, when food consumption studies are reported on (Labadarios, 2005).

The South African food composition database provides limited nutrient information for indigenous vegetables and traditional recipe foods of South African origin (SAFOODS, 2010). Presently, information for 21 indigenous vegetables are listed for 12 species of indigenous vegetables of varying cultivars, e.g. *Amaranthus hybridus*; *Colocasia esculenta*; *Solanum nigrum*; *Cleome gynandra*, etc., to name a few, are available in SAFOODS. These leafy cultivars are collectively grouped as African leafy vegetables and recorded as spinach in many dietary intake studies, affecting the resultant nutrient composition of the actual intake of food item in communities (Mbhenyane, Venter & Vorster, 2005). Presently biodiversity information is not captured in SAFOODS and this is regarded as a gap which has to be addressed when food composition data is updated.

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Table 1: Summary of literature identifying indigenous and traditional food items and which studies chemically analysed nutrients

Author	Year	Areas studied (Population group identified)	Title of article	Type of data reported
<i>Studies reporting on consumption</i>				
Quin, P.J	1964	Transvaal (Pedi people)	Foods and feeding habits of the Pedi	Classification of foods linked to food group; names of traditional and indigenous vegetables listed
Mbhenyane, X.G. et al.	2005	Limpopo	Nutrient intake and consumption of indigenous foods among college students in Limpopo Province.	28 indigenous foods consumed amongst college students.
Jansen van Rensburg, W.S. et al.	2007	KwaZulu-Natal, Mpumalanga, Limpopo (Xhosas, Zulus, Shangaan groups)	African leafy vegetables in South Africa.	Seven groups of leafy vegetables discussed and described and preservation methods listed.
Kirsten, C.M	1974	Mount Ayliff district, Transkei (Xhosa people)	Age and sex dependence of food intake in the Mount Ayliff District	Habitual food intake patterns of the people in this district; wild foods identified and gender differences in consumption patterns noted.
Twine, W. & Hunter, L.	2007	Agincourt field site	AIDS mortality and the role of natural resources in household food security in a rural district of South Africa	AIDS exposed households utilising wild resources when food insecure.
Kaschula, S.A.	2008	KwaZulu-Natal	Wild foods and household food security responses to AIDS: evidence from South Africa.	Coping strategy used by HIV infected households included consumption of wild foods/natural resources
<i>Studies reporting on nutrient content</i>				
Nesumvumi, C.N.	2000	Venda (Vhavenda people)	The use and nutritional value of common edible indigenous green leafy vegetables in the diet of the Vhavenda. (Master thesis).	Nutrient content of foods consumed listed.
Shava, S.	2000	Eastern Cape (Xhosas)	The use of traditional plants as foods by rural community in the Eastern Cape: an educational exploration.	Nutrient content of commonly consumed plants.
Nesumvumi, C.N. et al.	2001	Thohoyandou districts (Vhavenda group)	Nutritional value of wild, leafy plants consumed by the Vhavenda.	Vitamin C, folate info of ten plants studied: delele mandane, thebe, vowa, mushidzi, murudi, mutohotoho, delele lupfumo, phuri, nngu, muxe.
Aletor, O., Oshodi, A.A., Ipinmoroti, K.	2002	Nigeria	Chemical composition of common leaf vegetables and functional properties of their leaf protein concentrates.	Protein content of few cultivars reported.
Aphane, J. et al.	2003	South Africa	Increasing the consumption of micronutrient-rich foods through production and promotion of indigenous foods.	Indigenous foods promoted for improved micronutrient status
Flyman, M.V. & Afolayan, A.J.	2006	Review of literature	The suitability of wild vegetables for alleviating human dietary deficiencies.	Effect of drying and storage decreased vitamin C, riboflavin, thiamine content; no significance reported for calcium and zinc?
Habwe, F.O. et al.	2008	Kenya (Kenyans)	Food processing and preparation technologies for sustainable utilisation of African indigenous vegetables for nutrition security and wealth creation in Kenya.	Nutrient content calcium, phosphorous, iron, magnesium, sodium, potassium, vitamin C listed for ALV consumed. Processing to extend shelf life; marketing to farmers

Author	Year	Areas studied (Population group identified)	Title of article	Type of data reported
Faber, M. et al.	2010	KwaZulu-Natal, Limpopo (Zulus, Pedi, Shangaan people)	African leafy vegetables consumed by households in the Limpopo and KwaZulu-Natal provinces in South Africa.	Vitamin A nutrient content analysed. 6 plants in KwaZulu-Natal and 10 plants in Limpopo identified as frequently consumed.
Makobo, N.D. et al.	2010	Zimbabwe	Nutrient content of amaranth (<i>Amaranthus cruentus</i> L.) under different processing and preservation methods.	How nutrient content changes when applying preservation methods to plants. Info for calcium, phosphorous, potassium, sodium, copper.
Uusiku, N.P. et al.	2010	Review of literature. Kenya, Uganda, South Africa, Malaysia	Nutritional value of leafy vegetables for sub-Saharan Africa and their potential contribution to human health: A review.	<i>Manihot esulenta</i> and <i>Chenopodium album</i> were good sources of micronutrients. High fibre content for species <i>Arachis hypogea</i> and <i>Bidens pilosa</i>
Schönfeldt, H.C & Pretorius, B.	2011	5 common leafy vegetables grown in same soil at one area, Roodeplaat, Gauteng	The nutrient content of five traditional South African dark green leafy vegetables – A preliminary study	<i>Amaranthus tricolor</i> , <i>Cleome gynandra</i> , <i>Corchorus olitorius</i> , <i>Curcubita maxima</i> , <i>Vigna unguiculata</i> species were analysed for protein, fat, ash, moisture, vitamin B2, β -carotene, iron, zinc, magnesium, calcium and phosphorous

1.7 Conclusion

Many studies reviewed have shown the importance of indigenous vegetables and traditional recipe foods amongst certain population groups. Despite some cultures showing a declining intake in traditional recipe foods, largely due to unavailability of products, others are still continuing to practise within South Africa (Jansen van Rensburg et al., 2007:318). A food composition database needs to be comprehensive and provide with commonly consumed foods of individuals, to produce accurate nutrient intake studies of populations studied.

Information on food composition is of importance for scientists, nutritionists and dietitians in the fields of nutrition and public health. It provides the basis for dietary assessment and the formation of healthier diets.

There is a growing need to access nutrient data on indigenous vegetables and traditional foods which have been chemically analysed. This will lead to improved analysis of actual nutrient intake of communities for future food consumption research studies.

Some organisations or research institutes may have the nutrient analyses of indigenous vegetables and traditional recipe foods available. This information needs to be accessed and jointly stored in a central database for optimal use by all researchers engaged in dietary intake studies.

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1 **Dietary analysis of South African indigenous vegetables– Assumptions of**
2 **nutritionists and the impact on nutrients**

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11 **Abstract**

12 The South African Food Data System (SAFOODS) is one of the food composition
13 databases used among nutrition researchers and academia nationally for food
14 consumption studies of South Africans. SAFOODS comprises of 37% truly analysed
15 South African nutrient values, with limited information for indigenous vegetables.
16 Researchers need to make assumptions when coding dietary records comprising of
17 these foods consumed. The aim of this cross-sectional descriptive study was to
18 collect and evaluate assumptions made by researchers when analysing food intake
19 data inclusive of indigenous vegetables and traditional foods, and how these
20 assumptions over or under report on actual dietary intake. Forty seven participants,
21 actively engaged in dietary intake studies across the 9 provinces of South Africa,
22 were included for this study. Assumptions recorded by the study investigator were
23 further entered into a sample menu dataset. Participants' nutrient information were
24 compared to a reference menu analysis and compared for energy, carbohydrate, fat,
25 protein, vitamin A and C, iron, magnesium and sodium. Over reporting for energy,
26 protein, carbohydrate, fat and iron was recorded whilst under reporting of
27 magnesium, vitamin A and C was found. Analysed data for indigenous vegetables
28 and traditional foods added to SAFOODS will improve food consumption results in
29 South Africa.

30 ***Keywords:*** *indigenous, vegetables, traditional, nutrients, food composition, recipes*

31

32 **1. Introduction**

33 A country-specific food composition database mainly contains nutrient information for
34 food items locally eaten and analysed. Indigenous vegetables are defined as having
35 their origin in South Africa whilst traditional recipe foods are defined as being
36 genuinely native to a particular region or that has been present in that region long
37 enough to have evolved through generations (Department of Agriculture, Forestry
38 and Fisheries, 2000). Many missing nutrient values have been identified in the
39 South African food composition database, when coding for indigenous vegetables
40 and traditional recipe foods. The South African Food Data System (SAFOODS)
41 comprises of 1472 food items grouped into 16 food groups with approximately 37%
42 of food items having a main reference source of South African origin (SAFOODS,
43 2010). Approximately 27% of the nutrient information is borrowed from the United
44 States Department of Agriculture (USDA), whilst 7% is from the United Kingdom food
45 composition database and a further 29% of information in the form of recipes. Due
46 to the escalating cost factor of nutrient analyses, food database compilers seek
47 alternative methods of accessing nutrient data to improve the comprehensiveness of
48 a country's food nutrient database. This includes information obtained from
49 published literature, recipe calculations and borrowed data from other countries. As
50 the research field of indigenous vegetables and traditional foods are limited in South
51 Africa (Faber et al., 2010; Shava, 2000; Nesamvuni, 2000), it is of major importance
52 to include locally analysed food items into SAFOODS to provide the nutrition
53 researcher with a more accurate nutrient profile of indigenous food items consumed
54 within the study area.

55 Specific objectives of this study were: (1) to identify the five frequently consumed
56 indigenous vegetables and traditional foods; (2) determine participant assumptions

57 and alternative food item choices for when nutrient information is not available in
58 SAFOODS; (3) perform dietary analysis with participant assumption food choices
59 and compare this to a reference menu analysis and compare the resultant analysis
60 for energy, macronutrients (carbohydrate, protein, fat) and micronutrients (vitamins A
61 and C, iron, magnesium and sodium).

62

63 **2. Materials and Methods**

64 **2.1 Study design**

65 This was a cross-sectional study among nutrition researchers based at academic
66 institutions and community dietitians in South Africa.

67

68 **2.2 Characteristics of study population**

69 **2.2.1 Selection and inclusion criteria**

70 To address the study objectives it was decided to target academic organisations and
71 to include dietitians/nutritionists from 9 provinces in South Africa. Where no nutrition
72 based academic institution existed in a province, community dietitians/nutritionists
73 from the Department of Health were targeted by contacting the Provincial
74 Department of Health Nutrition Directorate, to identify participants to complete the
75 questionnaire, as they could address dietary intake patterns of communities
76 (specifically for provinces such as Eastern Cape, Mpumalanga and Northern Cape).

77 The inclusion criteria for this study were that only nutrition researchers who use
78 products of the South African food composition database for analysing food intake
79 data and for coding of dietary intake data would be selected for this study.

80 Telephonic communication with the head of Nutrition Departments from academic
81 institutions indicated that not more than two researchers were actively involved in
82 research on indigenous vegetables and traditional foods. The number of
83 dietitians/nutritionists across South Africa currently actively engaged in dietary
84 analysis studies, inclusive of indigenous vegetables and traditional food research, is
85 limited. A total of 40 participants were targeted via email outreach. Additional
86 information was received from nutrition colleagues who met the inclusion criteria,
87 and who came to hear about the study by the selected participants.

88

89 **2.2.2 Study area**

90 Participants identified were from the Nutrition Departments of the 9 Universities and
91 2 Universities of Technology, totalling 11 academic institutions. Community
92 dietitians and nutritionists from the Provincial Department of Health for 9 provinces
93 were selected in areas where no academic institution is available.

94

95 **2.2.3 Exclusion criteria**

96 Participants who were not current users of food composition database products and
97 who had no experience in food data coding for dietary intake studies were
98 automatically excluded from the study.

99

100 **2.3 Ethical considerations**

101 **2.3.1 Approval**

102 The Human Research Ethics Committee of the University of Cape Town (HREC
103 REF 193/2012) and the Medical Research Council's Ethics Committee (EC 012
104 5/2012) approved this study.

105

106 **2.3.2 Informed consent process**

107 Participants were invited via electronic communication letter describing the purpose
108 of the study. A link to the online questionnaire was sent to those participants who
109 had internet access. For participants who were not able to complete the online
110 questionnaire, it was sent via email and fax. Participation was voluntary, and no
111 penalties were incurred should participants withdraw from this study.

112

113 **2.3.3 Privacy and confidentiality**

114 Information obtained in this study and identified with the participant will remain
115 confidential and will be disclosed only with the participant's permission. Completed
116 hard copy questionnaires obtained were recorded anonymously and kept in the
117 strictest confidence by the principal investigator. Questionnaires completed via the
118 online questionnaire link, was kept in a confidential database only viewed by the
119 principal investigator/researcher. Aggregated data was presented using averages or
120 generalisations about the responses as a whole with no information about specific
121 individuals.

122

123 **2.4 Research procedures and data collection methods**

124 **2.4.1 Development of the questionnaire**

125 Open ended questions formed part of the qualitative data that was collected and
126 served as a baseline assessment of information, whilst the rest of the questionnaire
127 provided quantitative data to report on. Gaps were identified by incorporating the
128 'frequently asked questions' clients have posed via email or telephonic contact
129 regarding the food composition database and indigenous vegetables and traditional
130 foods. Many clients have highlighted the lack of food items within the food
131 composition tables and software program, especially for traditional foods and
132 indigenous vegetables as a major challenge. The questionnaire was developed to
133 collect information on the following: definition used for indigenous vegetables and
134 traditional recipe foods; frequently consumed indigenous vegetables (listed by
135 species) to improve on the biodiversity of the food database; commonly consumed
136 traditional recipe foods per province; products of South African food composition
137 database most commonly used for dietary analysis surveys; challenges experienced
138 with these products of the South African food composition database and
139 assumptions made regarding specific recipe foods.

140

141 **2.4.2 Piloting of the questionnaire**

142 The online link to the questionnaire was piloted amongst five (5) individuals within
143 the Nutritional Intervention Research Unit (NIRU) of the MRC on 7 June 2012.
144 Three (3) individuals with prior knowledge of the South African food composition
145 database and dietary consumption studies, as well as two (2) individuals with no
146 prior knowledge of the food composition database, completed the online
147 questionnaires to determine if any challenges were experienced. Problems
148 encountered and refinements required were identified and addressed prior to the
149 implementation of the survey.

150 **2.4.3 Questionnaire**

151 An email link sent to 40 participants provided access to the online questionnaire for
152 completion. Following completion of the 30 minute online questionnaire, it was
153 automatically stored in an Excel spread sheet. Electronic and hard copies of
154 completed questionnaires received from participants via email or fax (those who had
155 no internet access, $n=28$) were saved in the same Excel spread sheet. The
156 questionnaire consisted of 14 questions ranging from information about the
157 participant (demographic information, contact details, personal information); areas
158 where nutrition research is conducted; commonly consumed indigenous vegetables
159 and traditional foods of studied populations; definitions/understanding of indigenous
160 vegetables and traditional foods; familiarity of South African food composition
161 database and alternative food choices where no information is available within the
162 South African food composition database.

163

164 **2.4.4 Development of the reference menu**

165 A three day menu was developed by the principal investigator inclusive of indigenous
166 vegetables ($n=3$) and traditional recipes ($n=11$). A total of 14 food items were
167 identified for replacement with information from participant's assumption food
168 choices listed in the questionnaire. Information for breakfast, lunch and supper for 3
169 days were analysed using the FoodFinder3TM software program. Fourteen of the
170 assumption food items in this reference menu drafted, were food items not currently
171 available within SAFOODS. Nutrient information needed to be included into the
172 software database (FoodFinder3TM) for analysis (e.g. Fry's brand vegetarian
173 sausage, DIVA brand Philani porridge) and other items comprised of recipe

174 calculation procedures which the participant needed to set up in the FoodFinder3™
175 recipe analysis report (e.g. baked bread with unfortified flour, black jack leaves
176 cooked). Table 1 lists the reference menu for 3 days and Appendix A provides
177 information on the nutrient analysis for energy, carbohydrate, fat, protein, vitamin A
178 and C, iron, magnesium and sodium of the reference menu.

179

180 **2.5 Data management and analysis**

181 **2.5.1 Statistical analysis**

182 Data were analysed in consultation with an MRC Biostatistician. p - values below
183 0.05 were considered to be statistically significant. Information for commonly
184 consumed indigenous vegetables and traditional recipe foods were tabulated, and
185 form the basis of important food items, to be further researched. Categorical data for
186 (1) participants involved in large South African dietary intake studies; (2) definitions
187 for indigenous vegetables and traditional foods and (3) participant profile information
188 were reported as percentages. Mean, median and standard deviations for nutrients
189 identified were reported in tabular format showing variations in data. Spearman's
190 correlation coefficients were used to test for correlations between continuous
191 variables for all the nutrients (energy, carbohydrate, protein, fat, vitamin A and C,
192 iron, magnesium and sodium).

193

194 **2.5.2 Sample menu analysis**

195 The reference menu was analysed for mean nutrient values for energy, protein, fat,
196 carbohydrate, vitamin A and C, iron, magnesium and sodium, using the

197 FoodFinder3™ software. Assumptions listed for the 14 food items from the
 198 questionnaire of the participants', were replaced in the reference menu.

199 **Table 1:** Reference menu for 3 days

Mealtime	DAY 1			DAY 2			DAY 3		
Breakfast	Amt	Details	Recipe	Breakfast	Details	Recipe	Breakfast	Details	Recipe
	150g	Philani porridge	150g Philani 100g water	155g	Baked bread	155g bread flour, unfortified 1g yeast 16g sugar	95g	Vegetarian sausage	
	15g	White sugar					40g	Pumpkin leaves, cooked	
	60g	Brown bread				163g water	40g	Black jack leaves, cooked	140g black jack leaves 100g water
	5g	Hard margarine				8.5g oil	100g	Soft maize meal, unfortified	
				25g	Hard margarine			130g maize meal, unfortified	
								500g water	
								2g salt	
Lunch				Lunch			Lunch		
	308g	Phutu	130g maize meal, fortified 375g water 2g salt	180g	Soft maize meal porridge	130g maize meal fortified 500g water 2g salt	150g	Chicken heads, boiled	
							150g	Chicken feet boiled	
	133g	Beans	133g beans 510g water	96g	Imifino, boiled		100g	Stiff pap	130g maize meal, fortified 375g water 2g salt
				96g	Cabbage, boiled				
							68g	Pumpkin, boiled	
Supper				Supper			Supper		
	125g	Horsemeat		250g	Pork trotters, boiled		445g	Maize meal and beans	187g maize meal, unforti 454g water 62.4g beans
	180g	Soft maize meal porridge	130g maize meal, fortified 500g water 2g salt	100g	Tripe, boiled				
				55g	Pumpkin leaves				
	96g	Wild spinach, boiled		150g	Crumbly maize meal porridge	130g maize meal, fortified 250g water 2g salt	100g	Beef lung fried	80g beef lung 20g cooking fat

200 The participant assumption information was then entered into the 3 day meal
201 analysis report using the FoodFinder3TM software. Further statistical analysis was
202 done using Microsoft Excel and statistical package STATA¹² Data Analysis and
203 Statistical package. Reports for means, median, standard deviations, minimum and
204 maximum values were tabulated for each nutrient identified. Comparison of the
205 reference menu and the participants menu for energy, proximate values
206 (carbohydrate, protein, fat) and micronutrients (vitamin A, vitamin C, iron,
207 magnesium and sodium) was analysed. Data will be presented in the form of a table
208 and scatter plots for all the nutrients identified for analysis. The variation between
209 participants menu was measured using interclass correlations, when compared to
210 the reference menu.

211

212 **3. Results**

213 **3.1 Participants**

214 Information was received from 47 participants nationally. Of the initial targeted
215 participants (n=40), 3 participants did not respond, initial response rate = 92.5%. A
216 further 10 questionnaires were included into the study. Additional responses were
217 received from 7 of the 9 provinces, excluding the Free State and Limpopo province
218 (Table 2). Reasons for the additional responses were linked to researchers
219 spreading news about this study by “word of mouth”, to colleagues found within the
220 same institutions, and who met the entry criteria. It was decided to include these
221 responses, as they provided valuable information linked to this study.

222

223 **3.2 Participant profile**

224 Of the 47 respondents who completed the online questionnaire, 23% of participants
 225 originated from the Western Cape, followed by Limpopo (13%), Gauteng, KwaZulu
 226 Natal and North West provinces (11% each). Information for one response from
 227 Lesotho was captured, despite it not being part of the initial targeted plan. The entry

228 **Table 2:** Characteristics of study population and sample size

Province		Institution – Details	Nr	Total participants targeted	Additional responses received	Total participants responded
1	Western Cape	University of Cape Town	2	8	3	11
		University of the Western Cape	2			
		University of Stellenbosch	2			
		Cape Peninsula University of Technology	2			
2	Northern Cape	Dietitians (Provincial office, hospital)	2	2	1	3
3	Eastern Cape	Dietitians (Community)	2	2	2	4
4	Gauteng	University of Pretoria	2	4	1	5
		Dietitians (Pretoria region)	2			
5	Kwa-Zulu Natal	University of Kwa-Zulu Natal	2	4	1	5
		Durban University of Technology	2			
6	Free State	University of the Free State	2	4	0	4
		Dietitians (Community)	2			
7	Limpopo	University of Limpopo – Turfloop campus	2	6	0	6
		University of Limpopo – Medunsa campus	2			
		University of Venda	2			
8	North West	North West University	2	4	1	5
		Dietitians (Community)	2			
9	Mpumalanga	Dietitians (Community)	2	2	1	3
	Other	Agricultural Research Council	2	2	-3	1
		Human Sciences Research Council	2	2		
TOTAL				n=40	n =7	n=47

229 criteria for this study was that participants had to be actively involved in research and
 230 areas most worked in by participants was the Western Cape (21%), Limpopo (15%),
 231 Northern Cape (13%), Eastern Cape and Kwa-Zulu Natal, (11% respectively). A

232 total of 15%of participants (n=7) reported being involved in a large South African
233 dietary intake study (Food consumption study, 1999) whilst 85% of participants had
234 no prior experience in large scale dietary intake studies in South Africa.

235

236 **3.3 Commonly consumed indigenous vegetables and traditional foods**

237 Information for commonly consumed indigenous vegetables and traditional foods
238 was captured in Table 3. Of the commonly consumed foods eaten, the boxes
239 highlighted in Table 3 shows that nutrient information is currently available in
240 SAFOODS, the rest being traditional recipes not found within the food database.
241 Information for provinces where the traditional foods commonly consumed identified
242 are included in the table. More information for traditional recipe foods were received
243 than expected, and no new additional varietal strains of indigenous vegetables were
244 identified.

245

246 **3.4 Definitions of indigenous vegetables and traditional foods**

247 Participants (64%, n=30) correctly defined indigenous vegetables as being
248 “vegetables which grow naturally or are cultivated in specific areas and which are
249 consumed by specific populations”, whilst 81% (n=38) of respondents correctly
250 defined traditional foods as being “food which is prepared according to a particular
251 culture or way of life as a preparation passed on from generation to generation”.

252

253 **3.5 Familiarity with South African Food Data products**

254 When analysing dietary intake data, participants used all of the SAFOODS products
 255 (Food Quantities Manual, 1991 Food composition table, 1998 Fruits & Vegetable
 256 supplement, 1999 Meat, Milk & Eggs supplement, 2010 Condensed food
 257 composition table and FoodFinder software program). Figure 1 depicts the usage of
 258 SAFOODS products.

259

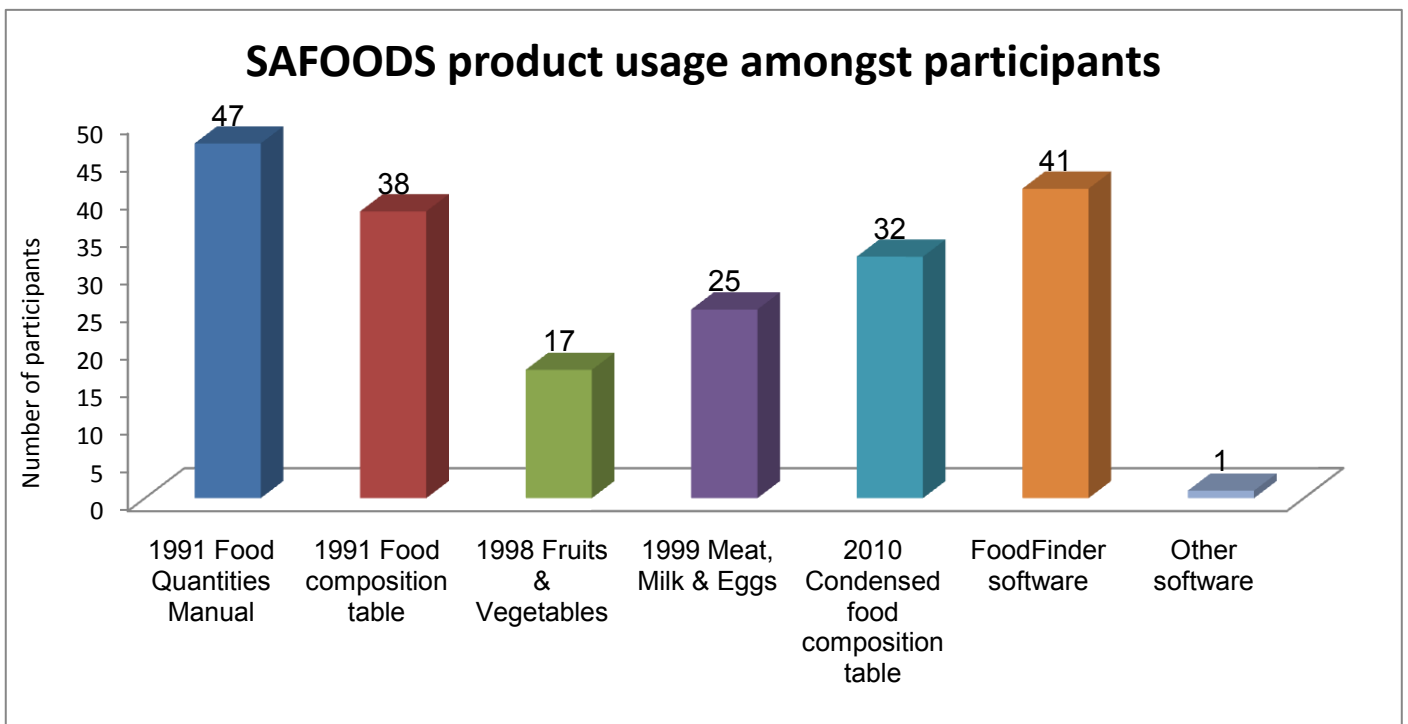
260 **Table 3:** Commonly consumed indigenous vegetables and traditional foods eaten in
 261 9 provinces of South Africa

Commonly consumed food items recorded by participants working in South Africa				
Samp and beans* (n= 43, 92%) All	Green leaves and stiff porridge (Isigwamba) (n=12, 26%) KZN, Limpopo, Mpumalanga	Pumpkin and stiff maize meal porridge (Isingingi) (n=33, 70%) All provinces	Vegetables and meat (Sishebo) (n=16, 24%) Gauteng, Limpopo, KZN, Northern Cape	Breyani * (n=7, 15%) KZN, Western Cape
Marogo (n=47, 100%) All provinces	Amaranthus (Dele) (n=41, 87%) Mpumalanga, Limpopo, NorthWest, KZN	Pumpkin leaves (Thanga) (n=4, 9%) KZN, Limpopo	Tomato and onion (Sheba) (n=12, 26%) Mpumalanga, Limpopo, NorthWest, KZN, Western cape	Marogo with potato and onion (n=37, 78%) Lesotho, Gauteng, Limpopo
Afval (lung, liver, heart) (n=11, 23%) North West, Limpopo, KZN	Cabbage (n=47, 100%) All provinces	Steamed bread (Ujege) (n=9, 19%) KZN	Vetkoek (Magwinya) * (n=12, 26%) Gauteng, Limpopo, Free State	Curry and rice* (n=3, 6%) KZN, Western Cape
Imifino and phutu (n=31, 66%) KZN, Limpopo, Western Cape,	Bitter gourd (n=8, 17%) Lesotho, Limpopo	Lufers (n=3, 6%) Limpopo, KZN	Amadumbe bulbs, leaves and stems (n=1, 2%) Limpopo	Fenugreek herbs (n= 1, 2%) Limpopo
Amadumbe (n=4, 9%) KZN, Limpopo	Imifino* (n=32, 68%) All provinces	Spinach* (n=40, 85%) All provinces	Pumpkin* (n=34, 72%) All provinces	Wild spinach (n=21, 44%) All provinces
White watermelon with maize meal porridge (n=3, 6%) Northern Cape, WesternCape	Spinach and maize meal porridge (n=33, 70%) All provinces	Spinach and potatoes (n=46, 97%) KZN, Mpumalanga	Walkers and talkers(chicken feet and heads)* (n=20, 42%) Gauteng, Free State, KZN	Sweet potato leaves (n= 13, 28%) KZN, Limpopo
Izindlubu (zulu/swazi), kind of nut/bean (n=1, 2%) (KwaZulu-Natal)	Mopani worms (Masonga)* (n=2, 4%) Limpopo; Gauteng	Chicken stomach (Mala) (n=1, 2%) Gauteng	Snoek heads (n=1, 2%) Western Cape	Sheep intestines (n=1, 2%) Northern Cape

262 * Where highlighted boxes indicate nutrient information available within the South African Food Data System (SAFOODS)

263 Only one participant reported utilising another dietary analysis software program,
264 Diet Manager for dietary analysis of intake data in addition to using the
265 FoodFinder3™ software program.

266 Of the 41 respondents who reported using the dietary analysis software,
267 FoodFinder3™ (2000), 17 participants (41%) indicated experiencing challenges
268 when using the software.



269 **Figure 1:** South African Food Data System (SAFOODS) product usage amongst
270 participants

271 Of the challenges listed, 88% reported that specific food items were not available in
272 the database; 6% had difficulties in selecting next best or similar food items and 6%
273 experienced technical problems such as program not being stable/cannot log in
274 efficiently. A total of 59% of the 41 respondents using the software reported no
275 challenges experienced with the software program, FoodFinder3™.

276

277 **3.6 Alternative food choices selected**

278 The basis of this study was to identify assumptions made by participants, when
279 faced with food items which are not currently available within SAFOODS. It was very
280 interesting to note the alternative food choices which participants make, as each
281 participant will base the decision on his/her own personal preferences or bias.
282 Appendix B depicts a list of alternative choices made and assumptions participants
283 listed for food items currently not available within the database. It is these food
284 alternatives that were used for further statistical manipulation when entered into the
285 participant menu and analysed using the FoodFinder3™ dietary analysis software
286 program.

287

288 **3.7 Reference menu analysis**

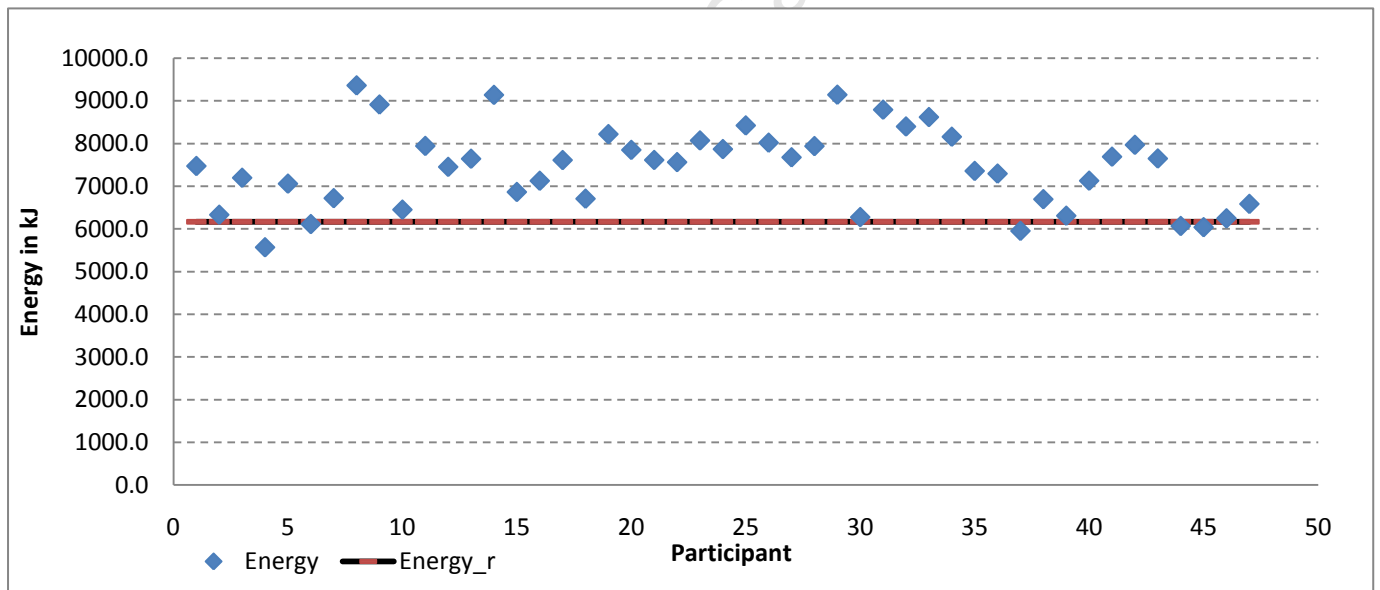
289 Reference menu analysis for nutrient information for the mean of 3 days was
290 recorded for energy (kJ), total carbohydrate (g), protein (g), fat (g) and vitamins A
291 (mcg) and C (mg), iron (mg), magnesium (mg) and sodium (mg). Table 4 lists the
292 reference mean values for the nutrients and provides information for 47 “participant
293 values” in the form of means, median, minimum and maximum values. p-values
294 reported was significant for all nutrients.

295 Participant analyses and reference menu analysis were compared, and depicted in
296 the Figures below for nutrients energy, protein, carbohydrate, fat, vitamins A and C,
297 iron, magnesium and sodium. Where “*nutrient_r*” refers to the reference mean value
298 of the menu analysed by the principal investigator (depicted by solid line) and the
299 “*nutrient*” shows the participant values, per nutrient.

300 **Table 4:** Descriptive statistics of Reference mean values of menu analysed and
 301 participant values

	Energy, kJ	Protein, g	Fat, g	CHO, g	Vitamin A, mcg	Vitamin C, mg	Fe, mg	Mg, mg	Na, mg
Reference Mean	6166	83.1	50.8	159.4	1364	58.7	16.2	392	918.7
Mean	7434	94.5	54.1	202.9	1029.7	41.3	18.4	352.5	831.2
SD	941	10.6	4.8	39.7	424.2	11.2	3.3	105.6	302
Median	7566	93.3	53.6	204.4	998	41.3	18.1	348.7	723.3
Minimum	5570	77.6	48	125.4	599.7	19	12.7	240	412
Maximum	9364	120.4	75.2	292.2	3639.3	77	29	886	2111.7
p-value Wilcoxon signed rank test*	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0054

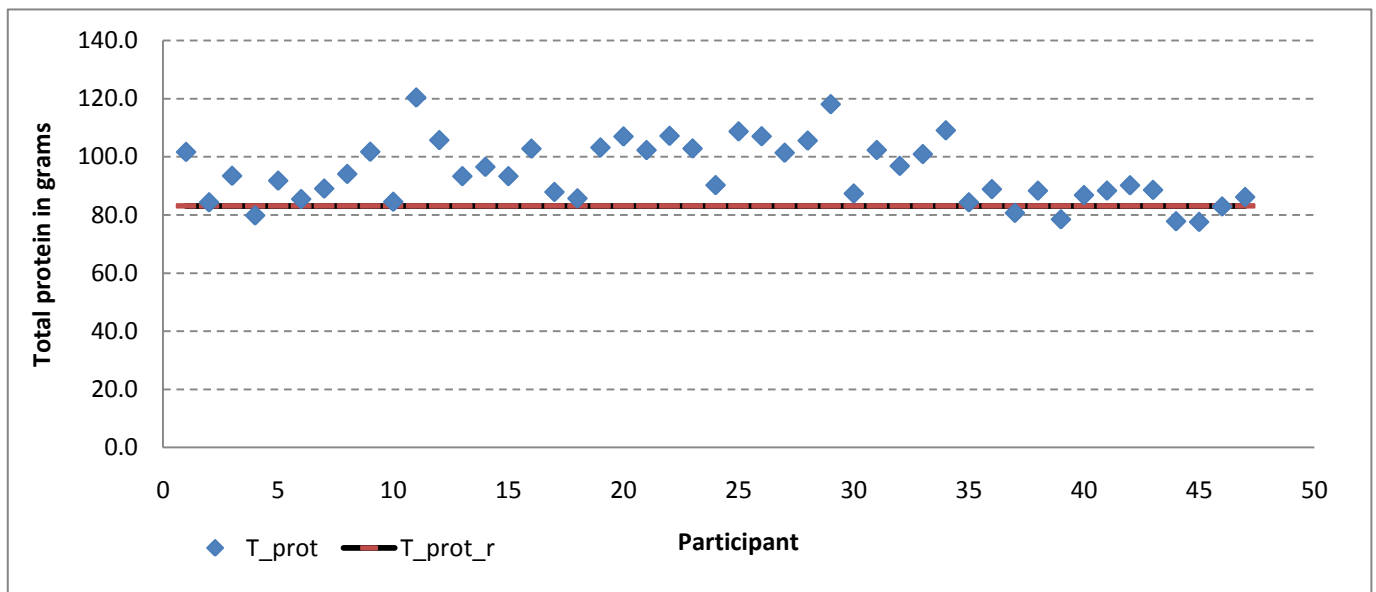
302 *where Wilcoxon signed rank test compared the difference between reference mean value and participant mean
 303 values.



304 **Figure 2:** Distribution of energy (kJ)content of participant value (energy) around the
 305 reference mean value (energy_r)

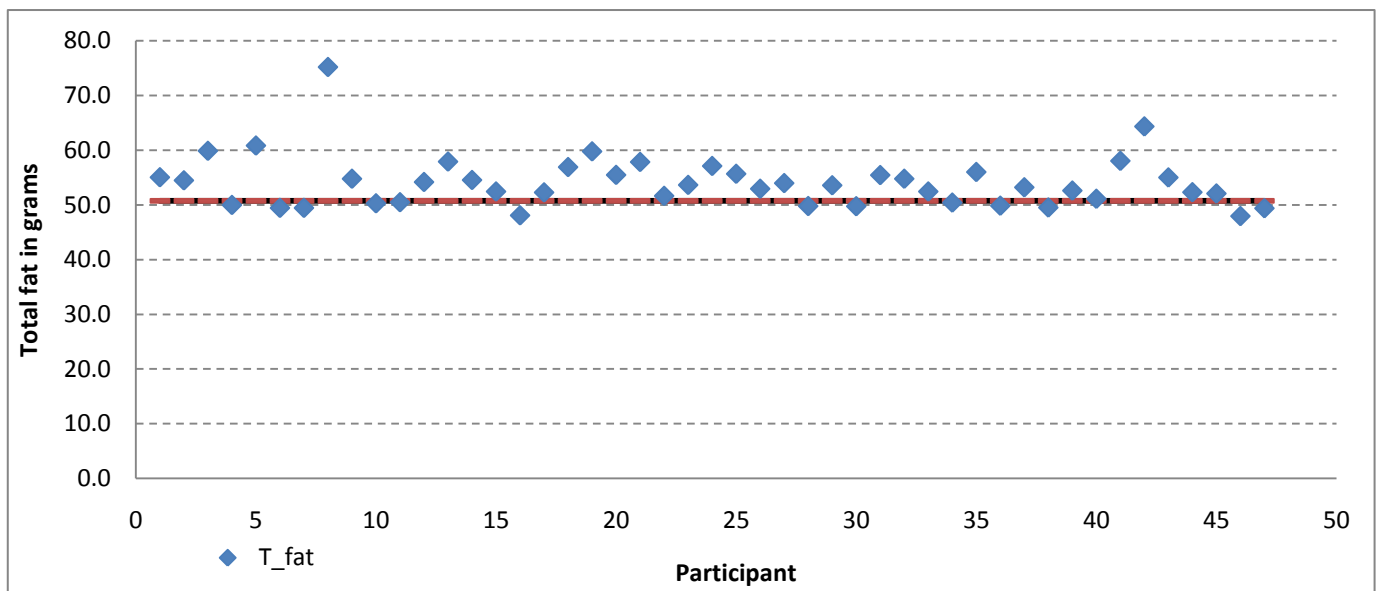
306 Higher values for energy was reported by most of the participants, when
 307 compared to the reference mean value (6166 kJ) of the menu. The participant mean
 308 value was 7434 kJ ± 941 SD. Nutrient data are skewed as shown by the median

309 value reported of 7566 kJ. Mean participant value for protein ($n=94.5 \text{ g} \pm 10.6 \text{ SD}$)
 310 was higher, when compared to the reference mean value of 83.1 g (*Figure 3*).
 311 Total fat mean values of participants were spread mostly above the reference mean
 312 value as shown in *Figure 4*. A standard deviation of 4.8 g was reported for total fat in
 313 the participant values, with a smaller distribution around the reference mean value
 314 observed (Table 4).

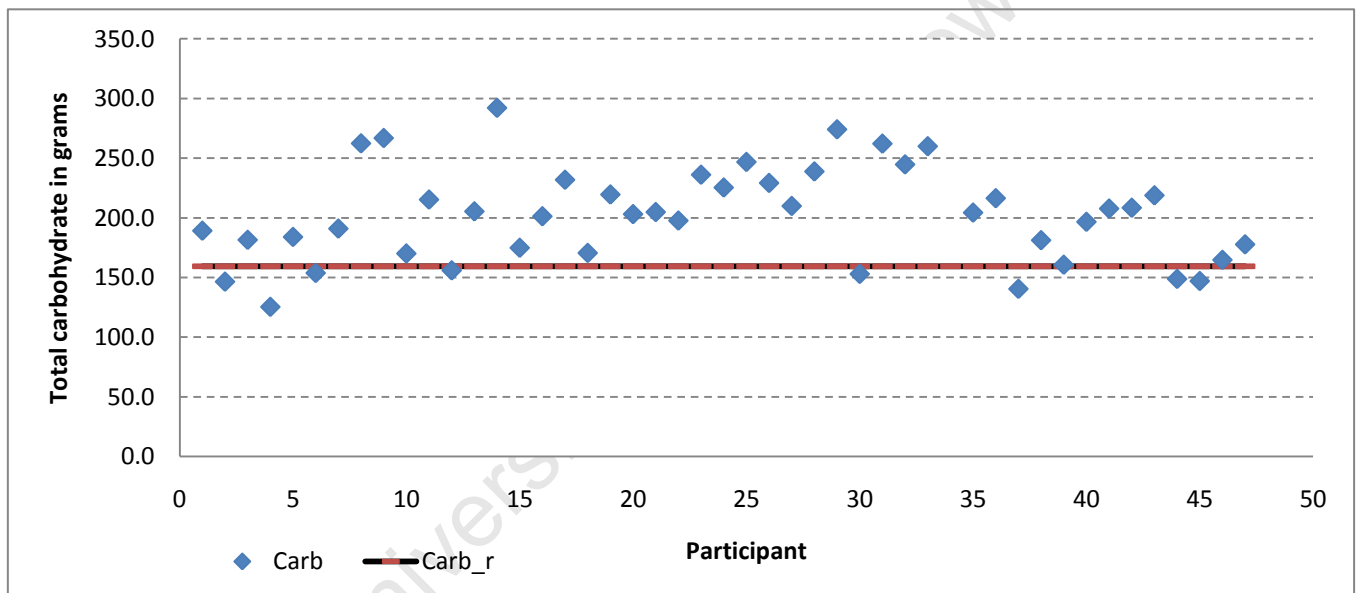


315 **Figure 3:** Distribution of protein (g) content of participant value (T_{prot}), around the
 316 reference mean value (T_{prot_r})

317 The distribution of carbohydrate content of participant values around the reference
 318 mean value of 159.4 g, showed the most variation around the mean ($SD = 39.7 \text{ g}$).
 319 Participant values ranged between 125 g and 292 g for carbohydrate content, over
 320 reporting on carbohydrate (*Figure 5*). Participant mean value for vitamin C was 41.3
 321 $\text{mg} \pm 11.2 \text{ SD}$ around the reference mean value of 58.7 mg. Participant menu
 322 analysis of 2 participants over reported on the vitamin C, whilst the rest showed
 323 lower values for vitamin C values as depicted in *Figure 6*.

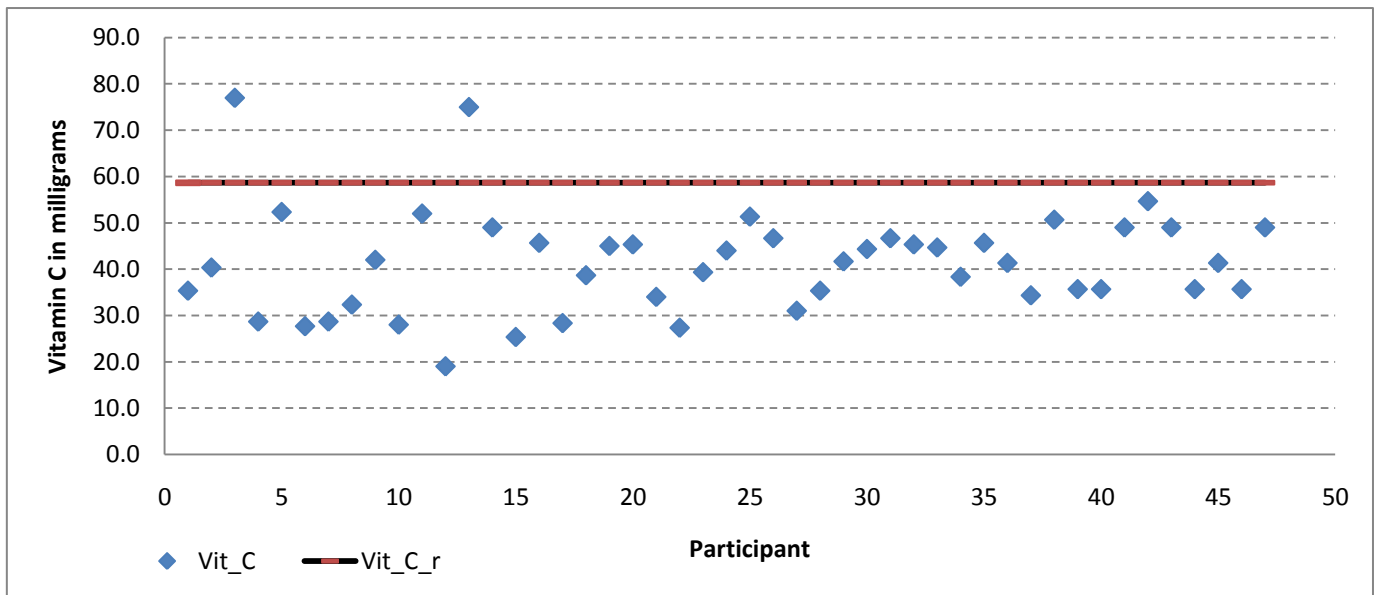


324 **Figure 4:** Distribution of fat (g) content of participant value (T_{fat}) around the
 325 reference mean value (T_{fat}_r)



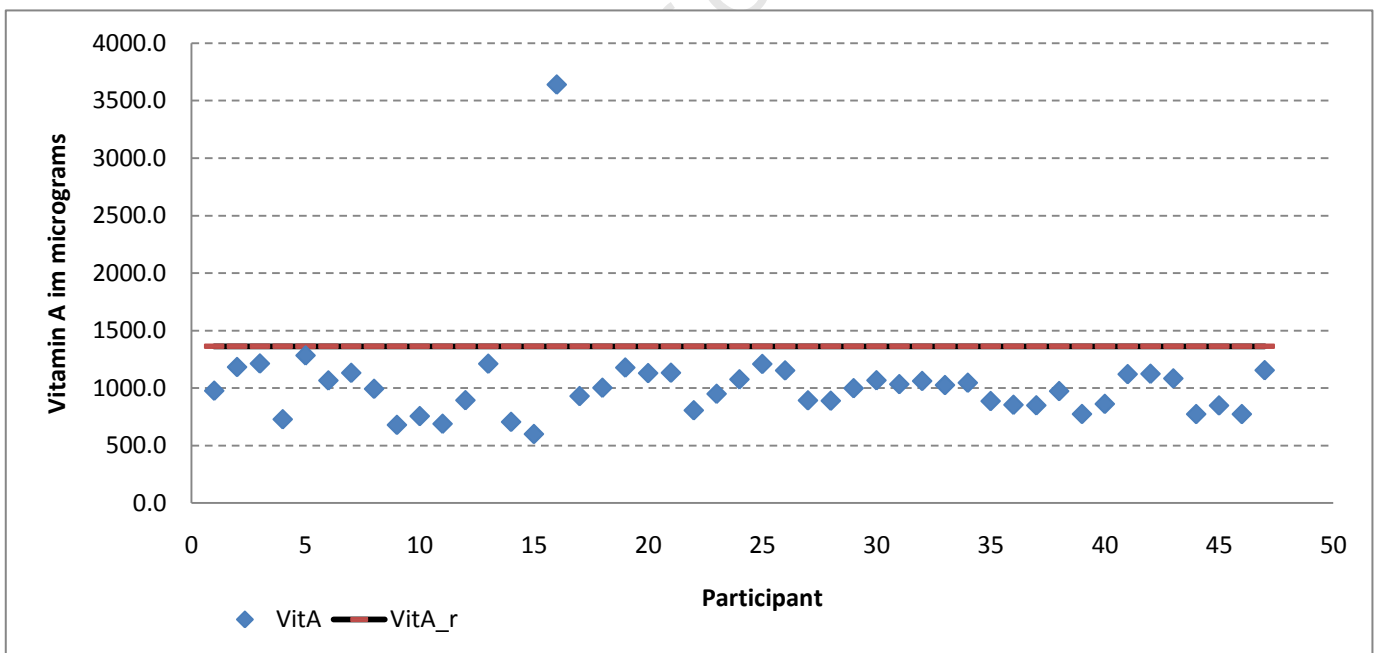
326 **Figure 5:** Distribution of carbohydrate (g) content of participant values ($Carb$) around
 327 the reference mean value ($Carb_r$)

328 One major outlier with a vitamin A value of 3 639.3 mcg for the 3 day menu analysis
 329 resulted for 1 of the participants. The rest of the participants (n=46), all showed
 330 lower vitamin A values when compared to the reference mean value of 1 364 mcg.
 331 The range for vitamin A was between 599 mcg and 3 639 mcg. Further
 332 investigation to this outlier showed that this participant used the alternative food
 333 choice for organ meat repeatedly, when alternative food choices were asked for



334 **Figure 6:** Distribution of vitamin C (mg) content of participant value (Vit_C) around
 335 the reference mean value (Vit_C_r)

336 horsemeat, offal tripe and trotters. The resulting extreme value for vitamin A of
 337 3 639 mcg was reported, whilst the 46 other participants under reported on vitamin A
 338 values when compared to the reference mean value.

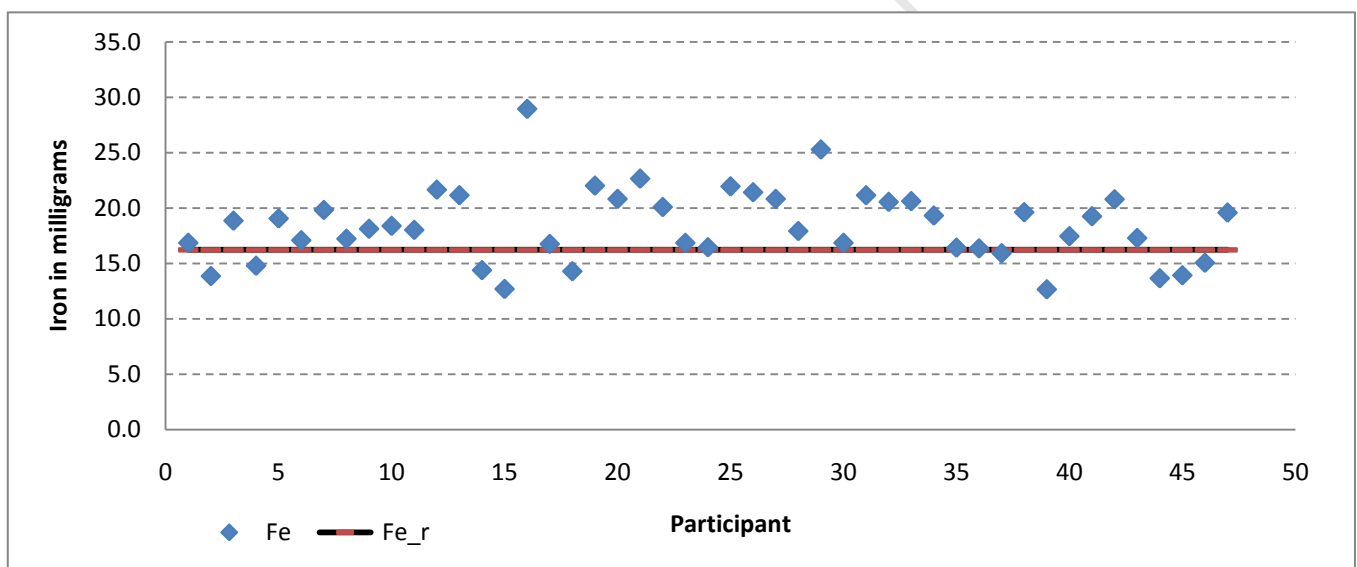


339 **Figure 7:** Distribution of vitamin A (mcg) content of participant value (VitA) around
 340 the reference value (VitA_r) 3

341 Distribution of iron, ranged from a minimum value of 12.7mg to a maximum value of
342 29 mg as reported in Table 4. Reference mean value amounted to 16.2 mg (*Figure*
343 8).

344 The mean reference value for magnesium was 392 mg, with a participant mean
345 value of 352.5 ± 105.6 SD mg reported. The value for magnesium calculated for the
346 participant's menu differed significantly ($p=0.0001$) from that of the reference value.

347 Sodium value calculated for the participant's menu was significant ($p=0.0054$) from
348 that of the reference value. The reference mean value for sodium was 918.7 mg
349 whilst participant mean value was 831.2 mg.



350 **Figure 8:** Distribution of iron (mg) content of participant value (*Fe*) around the
351 reference mean value (*Fe_r*)

352

353 3.8 Statistics

354 The Wilcoxon signed rank test was used to assess whether the participant mean
355 ranks differ, as data for this population were skewed, largely due to the variations
356 and linked to the reporting of assumptions for each individual. p -values for all

357 nutrients energy, carbohydrate, fat, protein, vitamins A and C, magnesium, iron and
358 sodium were significant ($p < 0.005$) when comparing between participant mean value
359 and reference mean value calculated for menu. Interclass variations amongst
360 participants and the reference menu, is highlighted in the large standard deviations
361 reported for all the nutrients analysed (Table 4). This is expected as the study is
362 based on assumption data from participants, and data skewness around the
363 reference mean for all nutrients identified is common for nutrient data reported
364 (Figures 2-8).

365

366 **4. Discussion**

367 **4.1 Study population**

368 The number of nutritionists included in this study was $n=6$, 13% and the number of
369 dietitians 41 (87%). The participants who were not recruited initially ($n=10$) but
370 included in the study, were from the Western Cape ($n=3$); Northern Cape ($n=1$);
371 Eastern Cape ($n=2$); Gauteng ($n=1$), KwaZulu-Natal ($n=1$), North West ($n=1$) and
372 Mpumalanga ($n=1$). Originally 40 participants were targeted, but at the Nutrition
373 Congress in Bloemfontein, 2012, I was networking with nutrition colleagues informing
374 them about this planned study, and by word of mouth, the above mentioned 10
375 participants volunteered to be included into this study (Table 2). The decision was
376 made to include them, as the initial target failed to reach the identified sample size
377 ($n=40$). In addition, these participants provided valuable information on traditional
378 recipes, indigenous vegetables and challenges experienced with using the products
379 of SAFOODS. One participant from Lesotho was included into the study, as she
380 uses the products of SAFOODS (food composition tables and FoodFinder3™)

381 extensively in her country and identified many food items lacking from the tables
382 which communities are consuming.

383

384 **4.2 Commonly consumed indigenous vegetables and traditional foods**

385 Indigenous South African food crops are defined as having their origin in South
386 Africa whilst traditional recipe foods are native to a particular region or that has been
387 in that region long enough to have evolved through generations, as defined by
388 Department of Agriculture, Forestry and Fisheries (2000). 64% of participants
389 accurately defined indigenous vegetables whilst 36% incorrectly defined the term;
390 81% accurately defined traditional recipe foods, based on the Departmental
391 definition above. A further investigation to the participants' background who
392 incorrectly termed the definition could not reveal any significant reasons for why they
393 incorrectly answered that question. Participants were scattered over various
394 provinces and no age classification was asked from the questionnaire, which made
395 one not able to link the reasons to having limited years of exposure in the field of
396 indigenous and traditional foods. Implications of those participants' who incorrectly
397 defined the definitions for indigenous vegetables (36%, $n=17$) and traditional foods
398 (19%, $n=9$), could result in incorrect assumptions being made when faced with the
399 selection of alternative for those food items not found within a food composition
400 database. The first specific objective was to identify the five frequently consumed
401 indigenous vegetables and traditional foods. Table 3 addresses this by showing
402 these food items as eaten in 9 provinces of South Africa and Lesotho. More data
403 was reported for traditional recipe foods and combinations of foods, than indigenous
404 vegetable species consumed. The top 5 food items ranked according to participants
405 reporting on the frequency of consumption of these food items in the areas where

406 they are doing research included: marogo (n=47, 100%); cabbage (n=47, 100%);
407 spinach and potatoes (n=46, 97%); samp and beans (n=43, 92%) and spinach
408 (n=40, 85%). Unlike Jansen van Rensburg et al. (2007), who identified 7 groups of
409 indigenous vegetable species consumed in areas of KwaZulu-Natal, Mpumalanga
410 and Limpopo provinces, this study failed to identify and extrapolate indigenous
411 vegetables by species. Participants' collectively grouped African leafy vegetables
412 (ALV) consumed into spinach (SAFOODS food code 3761). This could have implied
413 that it was the easiest option for selection and next best assumption for ALV,
414 alternatively it may imply that participants are not fully aware of the varying leafy
415 species available across the country, and based on ease of convenience selected
416 the food code 3761, spinach. Traditional recipes have been identified in different
417 provinces (e.g. spinach and maize meal porridge, reported in all provinces; white
418 watermelon and soft maize meal porridge, consumed in Northern Cape; steamed
419 bread, KwaZulu-Natal) for further investigation and chemical analysis for inclusion
420 into SAFOODS (Table 3). Traditional recipe food items reported showed similarities
421 to food items from the study by Mbhenyane et al. (2005) in Limpopo province
422 amongst college students.

423

424 **4.3 Assumptions identified**

425 Specific objective 2 aimed to identify participants' alternative food item choices when
426 food items were not available in SAFOODS, is listed in Appendix A. Nutrient
427 information for food items not available in FoodFinder3TM, can be entered into the
428 software program for more accurate analysis. A new food item, e.g. Philani DIVA
429 brand porridge can be created and the actual nutrient information on the label can be
430 included in the software for analytical purposes. Only 6% (n=3) of participants'

431 created a new food code for this food item, whilst 94% opted for an alternative food
432 item, ranging from Pronutro cereals (n=24, 51%), maize meal porridges (n=18, 38%),
433 shape powder (n=1, 2%) and Maltabella porridge (n=2, 3%). Needless to say,
434 different food choices will produce different nutrient results for a specific food item,
435 e.g. Philani porridge. The results showed that even with food items available within
436 SAFOODS, participants' were not in consensus when selecting a food item, when
437 compared to the reference menu item selected, i.e. raw black jack leaves
438 (SAFOODS food code 4210); 85% (n=40) selected the exact same food code as the
439 reference value; amaranth leaves was selected by 9% (n=4); spinach leaves boiled
440 selected by 4% (n=2) and 1 participant (2%) selected beetroot leaves boiled as a
441 food item choice for raw black jack leaves. Interclass variations existed in the data,
442 as identified in Table 4 for participant values calculated for nutrients when compared
443 to the reference mean value.

444

445 **4.4 Impact on nutrients**

446 Biodiversity can assist the Agriculture sector of a country, to produce and generate
447 more nutritious varieties of crops, and in so doing alleviate the nutritional imbalances
448 present within the country. Nutrient and dietary intake data for different varieties
449 must be collected and analysed in order to understand the impact of biodiversity on
450 food and nutrition security. Dietary counselling of marginalised communities,
451 especially where nutrient imbalances are reported, should target alternative food
452 choices, based on the nutrient contribution these food items provide. In the case of
453 indigenous vegetables, where high nutrient values for vitamin A have been reported
454 (Faber et al., 2010) could alleviate vitamin A deficiencies, by incorporating inclusion
455 of selected genus and species of wild plants locally available for consumption. Menu

456 analysis for a 3 day reference menu was analysed by the principal investigator using
457 the FoodFinder3™ software.

458 Food items included in this reference menu were indigenous vegetables (wild
459 spinach, imifino, black jack leaves, pumpkin leaves) and traditional recipe foods
460 (phutu, horsemeat, baked bread with unfortified flour, beef lung fried, tripe and
461 trotters), outlined in Table 1. Participant assumptions were replaced in the reference
462 menu and nutrient analysis were compared to the reference menu analysis for
463 energy, macronutrients (carbohydrate, protein, fat) and micronutrients (vitamins A
464 and C, iron, magnesium and sodium), addressing the final specific objective of this
465 study.

466 **4.4.1 Energy**

467 Variations in energy values for participants' is linked to the higher values for protein,
468 fat and carbohydrate calculated.

469 **4.4.2 Protein, Fat and Carbohydrate**

470 Higher values for protein, fat and carbohydrate were shown when compared to the
471 reference mean. High fat choices selected for meat cuts, especially information for
472 the offal items which has a high protein and total fat content. Assumptions made for
473 the selection of maize meal showed varied alternatives identified by participants.
474 Method of preparations, i.e. stiff, crumbly or soft porridges where preselected from
475 the availability within the current food composition database, despite certain
476 conditions listed, i.e. unfortified soft porridge, yet fortified soft porridge information
477 selected for nutrient analysis, which influences nutrient outcomes when compared to
478 the reference mean value.

479 **4.4.3 Vitamins A and C**

480 Gross under reporting for vitamins A and C resulted when compared to the reference
481 value for this study. This contradicts findings from a study by Faber et al. (2010)
482 reported on African leafy vegetables consumed in households from KwaZulu-Natal
483 and a Limpopo district, which showed high levels of vitamin A for the vegetable
484 species by their study. From the data it is evident that when indigenous leafy
485 vegetables were reported on, participants' collectively chose various spinach items
486 from the food database for analysis. It is important to always note and acknowledge
487 the reference source of nutrient information as this influences the resultant outcome
488 of nutrient data analysis. The collective food item spinach which was selected by
489 participants' was of American origin and not locally grown in South Africa. This could
490 be the reason for a lower vitamin A and vitamin C results reported.

491 **4.4.4 Iron, Magnesium and Sodium**

492 When compared to the reference value, magnesium and sodium values reported
493 were lower and iron values higher. Leafy vegetables contribute to high levels for
494 magnesium, iron, sodium, copper and phosphorous when consumed and
495 concentrations of the nutrient increases with the addition of a preservation method,
496 e.g. drying, as shown by a study performed by Makobo et al. (2010) in Zimbabwe.
497 Similarly, Habwe et al. (2008) reported on the important contribution of iron,
498 magnesium, sodium, calcium, potassium and vitamin C from indigenous vegetables
499 farmed in the Kenya region. Processing of the vegetable found to increase the shelf
500 life of the food item even longer, which has important implications for the dry season,
501 when access to vegetables are limited.

502

503

504 **5. Conclusion**

505 The study collected information on assumptions reported by participants when
506 nutrient information was not available in SAFOODS. Data reported in this study has
507 reached the aim set out at the start. A list of indigenous vegetables and traditional
508 recipe foods not available in SAFOODS will now serve as the basis for a follow on
509 study to access nutrient information for the recipes identified. This would serve as a
510 future rationale to chemically analyse and compute nutrient information of these food
511 items consumed locally, into SAFOODS to improve on its comprehensiveness,
512 inclusive of the biodiversity of species. Ideally the intention was to acquire
513 information on biodiversity of species consumed in the rural areas, but the
514 questionnaire didn't record this information from participants adequately and can be
515 regarded as a limitation of this study. Similarly, information on participants'
516 knowledge levels of indigenous vegetables and traditional foods were not captured
517 and could have been included in the questionnaire to provide a basis of what is
518 known amongst participants.

519 The study reported on the variation which exists between nutrition researchers,
520 based on personal assumptions, when allocating alternative food items for diet
521 intake studies in the field. Over and under reporting of nutrients can easily result
522 from researchers analysing diet intake studies with the current food composition
523 database available. This has major public health implications on the community
524 being studied. Indigenous vegetables and traditional foods are part of localised
525 diets, and with the consumption of wild vegetables avidly available come the
526 resultant increase in consumption of certain minerals, e.g. magnesium, iron, and
527 vitamins A and C for certain plant species. The study highlighted the over reporting
528 for energy, protein, fat, carbohydrate and iron values when compared to the

529 reference mean value, but under reporting occurred for vitamins A, C and
530 magnesium. Some limitations of the study included that it was based on a very small
531 sample size ($n=47$) of participants who are actively engaged in the research field of
532 indigenous vegetables and traditional foods and a further recommendation following
533 onto this is to expand the research to a wider audience. As only 2 knowledge
534 questions were included in the questionnaire; (i) definitions or understanding of
535 indigenous vegetables and (ii) definition and understanding of traditional foods. It
536 can be suggested that further knowledge questions be added or perhaps to record
537 the education level of each participant who engaged in this study, i.e. postgraduate
538 qualification, undergraduate info.

539

540 The South African food composition database is striving towards becoming fully
541 country-specific, with 37% of current food items having a main South African
542 reference source. Recommendations for this study would include the following:

- 543 a) Broadening the outreach to more researchers in the field of food composition
544 analyses specifically with the focus on indigenous vegetable and traditional
545 foods;
- 546 b) With funding sourced, chemical analysis of the reference menu to be performed,
547 to provide with the actual nutrients the menu comprises of, and then to be
548 officially termed the 'gold standard' analysis and reference point to which
549 participant analysis can be compared to and with the identification of commonly
550 consumed indigenous vegetables and traditional foods, as highlighted in Table 3,
551 priorities can be set for chemical analyses thereof to include in recipe calculations
552 and inclusion into SAFOODS;

553 c) Results from this research can be used as a guideline for a larger and more
554 comprehensive food consumption study of indigenous vegetables and traditional
555 foods across South Africa with the intention of improving on the South African
556 food composition database.

557 A concerted effort should be made in future studies to incorporate varietal
558 information of indigenous vegetables for biodiversity classifications, when conducting
559 food intake surveys, compiling food composition data and providing dietary guidance
560 to the general South African public.

University of Cape Town

Appendix A

Food item, suggested	Gold standard food code	Gold standard food item	Assumptions made by participants						
Maize meal crumbly porridge	3377	Maize meal, special, raw, white (fortified)	mm* special raw, white, unfortified 3377 (1; 2%)	mm special porridge, crumbly, white, fortified 4402 (32; 68%)	mm special, porridge, crumbly, white, unfortified 3401 (11; 23%)	mm super, porridge, crumbly, white, fortified 4412 (3; 6%)			
Maize meal soft porridge (fortified)	3377	Maize meal, special, raw, white (fortified)	mm special, porridge, soft, white, unfortified 3399 (7; 15%)	mm special, porridge, soft, white, fortified 4400 (15; 32%)	mm super, porridge, soft, white, fortified 4410 (23; 49%)	mm special raw, white, unfortified 3377 (1; 2%)	mm super, porridge, soft, white, unfortified 4405 (1; 2%)		
Maize meal soft porridge (unfortified)		Maize meal, special, raw, white (fortified)	mm special, porridge, crumbly, white, unfortified 3401 (1; 2%)	mm special, porridge, soft, white, unfortified 3399 (31; 66%)	mm super, porridge, soft, white, fortified 4410 (1; 2%)	mm sifted, raw, white, unfortified 3398 (1; 2%)	mm special, porridge, soft, white, fortified 4400 (2; 4%)	mm special, raw, yellow 3275 (1; 2%)	mm super, porridge, soft, white, unfortified 4405 (10; 21%)
Stiff pap	3377	Maize meal, special, raw, white (fortified)	mm, special porridge, stiff, white, unfortified 3400 (22; 47%)	mm special, porridge, stiff, white, fortified 4401 (21; 45%)	mm super, porridge, stiff, white, fortified 4411 (2; 4%)	mm special, porridge, crumbly, white, unfortified 3401 (1; 2%)	mm special raw, white, unfortified 3377 (1; 2%)		
Phutu	3377	Maize meal, special, raw, white (fortified)	mm special, porridge, crumbly, white, unfortified 3401 (12; 26%)	mm, special porridge, stiff, white, unfortified 3400 (10; 21%)	mm special, porridge, soft, white, fortified 4400 (1; 2%)	mm super, porridge, crumbly, white, fortified 4412 (13; 28%)	mm special porridge, crumbly, white, fortified 4402 (4; 9%)	mm super, porridge, stiff, white, fortified 4411 (7; 15%)	
Pumpkin	4164	Pumpkin boiled	Squash, gem, boiled with sugar 3754 (1; 2%)	Pumpkin, boiled 4164 (43; 91%)	Squash, butternut, boiled 3759 (1; 2%)	Pumpkin, raw 4163 (1; 2%)	Squash, baby marrow, raw 3769 (1; 2%)		
Pumpkin leaves	4205	Leaves, pumpkin, boiled	Leaves, amaranth, boiled 3980 (17; 36%)	Leaves, pumpkin, boiled 4205 (18; 38%)	Spinach, small leaved, boiled 3761 (1; 2%)	Squash, baby marrow, raw 3769 (1; 2%)	Leaves, pumpkin, raw 4204 (8; 17%)	Spinach, swiss chard, boiled 3913 (2; 4%)	
Beans	3206	Beans, sugar, dried, raw	Beans, sugar, dried, cooked 3205 (31; 66%)	Beans, dried, canned in tomato sauce 3176 (4; 9%)	Beans, haricot, dried, cooked 3185 (5; 11%)	Beans, sugar, dried, raw 3206 (7; 15%)			
Wild spinach	3761	Spinach, small leaved, boiled	Spinach, small leaved, boiled 3761 (13; 28%)	Leaves, amaranth, boiled 3980 (2; 4%)	Spinach, swiss chard, boiled 3913 (6; 13%)	Leaves, amaranth, raw 3785 (1; 2%)	Spinach, swiss chard, raw 4168 (8; 17%)	Spinach, small leaved, raw 4167 (16; 34%)	Squash, baby marrow, raw 3769 (1; 2%)
Imifino	3980	Leaves, amaranth, boiled	Leaves, amaranth, boiled 3980 (6; 13%)	Spinach, small leaved, boiled 3761 (5; 11%)	Spinach, swiss chard, boiled 3913 (24; 51%)	Spinach, swiss chard, raw 4168 (5; 11%)	Leaves, amaranth, raw 3785 (1; 2%)	Spinach, small leaved, raw 4167 (6; 13%)	

Maize	3250	Maize, samp/rice, cooked, white	mm special, porridge, crumbly, white, unfortified 3401 (3; 6%)	mm, special porridge, stiff, white, unfortified 3400 (2; 4%)	mm special, porridge, soft, white, fortified 4400 (3; 6%)	mm special, porridge, stiff, white, fortified 4401 (1; 2%)	mm super, porridge, crumbly, white, fortified 4412 (1; 2%)	Maize, samp/rice, cooked, white 3250 (10; 21%)	mm special raw, white, unfortified 3377 (1; 2%)
			Mealie, sweetcorn, boiled 3725 (1; 2%)	Maize, samp/rice, raw, white degermed 3274 (12; 26%)	Wheat bran, selected 3280 (1; 2%)	mm special, raw, yellow 3275 (2; 4%)	mm special porridge, crumbly, white, fortified 4402 (2; 4%)	Maize grit, raw, white, degermed 3451 (1; 2%)	Maize, whole kernel, raw, yellow 3276 (3; 6%)
			Maize, whole kernel, raw, white 3271 (4; 9%)						
Black Jack leaves	4210	Leaves, black jack, raw	Leaves, amaranth, boiled 3980 (4; 9%)	Leaves, black jack, raw 4210 (40; 85%)	Spinach, small leaved, boiled 3761 (2; 4%)	Leaves, beetroot, boiled 3914 (1; 2%)			
Horsemeat	2913	Venison, buck/deer, roasted	Beef, topside/lean mince, cooked, moist 2921 (2; 4%)	Venison, buck/deer, roasted 2913 (5; 11%)	Beef, fillet, cooked, dry 2933 (1; 2%)	Beef, chuck, cooked, moist 2945 (2; 4%)	Beef, raw 4360 (15; 32%)	Beef, rump, cooked, dry 2943 (1; 2%)	Goat, roasted 4281 (4; 9%)
			Biltong, game 2912 (2; 4%)	Ham, sliced/canned, lean 3008 (1; 2%)	Veal, rib, cooked, dry 4354 (2; 4%)	Beef, thick flank, cooked, moist 4362 (4; 9%)	Beef, shoulder, cooked, moist 4365 (1; 2%)	Beef, loin, cooked, dry 2946 (2; 4%)	Beef, hind shin, cooked, moist 4367 (2; 4%)
			Beef, silverside, cooked moist 4361 (1; 2%)	Beef, brisket/regular mince, cooked, moist 4363 (1; 2%)					
Tripe			Offal, cooked, tripe/brawn/brain/tong ue 3003 (40; 85%)	Tripe, beef, raw 4342 (7; 15%)					
Trotters			Trotters, pork, cooked 3017 (47; 100%)						
Chicken heads			Chicken head, raw 2999 (43; 91%)	Chicken, dark meat, fresh, raw 4305 (1; 2%)	Chicken feet, raw 2997 (1; 2%)	Chicken, meat only, frozen, boiled 2963 (1; 2%)	Chicken, giblets, cooked 2998 (1; 2%)		
Chicken feet			Chicken feet, raw 2997 (44; 94%)	Chicken, skin, fresh, raw 4297 (1; 2%)	Chicken, meat only, frozen, boiled 2963 (1; 2%)	Chicken, giblets, cooked 2998 (1; 2%)			
Philani porridge (Diva brand)	New code		Breakfast cereal, Pronutro High Energy 3245 (15; 32%)	mm special, porridge, soft, white, unfortified 3399 (9; 19%)	Shape powder, 4084 (1; 2%)	New code (3; 6%)	mm super, porridge, soft, white, fortified 4410 (5; 11%)	Breakfast cereal, Pronutro Wholewheat 3436 (1; 2%)	mm special, raw, white, unfortified 3270 (1; 2%)
			mm special, porridge, soft, white, fortified 4400 (3; 6%)	Maltabella, cooked 3241 (2; 4%)	Breakfast cereal, Pronutro Great Start 3438 (8; 17%)				
Vegetarian sausage (Fry's brand)	New code		Soybean flour, low fat 3189 (3; 6%)	Vienna sausage, beef and pork, canned 2936 (1; 2%)	Sausage, beef, grilled 4349 (1; 2%)	TVP, plain, dehydrated, Jabula Vegeteen 3197 (9; 19%)	Toppers, cooked 3196 (25; 53%)	Soybeans, dried, cooked 3188 (6; 13%)	

			<i>New code</i> (2; 4%)					
Beef lung fried		Beef lung	Lung, beef, braised 3019 (43; 91%)	Offal, cooked 3003 (2; 4%)	Heart, beef, cooked 2968 (1; 2%)	Pastrami, turkey 4343 (1; 2%)		
		Cooking fat	Cooking fat, white 3516 (37; 79%)	Beef tallow 3494 (1; 2%)	Lard 3495 (1; 2%)	Sunflower oil 3507 (8; 17%)		
Baked bread	<i>New code</i>	Bread flour, unfortified	Wheat flour, cake flour 3273 (17; 36%)	Maize flour/cornflour/starch 3297 (1; 2%)	Wheat flour, brown bread meal 3298 (14; 30%)	Wheat flour, white bread flour, fortified 4404 (14; 30%)	Bread/rolls, wholewheat 3212 (1; 2%)	
	4049	Yeast	Yeast, bakers dried 4049 (47; 100%)					
	3989	Sugar	Sugar, white 3989 (45; 96%)	Sugar, brown 4005 (2; 4%)				
	4042	Water	Water 4042 (47; 100%)					
	3507	Oil	Sunflower oil 3507 (44; 94%)	Veg oil 3486 (2; 4%)	Safflower oil 3527 (1; 2%)			

*where mm = maize meal; and the number in brackets, indicative of absolute number of participants who selected the food item, followed by percentage contribution

Appendix B

Reference Menu: Average intake (mean for 3 days)

Daily intakes	Energy (kJ)	Carbohydrate available (g)	Total Fat (g)	Total Prot (g)	Vitamin A (mcg)	Vitamin C (mg)	Fe (mg)	Mg (mg)	Na (mg)
Day 1	5757	195	28.7	71.4	1935	104	22.7	667	1324
Day 2	5882	124.9	62.2	81.8	902	24	13.4	180	880
Day 3	6810	157.9	61.2	94.6	688	35	12.6	261	489
Average intake of 3 days (mean)	6166	159.3	50.7	83.1	1364	58.7	16.2	392	918.7

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PART D

APPENDICES

LIST OF APPENDICES

Appendix A	Questionnaire
Appendix B	Consent form and participation information form
Appendix C	Letter of approval from Research Ethics Committee, UCT
Appendix D	Letter of approval from Research Ethics Committee, MRC
Appendix E	Instructions for Author of Journal of Food Composition and Analysis
Appendix F	Budget summary
Appendix G	Sample menu for reference menu analysis
Appendix H	Critical review of study process J Chetty

University of Cape Town

Dear Nutrition Colleague,

This questionnaire aims to identify gaps which exist within the South African Food Composition Database, when coding for indigenous vegetables and traditional recipe foods. This research will contribute to an improvement of the South African Food Composition Database. It should take approximately 30 minutes to complete.

Personal

Name: _____

Title: _____

Respondent Code:

--	--	--

Date questionnaire completed:

				2	0	1	2
d	d	m	m	y	y	y	y

Address of Organisation:

Contact details: (T) _____

Email address: _____

Province:

Western Cape		
Eastern Cape		
Northern Cape		
Free State		
Mpumalanga		
North West		
Limpopo		
Gauteng		
KwaZulu Natal		

Please mark your selection in the blank boxes, with an X

Background

1. Are you doing nutrition research in areas where indigenous vegetables and traditional foods are reported by participants?

Yes		
No		

2. Specify areas and province _____

3. Have you coded dietary intake data before?

Yes		
No		

4. Have you been involved in any large South African dietary intake study?

Yes		
No		

If YES, specify study name _____

5. What is your understanding or how would you define indigenous vegetables?

6. What is your understanding or how would you define traditional recipe foods?

7. What are the top 5 commonly consumed indigenous vegetables and/or traditional recipe foods in your working area? *Include commonly referred to names (local names) in area*

7.1		
7.2		
7.3		
7.4		
7.5		
7.6	Not applicable	

South African Food Data System - SAFOODS

8. Have you used products of the South African food composition database?
If No, skip to question 11

Yes		
No		

9. Which products of the South African food composition database do you use when analysing dietary intake data? Mark the selected block with an X, alternatively specify if Other block selected

Food composition tables/publications	1986 Food Quantities Manual		
	1991 Food composition table		
	1998 Fruits & Vegetables		
	1999 Meat, Milk & Eggs		
	2010 Condensed Food composition table		
Dietary analysis software program, FoodFinder			
Other. Please specify			
Unsure			
Not applicable			

10. Select a Dietary analysis software program, version if used

FoodFinder 2		
FoodFinder 3		
Other dietary analysis software – specify		

11. Do you experience challenges when analysing dietary intake data for indigenous and traditional recipe foods with the food analysis software programme?
If No, skip to question 13

Yes		
No		

12. Select the challenges you experience when using products of dietary software programme for analysis.
Mark the selected block with an X; alternatively specify if Other challenges are experienced

Food items not available in database		
Difficulty in selecting next best or similar food items		
Technical problems, i.e. program not stable, cannot login/cuts off whilst busy		
Unsure		
Other – specify		

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Background info for Question 13

When dietary data needs to be coded using the South African food composition tables or database, many times, we are challenged with not being able to find a close/similar food or “next best” food item option to select. By drawing from your dietary intake study experience, can you identify such food items which were difficult to find in the food composition tables or database (software FoodFinder). By acquiring this information from various sources, it will assist in improving and expanding our food composition database for accuracy when reporting on consumption studies in South Africa.

From your experience, please list commonly consumed indigenous vegetables and/or traditional South African recipe foods, where assumptions had to be made in order to analyse using the South African food composition database. Also list “next best” food items which were selected, and define study area

13. From your experience, please list commonly consumed indigenous vegetables and/or traditional South African recipe foods, where assumptions had to be made in order to analyse using the South African food composition database. Also list “next best” food items which were selected, and define study area

Indigenous and/or traditional recipe food items reported in study area	Assumption made and “next best” food item selected from South African food composition database	Food item code used from the South African food composition database	Study area defined, i.e. population age group, area	
e.g. beef lung mixed with beef fat “gemaldes”	e.g. Beef liver with fat	2920: beef liver fried + 3516: cooking fat	e.g. North West province, adult community	

Background info for question 14

To complete this question, you need to have access to either the FoodFinder software program **or** printed copy of the Food Composition Tables, to select the necessary food codes. Please provide with your selection of “next best” food items, for the following dishes suggested. A food code and name has to be included for all fourteen (14) items suggested. The recipe details column shows the breakdown of the sample dishes. It is imperative that a food code is selected for each ingredient, e.g. 3206 = beans sugar, dried, raw.

For the following sample foods, what “next best” food items will you select from the South African food composition database to analyse data? Please list the food item codes used for your selection.

14. For the following sample foods, what “next best” food items will you select from the South African food composition database to analyse data? Please list the food item codes used for your selection.

Sample foods / dishes		Recipe details	Food item codes selected
1	Pumpkin leaves and crumbly maize meal	200g maize meal crumbly	
		40g pumpkin leaves	
2	Phutu and beans	100g phutu	
		100g beans	
3	Wild spinach and soft maize meal	120g wild spinach	
		200g maize meal soft	
4	Imifino	200g imifino	
5	Maize and beans	150g maize	
		90g beans	
6	Black Jack leaves and stiff pap	50g black jack leaves	
		100g stiff pap	
7	Soft maize meal and pumpkin	150g maize meal soft	
		60g pumpkin	
8	Horse/donkey meat	150g horse/donkey meat	
9	Offal -tripe and pork trotters	250g tripe	
		150g pork trotters	
10	Chicken feet and chicken heads	50g chicken heads	
		50g chicken feet	

Please forward the completed questionnaire to joelaine.chetty@mrc.ac.za or fax to +27 21 938 0321

Thank you for your participation!

INFORMED CONSENT FORM TO PARTICIPANTS WHO PARTICIPATE IN RESEARCH

Information about the study:

TITLE OF STUDY: Dietary analysis of South African indigenous vegetables and traditional foods – assumptions made by nutritionists and the impact on public health outcomes.

PURPOSE OF THE STUDY

The purpose of the study is to explore the gaps which exist within the South African food composition database, when coding indigenous vegetables and traditional South African recipe foods commonly consumed in research study areas and how the assumptions made by researchers possibly over or under reports on actual dietary intake.

POTENTIAL RISKS AND DISCOMFORTS

The investigator does not perceive any risks from your involvement in this study.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

The results of this study may advance the need to secure nutrient information for indigenous vegetables and traditional recipe food items into our South African Food composition database which will be beneficial for future food consumption surveys in our country to accurately predict dietary intake studies.

CONFIDENTIALITY

Any information that is obtained in this study and identified with you will remain confidential and will be disclosed only with your permission. Completed questionnaires and dietary analysis records obtained will be recorded anonymously and kept in the strictest confidence by the project leader, aggregate data will be presented representing averages or generalizations about the responses as a whole. No identifiable responses will be presented in the final form of the study. All data will be stored in a secure location accessible only to the researcher. Any reports of this study sent to a scientific journal for publication will contain information that reflects group results and not information about specific individuals.

PARTICIPATION AND WITHDRAWAL

Your participation is entirely voluntary. You are free to choose not to participate. Should you choose to participate, you can withdraw at any time without consequences of any kind. However, once your responses have been submitted and anonymously recorded you will not be able to withdraw from the study.

QUESTIONS ABOUT THE STUDY

If you have questions or concerns during the time of your participation in this study, or after its completion or you would like to receive a copy of the final aggregate results of this study, please contact:

Researcher's Name: Joelaine Chetty
Address: MRC Nutritional Intervention Research Unit. PO Box 19070. Tygerberg. 7505
Telephone: 021 938 0259
Email Address: joelaine.chetty@mrc.ac.za

Alternatively, if you have any further queries or problems you are welcome to contact the MRC Ethics Committee Chairperson, Prof Danie du Toit on 021 938 0341 or email: adri.labuschagne@mrc.ac.za

FEEDBACK OF RESULTS OF THIS STUDY TO PARTICIPANTS

Once the research is complete a brief report explaining the findings of this study will be available for those interested.
Date when results will be available: March 2013

Dear Nutrition Colleague,

RE: LETTER OF INFORMATION FOR CONSENT TO PARTICIPATE IN RESEARCH

You are invited to participate in a research study conducted by Mrs Joelaine Chetty (joelaine.chetty@mrc.ac.za), from the Medical Research Council's Nutritional Intervention Research Unit in Parow, Cape Town. This research aims to identify challenges faced when coding of dietary data for indigenous vegetables and traditional recipe foods are consumed in study populations and will also contribute to an improved understanding of indigenous vegetables and traditional recipe foods available throughout South Africa, for inclusion into the South African food composition database. In addition, it will contribute to a mini-dissertation for the Masters of Public Health degree for Mrs Chetty as supervised by Mrs Sharmilah Booley and Dr Petro Wolmarans.

This study consists of a questionnaire survey that will be administered via email. If you volunteer to participate in this study, you are invited to complete a short questionnaire. This questionnaire should take approximately 30 minutes to complete.

More information about the study:

TITLE OF STUDY: Dietary analysis of South African indigenous vegetables and traditional foods – assumptions made by nutritionists and the impact on public health outcomes.

PURPOSE OF THE STUDY

The purpose of the study is to explore the gaps which exist within the South African food composition database, when coding indigenous vegetables and traditional South African recipe foods commonly consumed in research study areas and how the assumptions made by researchers possibly over or under reports on actual dietary intake.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

The results of this study may advance the need to secure nutrient information for indigenous vegetables and traditional recipe food items into our South African Food composition database which will be beneficial for future food consumption surveys in our country to accurately predict dietary intake studies.

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Any information that is obtained in this study and identified with you will remain confidential and will be disclosed only with your permission. Completed questionnaires and dietary analysis records obtained will be recorded anonymously and kept in the strictest confidence by the project leader, aggregate data will be presented representing averages or generalizations about the responses as a whole. No identifiable responses will be presented in the final form of the study. All data will be stored in a secure location accessible only to the researcher. The researcher retains the right to use and publish non-identifiable data. Any reports of this study sent to a scientific journal for publication will contain information that reflects group results and not information about specific individuals.

PARTICIPATION AND WITHDRAWAL

Your participation is entirely voluntary. You are free to choose not to participate. Should you choose to participate, you can withdraw at any time without consequences of any kind. However, once your responses have been submitted and anonymously recorded you will not be able to withdraw from the study.

QUESTIONS ABOUT THE STUDY

If you have questions or concerns during the time of your participation in this study, or after its completion or you would like to receive a copy of the final aggregate results of this study, please contact:

Researcher's Name: Joelaine Chetty

Address: MRC Nutritional Intervention Research Unit. PO Box 19070. Tygerberg. 7505

Telephone: 021 938 0259

Email Address: joelaine.chetty@mrc.ac.za

FEEDBACK OF RESULTS OF THIS STUDY TO PARTICIPANTS

Once the research is complete a brief report explaining the findings of this study will be available for those interested. Date when results will be available: March 2013

University of Cape Town

UNIVERSITY OF CAPE TOWN



Health Sciences Faculty
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • Facsimile [021] 406 6411
e-mail: s.thomas@uct.ac.za

24 May 2012

HREC REF: 193/2012

Ms J Chetty
c/o Ms S Boolcy
MRC Nutritional Intervention Research
PO BOX 19070
Tygerberg
7505

Dear Ms Chetty

PROJECT TITLE: DIETARY ANALYSIS OF INDIGENOUS AND TRADITIONAL SOUTH AFRICAN RECIPE FOODS-ASSUMPTIONS MADE BY NUTRITION RESEARCHERS AND THE IMPACT ON PUBLIC HEALTH OUTCOMES.

Thank you for responding to the issues raised by the Faculty of Health Sciences Human Research Ethics Committee in your letter dated 21st May 2012.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study provided the MCC Approval is granted.

Approval is granted for one year till the 30th May 2013

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC REF in all your correspondence.

Yours sincerely

signature removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

s.thomas

HREC Ref 193/2012 - 24 May 2012



ETHICS COMMITTEE

PO Box 13070, Tygerberg 7505, Cape Town, South Africa
Francie van Zijl Drive, Parow Valley 7500
Tel: +27 (0)21 538 0341; Fax: +27 (0)21 938 0201
E-mail: ndri.labuschagne@mrc.ac.za
http://www.sah.co.za/info_eng/ethics/ethics.htm

31 July 2012

Ms Joelaine Chetty
Nutritional Intervention Research Unit
MRC Cape Town

Dear Ms Chetty

Protocol ID: EC012-5/2012
Protocol title: Dietary analysis of indigenous vegetables and traditional South African recipe foods – assumptions made by nutritionists and the impact on public health nutrition
Meeting date: 30 July 2012

Thank you for your response to the Committee, dated 10 July 2012. The response was found to be satisfactory. I am pleased to inform you that ethics approval is now granted for the study.

Please note that the approval is valid for 1 year, i.e. from 30 July 2012 to 29 July 2013. Any changes to the research protocol must be submitted as an amendment.

Wishing you well with your research.

Yours sincerely

Signature removed

PROF. D DU TOIT
CHAIRPERSON: MRC ETHICS COMMITTEE

MRC Ethics Committee: Prof D du Toit (chairperson), Prof A Dhai, Dr N Khaole, Dr NE Khomo, Prof D Labadarios, Ms L Mpahlwa, Prof H Costhuizen, Dr L Schoeman, Prof AA van Niekerk



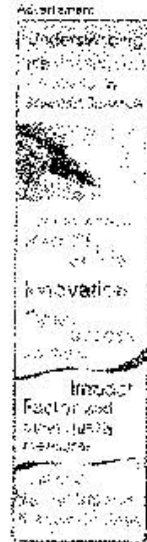
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Guide for Authors

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Introduction

The *Journal of Food Composition and Analysis* publishes manuscripts on scientific aspects of data on the chemical composition of human foods, with particular emphasis on: actual data on composition of foods; analytical methods; studies on the manipulation, storage, distribution and use of food composition data; and studies on the statistics, use and distribution of such data and data systems. The Journal's basis is nutrient composition, with increasing emphasis on bioactive non-nutrient and anti-nutrient components. Papers must provide sufficient description of the food samples, analytical methods, quality control procedures and statistical treatments of the data to permit the user of the food composition data to evaluate the appropriateness of such data in their projects.

- The Journal does not publish papers on:
- microbiological compounds;
 - sensory quality;
 - any volatile in food and wine;
 - essential oils;
 - organoleptic characteristics of food;
 - physical properties, or
 - clinical aspects or pharmacology-related papers.

Research may be published as Original Research Articles, Short Communications, Critical Reviews, Study Reviews, Reports or Commentaries, according to subject matter and presentation. Assignment will be made by the Editorial Office, but author guidance is appreciated. Only original papers will be considered. Manuscripts are submitted for review with the understanding that the same work has not been copyrighted, published, or submitted for publication elsewhere.

Types of paper

The following types of papers are published:

- Original Research Articles** are complete reports of original, scientifically sound research. They must contribute new knowledge and be organized as described in this Guide. Please follow carefully the organization of the sections described in Article Structure (see below).
- Short Communications** are brief reports of scientifically sound research, but of limited scope (for example, limited number of samples and years), that contribute new knowledge. They may be preliminary reports of new findings, in which case the author is expected to publish complete findings later in a article.
- Reviews** are papers which provide an analysis of a scientific or applied field, which include all important findings and bring together reports from a number of sources. There are two categories of reviews: Critical reviews provide a comprehensive, extensive review of a topic and a thorough referencing of the relevant literature. Study reviews provide an analysis of a selected number of published or unpublished studies. Review articles may be invited by the Editor or the Editorial Board. Alternatively, potential authors considering the preparation of a Review article should contact the Editor to suggest the topic and its scope, providing an outline in the form of major headings and a summary statement. In any case, such articles are subject to the normal processes of peer review and revision.

- **Reports** are papers presenting the results of an expert consultation, or a scientific or regional committee, in the field of food composition and analysis.
- **Commentaries** are opinion pieces, focused on some scientific or applied aspect of food composition. They are informative, and may link diverse disciplines or address difficult implications or issues. Controversial commentaries are acceptable, as are ones expressing contrasting opinions. In most cases, those will be invited, but suggestions and unsolicited submissions will be considered by the Editor.
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Items	Details	Costs in Rands
1	Implementation	Photocopies
	<ul style="list-style-type: none"> 60 articles @ 5 pages each @ R1.00 per page Draft protocol versions ; 12 versions reprinted @ 22 pages each, R1.00 per page 	300 264
	Emails to participants	120
	<ul style="list-style-type: none"> 40 x emails + 40 x reminder emails sent @ R1.50 an email 	
	Collecting data	Telephone calls to verify any questions
	<ul style="list-style-type: none"> 40 x 2 calls per participant @ R1.50/call @ 5min per call 	600
2	Analysis	Printing of questionnaires
	<ul style="list-style-type: none"> 40 questionnaires @ R1.00 per page x 4pages 	160
	Faxing of questionnaires	120
	<ul style="list-style-type: none"> Assumption that 50% of participants will not have email access – 20 x 4pages @ R1.50 per page 	
3	Processing data	Consultation with statistician
	<ul style="list-style-type: none"> 4hours scheduled with statistician @ R300per hour 	1200
4	Preparing final report	Write up of findings
	<ul style="list-style-type: none"> Printing costs of final document@ R1.00 per page, approximately 50 pages in total Journal publication costs – page charges (Journal of Food Composition and Analysis) 	50 0
Total costs		R2 814

APPENDIX G SAMPLE MENU FOR REFERENCE MENU ANALYSIS

Reference menu

Details of client: Male, 26yr old. Mr X Sample

Mealtime	DAY 1			DAY 2			DAY 3					
	Breakfast	Amt	Details	Recipe	Breakfast	Details	Recipe	Breakfast	Details	Recipe		
Breakfast	150g	Philani porridge	150g Philani	155g	Baked bread	155g bread flour, unfortified	150g bread flour, unfortified 1g yeast 16g sugar 163g water 8.5g oil	95g	Vegetarian sausage			
			100g water			40g		Pumpkin leaves, cooked				
	15g	White sugar				40g		Black jack leaves, cooked				
	60g	Brown bread				100g		Soft maize meal, unfortified 130g maize meal, unfortified 500g water 2g salt				
	5g	Hard margarine										
						25g		Hard margarine				
Lunch				Lunch				Lunch				
Breakfast	308g	Phutu	130g maize meal, fortified	180g	Soft maize meal porridge	130g maize meal fortified	130g maize meal fortified 500g water 2g salt	150g	Chicken heads, boiled			
			375g water			150g		Chicken feet boiled				
			2g salt			100g		Stiff pap	130g maize meal, fortified			
	133g	Beans	133g beans	96g	Imifino, boiled		96g	Cabbage, boiled		68g	Pumpkin, boiled	
			510g water									
	Supper				Supper				Supper			
Breakfast	125g	Horsemeat		250g	Pork trotters, boiled		445g	Maize meal and beans		187g	maize meal, unforti	
	180g	Soft maize meal porridge	130g maize meal, fortified		100g	Tripe, boiled				454g	water	
			500g water		55g	Pumpkin leaves				62.4g	beans	
			2g salt									
96g	Wild spinach, boiled			150g	Crumbly maize meal porridge	130g maize meal, fortified 250g water 2g salt	100g	Beef lung fried 80g beef lung 20g cooking fat				

REFERENCE MENU

DAY 1

Mealtime	Amt (g)	Food item	Food code	Amount (g)	Details of food item	Energy (kJ)	CHO (g)	Fat (g)	Prot (g)	Vit A (mcg)	Vit C (mg)	Fe (mg)	Mg (mg)	Na (mg)	
Breakfast	150	Philani porridge	4042	100	Water	1792	56.5	15.4	11.9	841	93	7.7	357	170	
			New code (new info added)		150										Philani porridge
	15	Sugar, white	3989			255	15	0	0	0	0	0	0	0	
	60	Brown bread	3211			649	26.5	1.2	5.2	0	0	0.9	44	271	
	5	Hard margarine	3484			149	0	4	0	35	0	0	0	40	
Lunch	308	Phutu	3377	130	Maize meal, fortified	1090	56.5	2.3	6.1	186	0	2.3	73	475	
			4042	375	Water										
			4288	2	Salt, iodised										
	133	Beans, cooked	3206	133	Beans, sugar	399	12.7	0.4	4.6	0	1	1.6	45	10	
			4042	510	Water										
Supper	125	Horsemeat, fried	2913		125	Venison	790	0	4	37.8	0	0	5.6	30	68
	180	Soft maize meal porridge	3377	130	Maize meal, fortified	511	26.5	1.1	2.9	87	0	1.1	34	223	
			4042	500	Water										
			4288	2	Salt, iodised										
96	Wild spinach, boiled	3761			122	1.3	0.3	2.9	786	10	3.5	84	67		
TOTAL, Day 1						5757	195	28.7	71.4	1935	104	22.7	667	1324	

DAY 1: Assumptions made: Maize meal, Special fortified (food code 3377) used; Maize meal, Special unfortified (food code 3270) used; Venison food code 2913, used for Horsemeat; nutrient info for Philani porridge added from company labels; sugar beans food code 3206 used for beans dish;

DAY 2

Mealtime	Amt	Food item	Food code	Amount (g)	Details of food item	Energy (kJ)	CHO (g)	Fat (g)	Prot (g)	Vit A (mcg)	Vit C (mg)	Fe (mg)	Mg (mg)	Na (mg)
Breakfast	155	Baked bread	New code	155	Bread flour, unfortified	1296	57	4.3	8	0	0	0.9	12	2
			4049	1	Yeast, instant									
			3989	16	Sugar									
			4042	163	Water									
			3507	8.5	Sunflower oil									
	25	Hard margarine	3484			744	0.2	20	0.1	173	0	0	0	201
Lunch														
	180	Soft maize meal porridge	3377	130	Maize meal fortified	511	26.5	1.1	2.9	87	0	1.1	3.4	223
			4042	500	Water									
			4288	2	salt									
	96	Imifino, boiled	3980			107	1.2	0.2	1.8	383	1	4.4	36	3
	96	Cabbage, boiled	3756			100	3.1	0	1	2	19	0.4	9	19
Supper														
	250	Pork trotters, boiled	3017			1963	0	31	48	0	0	1.3	13	75
	100	Tripe, boiled	4242			396	0	4	14.6	0	3	2	8	46
	55	Pumpkin leaves	4205			61	0.4	0.1	1.5	137	1	1.8	21	4
	150	Crumbly maize meal porridge	3377	130	Maize meal, fortified	704	36.5	1.5	3.9	120	0	1.5	47	307
			4042	250	Water									
			4288	2	Salt									
TOTAL, Day 2						5882	124.9	62.2	81.8	902	24	13.4	180	880

DAY 2: Assumptions made: Bread flour unfortified, composite values used from Technical report for Wheat analysis, 2005; Beef tripe (food code 4342) used for tripe food item; Imifino was replaced with Amaranth leaves for analysis (food code 3980)

DAY 3

Mealtime	Amt	Food item	Food code	Amount (g)	Details of food item	Energy (kJ)	CHO (g)	Fat (g)	Prot (g)	Vit A (mcg)	Vit C (mg)	Fe (mg)	Mg (mg)	Na (mg)
Breakfast	95	Vegetarian sausage	New code	95	Vegetarian Fry's sausages	494	4.8	5.7	15.7	0	0	0	0	1
	40	Pumpkin leaves, cooked	4205			44	0.3	0.1	1.1	100	0	1.3	15	3
	40	Black jack leaves, cooked	4042	100	Water	52	0.6	0.1	0.8	229	5	1.4	32	2
			4210	140	Black jack leaves raw									
	100	Soft maize meal porridge	3270	130	Maize meal, unfortified	347	16.8	0.5	1.8	0	0	0.1	16	124
			4042	500	Water									
			4288	2	Salt									
Lunch														
	150	Chicken heads, boiled	2999	150	Chicken heads, raw	408	0	5.6	10.1	0	0	0	0	0
			4042	150	Water									
	150	Chicken feet, boiled	New code	150	Chicken feet boiled	1350	0.3	21.9	29.1	0	0	1.4	8	101
	100	Stiff pap	3377	130	Maize meal, fortified	354	18.3	0.7	2	60	0	0.7	24	154
			4042	375	Water									
			4288	2	Salt									
68	Pumpkin, boiled	4164			63	2	0.1	0.5	145	3	0.2	5	1	
Supper														
	445	Maize meal and beans	3270	187	Maize meal, unfortified	2571	114.8	3.5	17.2	0	1	3.2	153	22
			4042	454	Water									
			4288	62.4	Beans									
	100	Beef lung, fried	3019	80	Beef lung	1127	0	23	16.3	154	26	4.3	8	81
			3516	20	Cooking fat									
TOTAL, Day 3						6810	157.9	61.2	94.6	688	35	12.6	261	489

DAY 3: Assumptions made: recipe used for Black jack leaves boiled, as database only has info for raw black jack leaves; chicken feet boiled – new nutrient information borrowed from the United States Department of Agriculture online database; recipe used for chicken heads, as database only has info for raw chicken heads; maize meal fortified (food code 3377) used and maize meal unfortified (food code 3270) used for recipe calculations.

Summary of 3 day Reference Menu

Mealtime				DAY 1			DAY 2			DAY 3									
Breakfast				Amt	Details	Recipe	Breakfast				Breakfast		Details	Recipe					
				150g	Philani porridge	150g Philani	155g Baked bread				95g	Vegetarian sausage							
						100g water						155g bread flour, unfortified			40g	Pumpkin leaves, cooked			
				15g	White sugar							1g yeast			40g	Black jack leaves, cooked			
												16g sugar				140g black jack leaves			
												163g water				100g water			
				60g	Brown bread			8.5g oil			100g	Soft maize meal, unfortified							
				5g	Hard margarine							130g maize meal, unfortified							
							25g	Hard margarine				500g water							
												2g salt							
Lunch				Lunch				Lunch				Lunch							
				308g	Phutu	130g maize meal, fortified	180g Soft maize meal porridge				150g	Chicken heads, boiled							
						375g water						150g Chicken feet boiled							
						2g salt						100g Stiff pap				130g maize meal, fortified			
				133g	Beans						133g beans	96g	Imifino, boiled				375g water		
											510g water	96g	Cabbage, boiled				2g salt		
											68g	Pumpkin, boiled							
Supper				Supper				Supper				Supper							
				125g	Horsemeat		250g Pork trotters, boiled				445g	Maize meal and beans		187g maize meal, unforti					
				180g	Soft maize meal porridge						130g maize meal, fortified		100g Tripe, boiled				454g water		
						500g water						55g Pumpkin leaves				62.4g beans			
						2g salt						150g Crumbly maize meal porridge				100g Beef lung fried			
												130g maize meal, fortified				80g beef lung			
								250g water				20g cooking fat							
								2g salt											

Reference Menu: Average intake (mean for 3 days)

Daily intakes	Energy (kJ)	Carbohydrate available (g)	Total Fat (g)	Total Prot (g)	Vitamin A (mcg)	Vitamin C (mg)	Fe (mg)	Mg (mg)	Na (mg)
Day 1	5757	195	28.7	71.4	1935	104	22.7	667	1324
Day 2	5882	124.9	62.2	81.8	902	24	13.4	180	880
Day 3	6810	157.9	61.2	94.6	688	35	12.6	261	489
Average intake of 3 days (mean)	6166	159.3	50.7	83.1	1364	58.7	16.2	392	918.7

University of Cape Town

Appendix H:

Critical review of study process by J Chetty

Protocol

With Part A being the Protocol document of thesis, it was exceptionally challenging for me at the end of the study execution, prepare the final thesis document. As the Protocol section was submitted to both the MRC and UCT Ethics committees, it was unclear as to whether any changes could be incorporated into this section, as it was approved by 2 committees. At the end, it was decided to secure minimal changes to the Protocol section of this submission. Upon instruction and suggestion of my supervisors, I edited the section with minimal changes.

Shortcomings of Protocol vs Publication section

In the Protocol it was envisaged to write up the final thesis in the conventional way, but I opted to complete this thesis according to the 2011 guideline framework of the Department of Public Health suggested. Again, I found that the various Parts listed for the final thesis could not be linked together and showed no logical flow of information, but formed separate parts to the research question raised by myself. Both supervisors, had concerns about the format of the thesis, but we decided to ultimately complete the write up in 4 parts as requested in the framework document for MPH students.

Publication

The Journal of Food composition and Analysis, note to authors suggests a different referencing style to what was used in the Protocol and Literature Review sections of the thesis. Information which was included in the Protocol section could not be repeated in the Publication section, and this was of extreme concern to me, as I was hoping much needed information was not excluded and lost?

Specific objectives were reduced to only 3 in the publication, as the 4th objective was incorporated into the 3rd. the protocol listed the specific objectives as (1) to identify the five frequently consumed indigenous vegetable and traditional foods; (2) determine participant assumptions and alternative food choices when nutrient information is not available in SAFOODS; (3) perform dietary analysis with assumption food choices and compare to a "gold standard" menu analysis and (4) compare the resultant analysis for energy, carbohydrate, protein, fat, vitamins A and C, iron, magnesium and sodium.