The youth's knowledge, perceptions and acceptance of African Leafy Vegetables growing in northern KwaZulu-Natal, South Africa

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ABSTRACT

In South Africa (SA), notable shift from traditional diets, rich in grains, pulses, fruits, and vegetables, to the consumption of easily accessible, high-energy, ultra-processed foods in most households has been reported. Despite the nutritional value and affordability of indigenous plant foods, they remain underutilized compared to conventional and exotic alternatives. This study explores the potential of underutilized local, indigenous, and traditional plant species in mitigating the adverse effects of the nutrition transition. Specifically, it investigates the knowledge, perceptions, and acceptance of African Leafy Vegetables (ALVs) among the youth (between 18 to 35 years old) in KwaZulu-Natal, South Africa.

A literature survey was conducted to examine the relationship between the "food environment," ultra-processed foods, and the nutrition transition. The assessment of youth's knowledge, perceptions, and acceptance revealed that factors such as repetitive preparation methods, limited availability of nutritive local African plant foods in supermarkets, and unattractive packaging contributed to the low consumption of indigenous plant foods. The in-season ALVs studied included Amaranthus, Pumpkin leaves, and Blackjack, with Spinach serving as a control. The study involved youths from two rural-based tertiary institutions in KwaZulu-Natal.

Findings suggest a positive shift in youth perceptions of ALVs. These vegetables, once considered 'backwards' or 'food for the poor/elderly' and even 'weeds,' are now recognized as essential components of a healthy diet to improve nutritional well-being. Among the studied ALVs, Amaranthus and Pumpkin leaves garnered greater interest among youths compared to Blackjack. Spinach, a widely consumed exotic vegetable, also attracted attention, as expected. This underscores the need for modernized approaches to ALV preparation to enhance acceptance and address utilization challenges. Diversifying ALV recipes can improve their appeal to young consumers.

The results further indicate that some participants express willingness to purchase ALVs from formal supermarkets if they were available. However, others may refrain from doing so due to a lack of information on how to prepare these vegetables. Consequently, raising awareness and providing information on ALVs and their nutritional benefits could play a vital role in increasing their acceptability and utilization among consumers.

TABLE OF CONTENTS

ABSTRACT ii
LIST OF FIGURES v
LIST OF TABLES vi
PREFACE vii
DECLARATION viii
DEDICATION ix
ACKNOWLEDGEMENTS x
RESEARCH OUTPUTS xiii
Publication 1 xiii
CHAPTER 1: Problem Statement and Its Setting 1
1.1 Introduction And Background 1
1.2 Problem Statement 3
1.3 Aim Of the Study 4
1.4 Specific Objectives of The Study 4
1.5 Dissertation Structure 4
References 5
CHAPTER 2: Literature Review 8
2.1 Introduction 8
2.2 The Concept of Food and Nutrition Security 12
2.2.1 Complexities Of Nutrition Security That Are Linked to Food Security 12
2.2.2 Nutrition Transition (NT) And Ultra-Processed Foods (Upfs) 14
2.2.3 Big Food Influences on The SA Food Environment 15
2.2.4 The Food Systems Concept 15
2.2.5 Consumer Trends and Preferences 16
2.2.6 Position And the Under - Consumption of Fruits, Vegetables, Grains And Pulses 17
2.2.7 Underutilised Foods for Food and Nutrition Security 20
2.2.8 Technology Development Efforts Using Underutilised Fruits and Vegetables 23
2.3 Recommendations To Further Improve Perceptions Towards Underutilised Plant Species 29
2.4 Conclusion 29
CHAPTER 3: Research Methodology and Design 40
3.1 Introduction 40
3.2 Research Approach 40
3.3 Description Of the Study Area 40
3.3 Population 41

3.4 Sampling 42
3.5 Ethical Considerations 42
3.6 Data Collection Methods and Instruments 43
3.6.1 Assessment Of ALVs Knowledge 43
3.6.2 Perceptions Of ALVs Assessment 43
3.6.3 Acceptability Of Available ALVs 43
3.7 Data Analysis 50
References 51
CHAPTER 4: Results 52
4. Introduction 52
4.1 Socio-Demographic Characteristics 52
4.2 Knowledge And Familiarity with ALVs 54
4.2.2 : Perception Towards ALVs 55
4.3 Consumption Pattern of ALVs 56
4.3.2 Consumption Of ALVs 56
4.3.3 Consumed ALVs 57
4.3.4 Reason For Non-Consumption of ALVs 58
4.4 Favourite ALVs 59
4.4.2 Favourite Cooking Method 61
4.4.3 Frequency Of Consuming ALVs 62
4.5 Identification Of ALVs 64
4.6.2 Keenness To Consume ALVs 66
4.6.3 Smell Of ALVs 68
4.6.4 Texture Of ALVs 69
4.6.5 Colour Of ALVs 70
4.6.6 Taste Of ALVs 72
4.6.7 After-Taste of ALVs 73
CHAPTER 5: Discussion 82
References 97
CHAPTER 6: Conclusion And Recommendations 99
Appendix A: Ethical Clearance Letter 101
Appendix B: Gatekeepers Letters 103
Appendix C: Consent Form 106
Appendix D: Survey Questionnaire 107
Appendix E: Sensory Evaluation Sheet 115
Appendix F: Focus Group Questionnaire 117

List Of Figures

Figure 2. 1: Relationship Between the Food Environment, Ultra-Processed Foods and Nutrition Transition.....14
Figure 2. 2: Different Types of Underutilised Plant Species: (A) Kei Apple (Dovyalis Caffra), (B) Moringa Oleifera, (C) Amarula (Sclerocarya Birrea), (D) Cleome (Cleome Gynandra), (E) Amaranth (Amaranthus Dubius) And (F) Pigeon Peas (Cajanus Cajan) (Daff, 2013).....23

Figure 3. 1: Maps Illustrating the University of Zululand (Left) And Owen Sithole College Of Agriculture (Right).....41
Figure 3. 2: Uncooked (Left) And Cooked (Right) Blackjack Leaves.....45
Figure 3. 3: Uncooked (Left) And Cooked (Right)Amaranthus Leaves.....46
Figure 3. 4: Uncooked (Left) And Cooked (Right) Spinach Leaves.....46
Figure 3. 5: Uncooked (Left) And Cooked (Right) Pumpkin Leaves.....47

Figure 4. 1: The Level of The Likeness of The Overall Appearance of Different ALVs.....65
Figure 4. 2: The Level of The Likeness of The Respondents' Keenness to Consume ALVs...67
Figure 4. 3: The Level of The Likeness of The Smell of ALVs.....68
Figure 4. 4: The Level of The Likeness of The Texture of ALVs.....69
Figure 4. 5: The Level of The Likeness of The Colour of ALVs.....71
Figure 4. 6: The Level of The Likeness of The Taste of ALVs.....72
Figure 4. 7: The Level of The Likeness of The Aftertaste of ALVs.....73

LIST OF TABLES

Table 2. 1: Different Types of Underutilised Leguminous Grains and Pulses (Per 100mg Boiled, Unsalted Sample)....18
Table 2. 2: Sensory Acceptability Studies on Underutilised Plants....25
Table 2. 3: Nutritional Composition of Different ALVs Per 100 G Of Cooked Samples (Hedges & Lister, 2007; Van Jaarsveld Et Al., 2014)....26
Table 2. 4: Nutritional Composition of Different Underutilised Fruits....28

Table 3. 1: Methodological Tools Summary....49

Table 4. 1: Socio-Demographic Characteristics....53
Table 4. 2: Respondents' Familiarity with Traditional Leafy Vegetables....54
Table 4. 3: Type Of Traditional Leafy Vegetables Respondents Are Familiar With....54
Table 4. 4: Youth's Knowledge and Perceptions Towards ALVs....55
Table 4. 5: Chi-Square Test of Demographic and ALVs Perception....56
Table 4. 6: Consumption Of ALVs Among Respondents Familiar with Them....57
Table 4. 7: ALVs Consumed by The Respondents....58
Table 4. 8: Respondents' Reason for Non-Consumption of ALVs....58
Table 4. 9: Response To Having Favourite ALVs....59
Table 4. 10: Respondents' Favourite ALVs....59
Table 4. 11: Reasons For Favourite....60
Table 4. 12: Respondents' Favourite ALVs Cooking Method....61
Table 4. 13: Respondents' Preferred Method of Consuming ALVs....62
Table 4. 14: Frequency Respondents Eat ALVs....62
Table 4. 15: Respondents' Reasons for Consuming ALVs....62
Table 4. 16: Source Of ALVs Consumed by The Respondents....63
Table 4. 17: Forms ALVs Are Obtained....64
Table 4. 18: Respondents' Identification of ALVs in Their Home Language and English....64
Table 4. 19: Comparison Of Traditional and English Identification of Vegetables....65
Table 4. 20: Analysis Of Variance (ANOVA) To Compare the Overall Appearance of Different ALVs....66
Table 4. 21: ANOVA To Compare the Keenness to Consume Different ALVs....67
Table 4. 22: ANOVA To Compare the Smell of Different ALVs....69
Table 4. 23: ANOVA Of the Texture of ALVs....70
Table 4. 24: ANOVA To Compare the Colour of Different ALVs....71
Table 4. 25: ANOVA To Compare the Taste of Different ALVs....72
Table 4. 26: ANOVA To Compare the Aftertaste of Different ALVs....74

PREFACE

This dissertation was developed at the School of Agricultural, Earth and Environmental Sciences at the University of KwaZulu-Natal from February 2021 to May 2023 under the supervision of Prof Unathi Kolanisi, Prof Nomali Ngobese and Prof Muthulisi Siwela.

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Prof Muthulisi Siwela (Co-Supervisor)

DECLARATION

I, Precious Sanelisiwe Shembe, declare that:

1. The work reported in this dissertation, except where otherwise indicated, is my original work.

2. The dissertation, or any part of it, has not been submitted for any degree or examination purposes at any university.

3. Where other sources have been used, they have been acknowledged properly.

4. This dissertation does not contain text, graphics or tables copied from other sources unless it is specified and acknowledged properly and in detail in the dissertation and in the references section.

Signed: 

Date: 10 May 2023

Precious Sanelisiwe Shembe (Candidate)

DEDICATION

This dissertation is dedicated to my late father, Mr M.A. Duma. I had hoped you will be able to see this dissertation, but I know that you are smiling down on me and proud. Continue to rest in perfect peace Mthombeni!

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RESEARCH OUTPUTS

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Conceptualisation, P.S.S and U.K.; investigation, P.S.S.; data curation, P.S.S.; writing—original draft preparation, P.S.S.; supervision, U.K., N.Z.N. and M.S.; project administration and funding acquisition, not applicable. All authors have read, edited and agreed to the submitted version of the manuscript.

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LIST OF ACRONYMS

ALV	**African Leafy Vegetables**
ANOVA	**Analysis of variance**
EV	**Exotic vegetables**
FAO	**Food Agricultural Organisation**
FNS	**Food and nutrition security**
HSSREC	**Humanities and Social Sciences Research Ethics Committee**
IARC	**International Agency for Research on Cancer**
IK	**Indigenous knowledge-based**
KPA	**Knowledge, perceptions and acceptability**
NDP	**National Development Plan**
NT	**Nutrition Transition**
OSCA	**Owen Sithole College of Agriculture**
PDIS	**Provincial dietary intake study**
SA	**South Africa**
SPSS	**Statistical Package for the Social Sciences**
WHO	**World Health Organisation**
GMO	**Genetically Modified Organisms**
KFC	**Kentucky Fried Chicken**
PI	**Project Investigator**
TLV	**Traditional Leafy Vegetables**
UKZN	**University of KwaZulu-Natal**

CHAPTER 1: Problem statement and its setting

1.1 Introduction and Background

The recommendation by the World Health Organisation (WHO) for a healthy balanced diet includes the consumption of at least 400 grams of fruits plus foods rich in diverse vegetables per day by every individual (Ruel et al., 2004, Gido et al., 2017). However, studies show that most countries especially in Asia and Africa are unable to meet their recommended vegetable and fruit intake requirements due to budgetary and psycho-social factors (Lans et al., 2012) Reports on studies conducted on Australian children by Thurber et al., (2017) revealed that availability, affordability and accessibility of fruits and vegetables are the influential factors in consumption. It is further reported that globally, there is a decline in the consumption of pulses, roots, and tubers such as, sweet potatoes, yams and taro. This decline poses a risk of further micro-nutrient deficiencies, especially for developing countries in Sub-Saharan Africa and China since these crops are the primary sources of essential nutrients like protein, vitamins, and minerals (Kearney, 2010).

South Africa boasts of an abundance of indigenous fruits and vegetable crops. In addition to the indigenous species are traditional or naturalised crops, which were introduced either in the form of grains, vegetables or fruits (DAFF, 2013). Some indigenous fruits and leafy vegetables [also known as African leafy vegetables (ALVs)] are known for being rich in essential nutrients such as protein, vitamins A and C, iron, calcium, and fibre compared to exotic vegetables (EVs). In addition, some African leafy vegetables (ALVs) grow well in the wild, where there is a limited supply of water and nutrients and have earned being labelled as "low-input crops". There are more than 100 species of ALVs that grow well in SA. Only a few of these species are utilised and they include *Cucurbita* spp, (Pumpkin), *C. olitonus* (Jute mallow), *Vigna unguiculata* (Cowpeas), *Amaranthus cruentus* (Pigweed), *Corchorus species, Citrullus lanatus* (Bitter melon) and *Cleome gynandra* (spider plant) with Pigweed and Pumpkin leaves being the most used (Maseko et al., 2017).

Pumpkin leaves, also known as curcubits (*Curcubita olarecia*), Amaranthus (*Amaranthus cruentus*) and Blackjack (*Bidens pilosa*) are some of the most common ALVs widely grown in most parts of Southern Africa including KwaZulu-Natal and Limpopo (DAFF, 2013). The main parts that are consumed in Cucurbits are the leaves, flowers, fruits, and seeds. In Amaranthus and Blackjack leaves are mostly consumed and in some parts seeds of the Amaranthus are also consumed (Ndoro et al., 2007). Amaranthus and Blackjack cultivation is not popular in SA, but

the plants grow as volunteer plants after the first Spring rains (DAFF, 2013). Research has demonstrated that when cultivated, Amaranthus can produce very high yields of ± 40 (forty) tonnes per hectare (DAFF, 2013). The availability of these ALVs during the first rains when other vegetables are still growing and their ability to grow with little to no inputs makes them an easily accessible and cheaper alternative to exotic vegetables (EVs).

Although there is active consumption and incorporation of some traditional vegetable varieties cultivated in SA like the *Corchorus* and the *Amaranthus* species that grow in abundance, their optimum utilisation is hindered by negative perception, as they are still regarded as "wild species/weeds", “backward” and “food for the poor” (Qumbisa, 2019). Previous studies have shown a decline in the consumption of ALVs amongst households, consequently affecting their utilisation. Nonetheless, the older generation still holds positive perceptions towards ALVs. Modi et al. (2006), Dweba & Mearns (2011), Taruvinga & Nengovhela (2015) and Dlamini & Viljoen (2020) have confirmed that negative attitudes, and primitiveness associated with ALVs have led to a declined usage and consumption by the general population.

A study by Sigaqa et al. (2017) done on the youth revealed the declining utilisation of ALVs due to monotonous preparation and concerns about food safety. Furthermore, Senyolo et al. (2019) reported safety concerns among consumers. According to the scholar, the fact that the ALVs were mainly sold in informal markets led to a lack of trust and compromised their consumption because they were not valued as their exotic counterparts. Another contextual fact that is related to this transgression of underutilisation of ALVs is the lack of intergenerational knowledge about ALVs and other traditional foods. Consequently, engineering the shift towards the declining knowledge and utilisation of ALVs influences food choices and decision–making in most consumers when purchasing foods (Dlamini & Viljoen, 2020). It is arguable that indigenous food crops could be a healthier option, boosting food and nutrition security, and reducing nutrition insecurity-related diseases and disorders.

Recent trends show that consumers are becoming very conscious of ethical, cultural, and technical characteristics related to the food they consume. Findings from several studies indicate that modern consumers go beyond the perception that food supplies energy to survive. They consider the accessibility of nutritious food, healthy eating, the how, where, and the type of food consumed and exercising when making diet choices. Hence, recent studies have

assessed modernising ALV food products to make them appealing to the general population and the youth as future consumers (Modi et al., 2006; Sigaqa et al., 2017; Dlamini & Viljoen, 2020; Qumbisa et al., 2020). There are noticeable research studies focusing on product development and interfacing indigenous and traditional ingredients. However, limited attention has been given to the acceptability, knowledge of ALVs in their original form, perceptions regarding these ALVs, and their recognition as traditional foods. It can be deduced that more exploration of the KwaZulu-Natal province youth's knowledge, perception, and acceptability of ALVs as future consumers, could provide valuable insight into future ALVs consumers know. Such information could be used to devise intervention strategies to promote the utilisation and acceptability of the ALVs.

1.2 Problem Statement

There is a reported decline and shift from the use of traditional foods in African countries compared to western foods (Dlamini & Viljoen, 2020). Numerous studies have reported that there is an association of African Leafy Vegetables with poverty and backwardness by the general population, which has led to a decline in the consumption and utilisation of ALVs. The Food Agricultural Organisation (FAO) recommends that indigenous foods can be used to meet food and nutrition requirements needed by the rapidly growing population in developing countries that are currently consuming food that is less nutritious and unhealthy. The FAO recommends the consumption of indigenous foods because some are rich in nutrients, easy to grow and abundantly available globally (Durst & Bayasgalanbat, 2014). Studies conducted in countries like Kenya, Malawi and Zambia show that there is an increasing trend in the consumption of indigenous foods, particularly, indigenous leafy vegetables (Gogo et al., 2017).

In contrast, a different context exists in SA, where there is a noticeably slow pace towards the inclusion of ALVs in household diets and commercial markets leading to low utilisation (Dlamini & Viljoen, 2020). This is a concern because SA is still faced with a multitude of nutritional deficiencies, including vitamin A and iron deficiency (Senekal et al., 2019). The cliché is that the ALVs grow in abundance in most rural communities, and these vegetables could strengthen diet diversity, improving food and nutrition security. Consequently, the ALVs could be included in the food value chain, and the youth could farm these vegetables for commercialisation and generate livelihoods.

1.3 Significance of the study

Understanding the younger generation's knowledge, acceptance, and perceptions of ALVs is of vital importance because it can help to address the current underlying food security challenges faced by most households in Sub-Saharan Africa and globally. There is an existing correlation between the utilisation and accessibility of ALVs. This means that the underutilisation of ALVs stems from the unavailability of information on how these vegetables can be accessed in sufficient quantities (Modi et al., 2006; Dlamini & Viljoen, 2020). This study will help to determine and to improve the awareness of ALVs by the youth and may, in turn, help in reducing marginalisation and misconceptions about ALVs. This research may also assist in preventing the loss of intergenerational knowledge about ALVs.

1.4 Aim of the study

The aim of the study was to evaluate the knowledge, perceptions, and acceptability (KPA) of the ALVs among youth of northern KwaZulu-Natal.

1.5 Specific Objectives of the Study

The objectives of this study were as follows:

1.5.1 Assess the knowledge of the ALVs among the youth.

1.5.2 Determine youth perceptions towards the consumption of ALVs.

1.5.3 Analyse the acceptability of in-season ALVs dishes among youth.

1.6 Limitations of the study

Only 120 participants were sampled in this study, which might not be a number large enough and representative of the South African youth. There were not sufficient ALVs to provide for of the samples in large quantities, therefore each participant was limited to a single tablespoon of each ALV.

1.7 Dissertation Structure

This dissertation consists of Chapter 1, which comprises the introduction and background, problem statement, rationale, research questions as well as the aim and objectives of the study. Chapter 2 consists of the literature review relevant to this study, which is a manuscript submitted to a peer-reviewed journal seeking to provide insight into the repositioning of underutilised plants for food and nutrition security. Chapter 3 describes the methodology that

was followed to carry out the study. The results and discussion of the study are presented in Chapter 4. Results are discussed in Chapter 5. Conclusions and recommendations are drawn and presented in Chapter 6.

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CHAPTER 2: Literature Review

[1]The potential repositioning of South African underutilised plants for food and nutrition security: a scoping review

2.1 Introduction

The Food and Agriculture Organisation (FAO) (FAO et al., 2021) has reported that in the year 2020, between 720 and 811 million people in the world (meaning one in three people) experienced hunger. Furthermore, more than one-third (282 million) of undernourished people are in Africa (FAO et al., 2021). The FAO has also Approximated that 149.2 million children (22%) below 5 years of age had stunted growth, 45.4 million (6.7%) suffered from wasting and 38.9 million (5%) were overweight, globally in the year 2020, with more children from Asia and Africa being affected the most. Also concerning are the major differences in the prevalence of anaemia in women of childbearing age between developed and developing regions. At least, 30% of African and Asian women of childbearing age were anaemic whereas only 14.6 % of the same age group of women from Northern American and European countries were anaemic (FAO et al., 2021). Worldwide, there is also a generally high prevalence of adult obesity. These data and information demonstrate the prevalence of hidden hunger and malnutrition, more especially in African and Asian countries. These reports are a confirmation that Sustainable Development Goal (SDG) 2, which is to end world hunger by the year 2030, is far from being achieved, without taking appropriate actions to end the causes of food insecurity.

From the 1950s, until the early 2000s, food security was measured using the 1st Comprehensive International Data Framework(CIDF), which only based food insecurity measurement on energy and protein deprivation (Berry et al., 2015). This means that the only concern had always been the availability of large quantities of food, while neglecting the quality of food and the availability and accessibility of quality foods. Hunger is generally defined by the FAO as an uncomfortable sensation caused by insufficient food and energy intake. It would be insufficient and inaccurate to measure hunger only as energy or calorie intake. Mozaffarian et al., (2021) describe this injustice of focusing just on food quantity over quality as "filling people with food but leaving them hungry". This measurement of food security using only energy intake has led to at least two billion people in the world being affected by hidden hunger (IFPRI, 2015).

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Nutrition transition is a shift from traditional diets to what is referred to as "energy-dense diets"- these are diets consisting mainly of high fat, salt and sugar content (Dandala, 2018). According to a study by Dandala, (2018), people were more concerned about not having sufficient food and the food required in adequate quantities consisted of monotonous starchy staples and as such, those foods led to a nutritionally unbalanced diet. The low-economic status (leading to low access to food) of the population groups following monotonous diets seems to be a major contributing factor in distorting and limiting the food choices of most households.

Hidden hunger occurs when people's diets are deficient in essential vitamins and micro-nutrients, with vitamin A, iron, iodine, and zinc being nutrients of major concern, globally (Harding et al., 2018). Hidden hunger can result from the consumption of ultra-processed foods that are rich in energy and fats and/or consuming monotonous starchy foods. The inability to consume enough nutritious foods required for a healthy and balanced life leads to nutrition insecurity. Malnutrition in its different forms is currently a concern and is being experienced globally, and as stated above, it is due to the not-optimal diets adopted by most households (Caron et al., 2017).

The current trends are that consumers place more preference on fast, more convenient foods that are ready-to-eat (Deloitte, 2019). However, consumer preferences do not single-handedly play a role in what foods are consumed, but also the "food environment". Food environment is defined by the FAO (FAO, 2016) as all the foods which are available and accessible to people in the settings in which they go about their daily lives i.e., supermarkets, street food stalls, restaurants, etc. The physical, economic, political and socio - cultural context which influences consumers' decisions when acquiring, preparing, and consuming food is also involved (Caron et al., 2017). Food environments, therefore, have a major contribution to the hidden hunger of most households, since they must limit their preferences based on what is available around them, which is usually fast, convenient, ultra-processed foods that are not nutritious, but relatively affordable. On the other hand, diversity diets containing nutritious foods have become increasingly too expensive for the average consumer.

In the year 2003, the government of SA introduced programmes to assist in fighting micro-nutrient deficiencies and they included a compulsory food fortification policy for maize meal and flour, as well as a vitamin A supplementation programme for post-partum women and children between 6 months and five years old (Shisana et al., 2013; Ngidi & Hendriks, 2014).

The SA government also developed a long-term plan in 2012 known as the National Development Plan (NDP) which aimed at providing a better future for all and which will ensure that no individual experiences poverty or goes hungry. The provision of adequate nutrition is among the ten elements/goals which the NDP aims to achieve by the year 2030 (NDP, 2012). Moreover, the Food and Nutrition Policy which was developed in 2015 included a multitude of agricultural programmes such as "one home, one garden," school feeding schemes, and social grants, to name a few (Delport, 2019).

Despite these interventions by the government, reports by Statistics South Africa continue to indicate that more households in SA are experiencing food insecurity. These interventions have provided dietary diversity for households. However, due to a lack of a food security tool to measure all four pillars holistically, there were still reports of hunger and food insecurity for at least 34.4% of rural households in the KwaZulu-Natal province alone in the year 2013 (D'Haese et al., 2013). There were also reports of stunting, wasting and underweight for boys and girls under 15 years of age (Shisana et al., 2013; Ngidi & Hendriks, 2014). Maziya et al., (2017) reported that SA is food secure, but only on the national level and not on a household level. Household food insecurity increases with a higher number of household members, a decrease in the level of income, households living in rural areas and female-headed households (Maziya et al., 2017).

Fruits and vegetables have always been praised for being high in micro-nutrients and antioxidants. However, their consumption is still reported to be very low (Pem & Jeewon, 2015). This low consumption of fruits and vegetables is also a major contributing factor to micro-nutrient deficiencies. Although some reports on the limited consumption of fruits and vegetables are related to their high cost, SA boasts of an abundance of underutilised wild and domesticated (crops) fruits and vegetables, which would be cheaper substitutes to expensive, exotic fruits and vegetables (Pem & Jeewon, 2015). Among the underutilised plant species are indigenous and traditional (or naturalised) crops, including grains, vegetables, and fruits (DAFF, 2013).

Underutilised plant foods, also known as neglected plant foods, are mostly wild, or semi-domesticated species that are adapted to local environments. These plant species were in the past used as traditional foods but became increasingly neglected when more productive crops were introduced to the farming systems (Modi et al., 2006). Some underutilised plants are

known for being rich in essential nutrients such as protein, vitamins A and C, iron, calcium, and fibre compared to exotic plants. In addition, they grow well in the wild, where there is a limited supply of water and nutrients, they have therefore earned being labelled as “low-input crops”. Despite this fact, the consumption and incorporation (in diets and as crops) of some underutilised plant species that are abundant in SA like the *Corchorus* and the *Amaranthus* species are hindered by the perception that they are "wild species/weeds", “primitive foods” and “food for the poor”. This perception has led to most underutilised plant foods not being considered for extensive commercial production, which influences their availability in commercial markets, thus, leading to a further decline in their consumption (Maseko et al., 2017).

Currently, in SA, there is little or no investment and recognition of underutilised plants through commercialisation by the bigger farming industry to ensure adequate and constant supply all year round. Most underutilised plants currently grow as volunteer plants and are cultivated at a very small scale. This lack of recognition makes underutilised plants ineffective in alleviating micro-nutrient deficiencies as well as improving food and nutrition security. As a result, food insecurity persists despite all interventions implemented by SA. The battle should continue to explore other ways of dealing with the challenge. This article, therefore, suggests repositioning underutilised indigenous foods to be part of the SA food system. These underutilised crops need to be mainstreamed into the SAn food system (Mabhaudhi et al., 2019). Currently, research and innovation on processed indigenous foods is limited in SA yet it would contribute to dietary diversification and a potential for home fortification and income generation, making a considerable contribution to food security.

This review was therefore conducted to evaluate the current consumption status of underutilised plant species and their potential role in addressing (through improving food and nutrition security) the adverse effects of the nutrition transition, which involves increased use of ultra-processed foods on the health and nutritional status of current households in SA, to prevent the same adverse effect on future generations. The following research question was then formulated: What is known from the literature regarding the causes of food insecurity and micro-nutrient deficiencies as well as the consumption/utilisation, perceptions and their potential in addressing the existing food insecurity challenges?

2.2 The Concept of Food and Nutrition Security

Previously, the measure of food security has always been about the availability of food in sufficient quantities while neglecting other food security parameters whose focus is on the food quality and nutrition status of an individual [(Berry et al., 2015). There is a known argument by scholars that states that food security does not guarantee nutrition security because of the focus on food quantity rather than quality, resulting in less costly affordable food (FAO, 2008; Ingram, 2020). The main driving factor for food that is made available by economists and policymakers is the demand for food to alleviate hunger, consequently aggravating hidden hunger since the quality of the food is neglected. The FAO, (2008) also states that all hungry people are food insecure, but not all food insecure people are hungry since other causes of food insecurity are related to micro-nutrient deficiencies.

Food and nutrition security is defined by the Committee on World Food Security (Committee on World Food Security, 2012) as the situation that exists when macro and micro-nutrients requirements are fully met for a good quality of life. Consumption of sustainable diets to address nutrient requirements via the consumption of nutritionally adequate foods, produced ethically, non-detrimental to the environment, accessible and affordable to everyone is one way to ensure healthy populations as well as economic, social and environmental sustainability for future generations (CAPONE et al., 2016; Rasmussen et al., 2020)

Food security exists when all people, at all times have physical, social and economic access to sufficient, safe and nutritious food. Notwithstanding, nutrition transition only embraces the 'availability of sufficient food, at all times' part, while neglecting the other three parameters which are: access, utilisation and stability. Nutrition transition has compromised the 'quality of food' to a great deal, therefore, to bridge this gap and to embrace all four food security concepts holistically, the best term to adopt would be food and nutrition security (FNS).

2.2.1 Complexities of nutrition security that are linked to food security

In recent decades, most individuals and households have shifted from well-balanced and highly nutritious diets of vegetables, fruits, pulses, grains, etc. to consumption of diets that are comprised of ultra-processed foods that are high in calories and energy, but less nutritious (Baker et al., 2020). Ultra-processed foods are manufactured through the usage of high-end industrialised technologies to alter (mould, pre-fry etc.) ingredients to turn them into highly

profitable food products that are convenient and highly palatable enough to replace home cooking of unprocessed food products. Examples include; energy and carbonated drinks, Pastries, Pizzas, Burger patties, meal replacement shakes, ice creams, candies etc. (Monteiro et al., 2018). This nutrition transition has largely been influenced by the food environment which only makes available ultra-processed foods at affordable prices and nutritious foods at expensive rates. Ultra-processed foods, nutrition transition and the food environment are interlinked in contributing to the food and nutrition security (FNS) status of individuals and households (see Figure 2.1 below). The food that is easily made available by the food environment is ultra-processed, yet not nutritious which forces households to transition towards the consumption of that which is made available to them, thus leading to poor FNS status. Buying power has been linked to distorted food choices by many households since ultra-processed foods are available at reasonable prices (Dandala, 2018). However, having sufficient money to afford expensive, nutritious food does not guarantee that one would stick to a nutritionally balanced diet which can therefore still lead to nutritional transition and food insecurity.

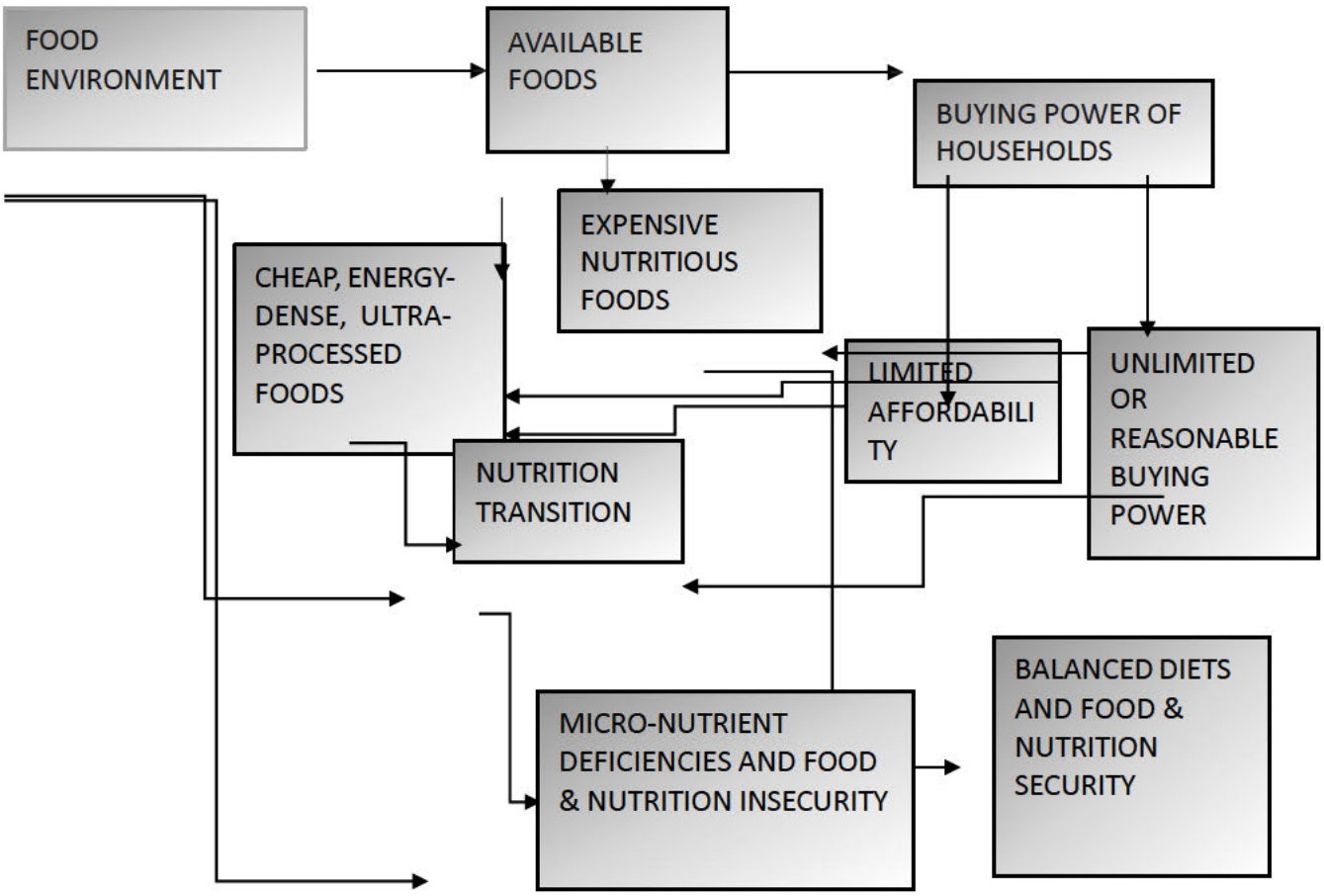

Figure 2. 1: Relationship between the food environment, ultra-processed foods and nutrition transition

2.2.2 Nutrition Transition (NT) and Ultra-Processed Foods (UPFs)

NT is described as a change in nutrient consumption influenced by modernisation and urbanisation due to economic development, and social and lifestyle changes which expose society to new food products which are usually ultra-processed and easy to prepare (Wentzel-Viljoen et al., 2018). Similarly, Kearney, (2010) confirms that NT creates a scenario where healthy, traditional staple diets consisting of pulses, vegetables and grains are replaced by high sugar and fat content diets, which are deemed tasty by society. NT has led to many countries shifting to high rates of malnutrition, obesity and noncommunicable diseases due to an exponential rise in the consumption of unhealthy foods. There were reports that SA was the most African country that showed an epidemiological NT on obesity trends amongst its' adult population of different race groups. This included under and over-nutrition due to instances of inconsistency in the intake of macro and micro-nutrients (Faber & Wenhold, 2016; Dandala, 2018). This was even at a higher rate in black African adult females, children and adolescents, which is highly concerning (Iversen et al., 2011; Dandala, 2018). Micro-nutrient deficiencies especially of vitamin A were reportedly more common among the black African population in SA compared to other ethnic groups (Iversen et al., 2011; Dandala, 2018).

Most UPFs have been directly linked by the World Health Organisation (WHO) to obesity and chronic noncommunicable diseases (Amine et al., 2003; WHO, 2013). Processing of food products involves the incorporation of synthetic food additives like colourants, flavourants, meat extenders, emulsifiers etc. to make them more attractive and tastier to consumers (Monteiro et al., 2018). However, synthetic additives like colourants are derived from coal tar, which produces carcinogenic effects after long-term use in the liver and the bladder according to Roelofzen et al., (2010). Synthetic additives were also reported to lead to hyperactivity in children (Dey & Nagababu, 2022). Although popular with the general population, due to their vigorous marketing and convenience, UPFs still do not provide balanced nutrition for a good quality of life (Amine et al., 2003; WHO, 2013; Monteiro et al., 2018).

2.2.3 Big food influences on the SA food environment

As the food security concept evolves, a research-based understanding of emerging key issues in global and regional food security has impacted local food security and the role of private sector influences. One of the major challenges SA is facing is that of large commercial entities that influence the food and beverage industry which are also referred to as "big food". These entities account for at least, 51,8% sales of packaged foods (Siphugu & Rubio, 2019) and 79% of soft drinks in SA (Igumbor et al., 2012). Such entities include Pioneer foods which is based in SA, has an international presence in some African countries and was partners with Heinz US as well as Coca Cola which is the largest big food influencer in the beverage industry with at least 49,8% sales of soft drinks in 2012 and this number increases by 10 to 12% every year. [(Siphugu & Rubio, 2019). In a survey conducted in August 2020 by Statista, 89% of the respondents preferred the Coca-Cola-carbonated beverage over others. Although, generally, food service outlets and retailers including restaurants, food trucks, kiosks etc. somewhat provide influence on consumers' food choices, larger entities like Nando's and KFC are major "big food" influencers on consumer food choices (Igumbor et al., 2012). The SAn government through the SAn Revenue Service has recently introduced the sugar tax whereby non-alcoholic, sugary beverage producers excluding fruit juice have to pay a tax of 10% per cost per litre of beverage produced. Perhaps this regulation policy may cause companies to reduce the amount of sugar added in carbonated drinks, iced teas etc. or maybe opt to produce healthier beverages that are mostly plant-based.

2.2.4 The food systems concept

Kennedy et al., (2021) highlight fundamental strategies that can assist in the transformation of food systems to curb the existing food insecurity challenges in SA. These include the re-invention of agriculture, the transformation of food environments for healthy diets, the mitigation of climate change, engagement of the private sector and influencing public policy priorities. In essence, this calls for collaboration between various sectors and disciplines to ensure sustainable agricultural practices that promote healthy, disease-free diets, and address food quality challenges that are not harmful to the environment (plants, animals and the planet as a whole). This transformation will not only assist in ending world hunger (SDG 2), but it will also reduce poverty, improve people's health and well-being and lead to sustainable communities and cities thus achieving other SDGs. This can only be achieved if policymakers have a shared goal and understanding with researchers from different disciplines. Rampa et al., (2020) assert that underutilised plant species can contribute to achieving some of the goals in

the SDG 30 agenda through their ability to provide necessary essential nutrients, enhancing economies of households through the provision of less costly, nutritious food which is mainly sold by local smallholder farmers, some who are women and youth. Underutilised plants can also contribute to the promotion of sustainable agriculture which does not harm the environment (since they require minimal fertilisers, pesticides and water usage) as well as the preservation of their indigenous knowledge and its transfer to future development technologies.

Climate-smart agriculture (CSA) would involve the production of plant- and animal-sourced foods that satisfy human diets without compromising the environment. Food-based dietary guidelines and consumer education, together with incentivising "big food" companies to produce foods that are considerably inclusive of necessary nutrients for a balanced diet. This would include the production of less sugary drinks and perhaps the use of more plant-based drinks made from underutilised fruits and vegetables. Most countries are placing more emphasis on the adoption of non-staple crops that are rich in micro-nutrients by commercial farmers and underutilised plants should naturally be the first choice. This job rests on the shoulders of policymakers.

2.2.5 Consumer trends and preferences

In the past, the food chain was a linear process that was directly from field/farm to consumer. In contrast, due to the evolution of demographics, consumer preferences and globalisation, a much more complex food chain has formed over the years (Deloitte, 2019). This evolution has been brought about by new technologies like food processing, online food applications for ordering food (like Uber Eats) etc. that ensure direct access to processed, fast foods that are ready-to-eat and available at all times. More and more consumers prefer to eat food from their favourite restaurant or kitchen due to convenience compared to preparing food from scratch.

Furthermore, there is a growing trend of consumers preferring to order their groceries online and have them delivered to their door at 'the click of a button' (Deloitte, 2019). O'Kane & Pamphilon, (2020) add that people prefer going to supermarkets and ordering online because this saves time compared to having to drive to farmers' markets where a variety of fruits and vegetables are available but requires more time and engagement from the consumers. This now means that consumers' diets are now governed by what is available at their restaurant of choice or supermarket. This also means that consumers' preferences and habits will always evolve as

and when restaurants and other food producers introduce the latest ‘trendy’ foods and as they advance in food technology.

More individuals consider meat and ultra-processed meat products an important part of their diets. However, the high consumption of meat and its products are being criticised due to environmental, ethical and social concerns. Meat production has been reported to account for two-thirds of greenhouse gas emissions as well as the reduction of the freshwater footprint for humans (Gerbens-Leenes et al., 2013). The International Agency for Research on Cancer (IARC) in 2015, reported red meat and processed meat products as possible carcinogens to humans. González et al., (2020) further reported that since meat and its products are high in soluble fats, they are the main derivative of cardiovascular disease, colorectal cancers and virus infections which are mainly caused by wild meat consumption. On the other hand, plant-based protein sources provide a better substitute that is more environmentally, socially and ethically sustainable compared to meat and ultra-processed derivatives (Profeta et al., 2021).

There is also a growing trend of consumers wanting to eat ethically and sustainably produced foods as well as foods that go with their social beliefs like Halaal, animal welfare, meat-free, gluten-free, non-genetically modified (non-GMO), locally produced etc. In a study conducted by Vergeer et al., (2020), respondents that were more conscious about the ethical and sustainable production of their food were mostly pescatarian, vegan and vegetarian compared to meat-eating respondents. This trend may assist in shifting from the consumption of unhealthy, ultra-processed foods to much healthier diets that are nutritionally balanced which will in turn combat hidden hunger and micro-nutrient deficiencies. Aspiring chefs who prepare food-based on the growing social media trends of ‘Insta-worthy’ food, as well as food from television food channels which is more appealing, are developing the culture of bringing families and friends together (Deloitte, 2019). This trend can lead to the promotion of the consumption of healthier foods if it is utilised wisely.

2.2.6 Position and the under - consumption of fruits, vegetables, grains and pulses

There is a perception that grains, pulses, fruits and vegetables are expensive to purchase. More often than not, fruits and vegetables have a shorter shelf-life, which makes it difficult to purchase and keep them for a long time. These are some of the reasons why people do not buy fruits and vegetables in comparable quantities to processed food. Unlike in the olden days, when various grains, pulses, fruits and vegetables were more popular, plant-based diets as sources of

protein are insufficient to provide a balanced diet. However, fruits and vegetables are a vital source of vitamins, minerals, and fibre, and are important for obtaining adequate micro-nutrients to reduce risks of chronic diseases, and obesity, and to ensure sustainable diets. The WHO, 2018) states that a high risk of noncommunicable diseases and poor health is mostly attributed to reduced or no intake of fruits and vegetables.

Fruits and vegetables have been considered a source of antioxidants, which are substances that protect the body cells from free radicals, diseases like heart diseases and certain cancers (Pem & Jeewon, 2015). Grains and pulses are no exception to the crops that are underutilised for human consumption and medicinal use. In 2021, Grain SA reported very limited cultivation of leguminous crops like Chickpeas, Groundnuts and Pigeon peas. This was due to these crops' narrow genetic base as well as the fact that they are only produced from local landraces by smallholder farmers. Leguminous crops are useful in improving soil fertility through atmospheric nitrogen fixation (Chaudhary et al., 2013). Leguminous crops are rich in starch, protein, calcium, fats, manganese, fibre and minerals which makes them an ideal source of protein-rich cereals as illustrated in Table 2.1. However, studies that have been conducted in recent years still showed that consumption of grains, pulses, fruits and vegetables is still very low despite their obvious health benefits (Pem & Jeewon, 2015; WHO, 2018). The WHO recommends the consumption of 400 grams of fruits and vegetables which are also diversified as five different fruits and vegetables per person, per day. Underconsumption of grains, pulses, fruits and vegetables causes a regression in the ongoing fight against noncommunicable diseases, hidden hunger, malnutrition, and obesity which necessitates calls for interventions to ensure an increase in their intake globally.

Table 2. 1: Different types of underutilised leguminous grains and pulses (per 100mg boiled, unsalted sample)

Nutrien	Unit	Pigeon pea [(Sharma et al., 2011	Chickpeas [(Wallace al., a	Cowpeas [(Affrifah al., a
Energy	kJ/100	5.2 (%)	164	116

Protein	g/100g	24.6 (%)	8.86	7.73
Calcium	mg/100g	16.3	49	24
Magnesium	mg/100g	78.9	48	53
Starch	mg/100g	57.6 (%)	4.8	-
Sodium	mg/100g	247	7	4
Potassium	mg/100g	-	291	278
Copper	µg/100g	1.3	0.35	-
Zinc	mg/100g	3.0	1.53	1.29
Iron	mg/100g	2.9	6.1	2.51
Fibre	mg/100g	1.2 (%)	0.76	6.5
Folate	µg/100g	-	172	208
Choline	mg/100g	-	42.8	32.2
Thiamine	mg/100g	0.03	0.01	-
Riboflavin	mg/100g	0.03	0.09	-
Carotene	µg/100g	3	3	-
Vitamin C	mg/100g	27.9	1.3	0.4

A study that was conducted in SA on the intake of most commonly available fruits and vegetables discovered that urban township dwellers purchased fruits and vegetables more than rural dwellers. The study also discovered that overall fruit and vegetable intake was still very low and below the recommended daily intake. It found that the consumption of fruits and vegetables was instead substituted by the common culprit, which is sugary, fizzy drinks (Okop et al., 2019). However, in most African countries, there is an increase in the consumption of ALVs among participants, but strong food cultural beliefs and taboos are still a hindrance to their effective consumption and utilisation (Kansiime et al., 2018; Ochieng et al., 2018).

In a study conducted by Thurber et al., (2017) on barriers to nutrition for children, "dislike" of fruits and vegetables was the main barrier to those children's nutrition. The "dislike" was mainly related to picky eating, which is described as discomfort in consuming foods that are known or unknown. Picky eating leads to poor-quality diets as a result of the deliberate avoidance of fruits and vegetables and a high intake of energy-rich snacks and sweets. Caregivers are conflicted in this regard because as much as they would like for children to be healthy, there is also a need to let them exercise their right to choose the types of food to consume.

2.2.7 Underutilised foods for FNS

Traditional plant foods are defined as plant foods that have been used over a long period and they can either be indigenous or indigenised. They are referred to as traditional because of the abundant indigenous knowledge system that constitutes them. Indigenised species are those species that a specific group of people occupying a particular area have learnt how to find those species, and how to produce and prepare them for consumption (Oelofse et al., 2012). This knowledge is transferred through generations. The whole process where a particular people adopt an external technology, in this case, which is a particular food into their culture is known as indigenisation. Once this process has fully advanced, the species can then be considered indigenised. In contrast to indigenised species, indigenous plants are those plants that were not consciously introduced into an area but will particularly grow due to their natural dispersal from their place of origin (Bean, 2007). Exotic plants are those plant species that have been recently introduced into the continent or a country (Oelofse et al., 2012).

Nutrition-sensitive localised food chains have manifested to promote agriculture that also places the main focus on yielding impact on the nutritional status of individuals and households, thus resulting in their good health and well-being (Koo, 2016). The purpose of nutrition- sensitive localised food chains is to meet households' nutritional requirements through sustainable production of diversified species that are micro-nutrient-rich while reducing food waste (Charrondiere et al., 2017). Studies that were conducted by Irungu et al., (2007); Gido et al., (2017) showed the adoption of nutrition-sensitive localised food chains in Kenya, where local-based food systems were adopted to improve FNS. The adoption of local food-based systems was assumed through the promotion of ALVs to households. These studies reported an increase in the utilisation of ALVs by households. This increase in usage was also linked to the proper packaging and promotion of ALVs by Kenyan supermarkets.

However, utilisation for most African countries is limited by the fact that most underutilised plants grow voluntarily and not through cultivation, as a result, there is limited availability (Maseko et al., 2017). Post-harvest handling of underutilised plants could have an impact on increasing or decreasing consumption. For instance, poor storage and handling of most underutilised foods reduces their quality and availability and makes them less appealing to consumers. Preservation of underutilised foods to improve shelf-life and to make them available at all times may be appealing to rural dwellers, but not to the youth and urban dwellers who are usually impressionable to aesthetics. Policymakers need to invest in research and development of new varieties that can be available all year round to increase availability and consumption.
There are a variety of underutilised crops that grow well in SA. Only a few of these species are utilised as vegetables, also known as ALVs and they include *Cucurbita* spp, (pumpkin), *Brassica rapa* (Chinese cabbage), *C. Olitonus* (jute mallow), *Vigna Unguiculata* (cowpeas), *Amaranthus Cruentus* (pigweed), *Corchorus species*, *Citrullus Lanatus* (Bitter melon) and *Cleome Gynandra* (spider plant) with pigweed and pumpkin leaves being the most commonly used (Maseko et al., 2017). Underutilised fruits that are available and grow well in SA including, marula (*Sclerocarya caffra*), red milkwood (*Mimusops zeyheri*), mobola plum (*Parinari curatellifolia*), wild medlar (*Vangueria infausta*), num-num (*Carissa macrocarpa*), kei apple (*Dovyalis caffra*), and monkey orange (*Strychnos spinosa*) (DAFF, 2013). The vast distribution and frequent use of Pigweed and Pumpkin leaves could be linked to these species' ability to grow without being formally cultivated. It also signifies the ability of pigweed and pumpkin species to adapt to most geographical environments despite the presence of harsh conditions.

Pumpkin leaves, also known as Curcubits (*Curcubita Olarecia*), Amaranthus (*Amaranthus Cruentus*) and Blackjack (*Bidens Pilosa*) are some of the most common ALVs widely grown in parts of Southern Africa which are mostly in KwaZulu-Natal and Limpopo (DAFF, 2013). The main parts that are consumed in Cucurbits are the leaves, flowers, fruits and seeds In Amaranthus and Blackjack, leaves are mostly consumed and in some parts, seeds of the amaranth are also consumed (DAFF, 2013). Amaranth and Blackjack are not largely cultivated in SA but grow as volunteer plants after the first Spring rains (DAFF, 2013). Research has demonstrated that when cultivated, amaranth can produce very high yields of ± 40 t. ha^{-1} . The availability of these ALVs during the first rains when other vegetables are still growing and their ability to grow with little to no inputs makes them an easily accessible, cheaper and nutritious alternative

to EVs. There are at least 70 species and 400 varieties of Amaranthus throughout the world, which is also a contributory factor to it being one of the most common vegetables (Suma et al., 2002; Aderibigbe et al., 2022).

Akinola et al., (2020) discovered that more underutilised foods are cultivated and utilised in other African countries than they are in SA. This is linked to the perceptions that were deeply rooted during the Apartheid era which also forced the relocation of different people from their original ecological environments. This is also evident in the South African database of food composition (SAFOODS, 2018) where only 21 ALVs species are part of the 1,472 foods which are consumed. This proves that there is a huge gap in the extent of studies that focus both on knowledge of underutilised plants as well as their benefits. Further studies on improving perceptions of underutilised foods and awareness about their nutritional benefits could play a vital role in influencing youth and the general population to utilise them more and to increase the number of consumed underutilised foods in the SAn database of food consumption.

In SA, the challenge that has been reported by scholars regarding the consumption of underutilised plants is the issue of socialisation whereby underutilised foods no longer form part of daily foods consumed (Mabhaudhi et al., 2017; Maseko et al., 2017; Senyolo et al., 2019). Also, the youth have shifted away from the consumption of underutilised foods leaving the elderly to be the main consumers of these crops. Earlier studies have mentioned the issue of monotonous preparation of underutilised foods, the issue of these foods being mainly found in informal markets, not being packaged like exotic fruits and vegetables as well as the promotion of fertilisers and GMOs by local extension workers as factors that are hindering the progress of the repositioning of underutilised foods for future consumers. Figure 2.2 illustrates different types of underutilised plants found mostly in Southern Africa (DAFF, 2013).

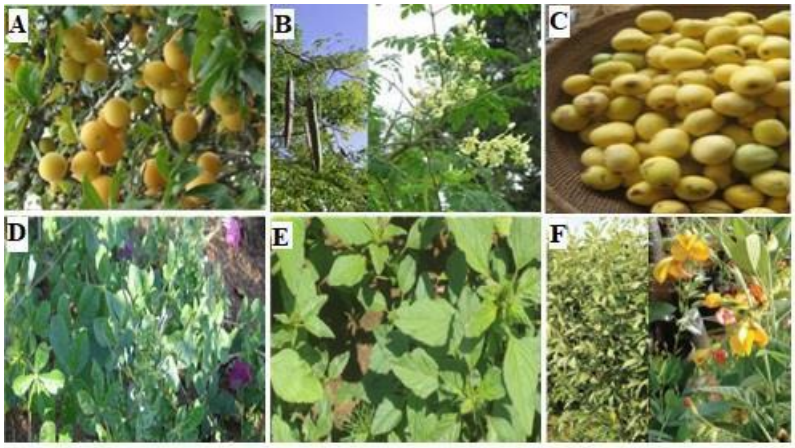

Figure 2. 2: Different types of underutilised plant species: (A) Kei apple (Dovyalis caffra), (B) Moringa oleifera, (C) Amarula (Sclerocarya birrea), (D) Cleome (Cleome gynandra), (E) Amaranth (Amaranthus dubius) and (F) Pigeon peas (Cajanus cajan) (DAFF, 2013)

2.2.8 Technology development efforts using underutilised fruits and vegetables

Fortification which is described by the WHO as the act of deliberately increasing the content of one or more micro-nutrients (vitamins and minerals) in food or condiment to improve its nutritional quality thus promoting public health plays a pivotal role in the improvement and development of new food technologies using underutilised fruits and vegetables. Although there are reported general neglect of underutilised plants, some scholars have taken up research initiatives to research new ways of incorporating underutilised plants into modern cuisine and daily diets of consumers to improve FNS.

A study was conducted recently in KwaZulu-Natal province, in SA on indigenising instant noodles through the incorporation of Amaranthus leaves to make instant noodles more nutritious (Qumbisa, 2019). What this study highlighted was that popular as they are, especially to the youth, instant noodles are a high-calorie and sodium food which lacks a great deal of essential nutrients. Table 2.3 illustrates the undeniable high-quality nutritional value of both micro and macro-nutrients of Amaranthus and other ALVs essential for a balanced diet. Zuniga et al., (2014); Huh et al., (2017) and Qumbisa et al., (2020) state that noodles and other pasta foods made from grains like buckwheat, rice etc. lack vastly on proteins, potassium and other essential nutrients which leads to malnutrition-related diseases. The study by Qumbisa et al., (2020) discovered that the addition of Amaranthus Leaf powder can help improve the nutritional quality of instant noodles, thereby enhancing FNS for consumers. This is confirmation of earlier studies conducted by Ebru & Mehmet, (2009) and Eyidemir & Hayta, (2009) that reported using vegetables instead of wheat flour to produce pasta foods can assist in improving their nutritional quality, thus offering healthier food options for consumers. Table 2.2 presents the results of

various studies that evaluated the sensory acceptability of different underutilised plants in SA. Some studies found that the Bitter taste, and strange green colour for some of the plants, reduced their acceptability by participants.

Table 2. 2: Sensory acceptability studies on underutilised plants

Title	Author	Area	Findings
1. Potential of using *Amaranthus* leaves to fortify instant noodles in the SAn context	Qumbisa Nothando D, Ngobese Nomali and Kolanisi Unathi (2020)	KwaZulu-Natal province, South Africa	Instant noodles can be fortified using *Amaranthus*, but youth might be disinterested due to queer colour of *Amaranthus* leaves and the perception that it is backward and meant for the poor [68]
2. Evaluation of the functional quality of cowpea-fortified traditional African sorghum foods using instrumental and descriptive sensory analysis	Joseph O. Anyango, Henriëtte L. de Kock, John R.N. Taylor* (2011)	South Africa	Cowpea can be added in the production of traditional sorghum foods but the functional quality of the fortified sorghum food will be influenced by the type of sorghum cultivar used. There was a good response from participants in relation to the texture of traditional African cowpea-fortified sorghum foods [74]
3. Preserving Traditional Leafy Vegetables (TLVs) using indigenous knowledge-based (IK) drying technologies to improve household food security	Nyembe Sinenhlanhla (2015)	Limpopo Province, South Africa	Green colour was an important factor in quality. IK-based technology preserved colour better. Sundried more preferred than oven dried vegetables [75]
4. Nutritional composition and sensory acceptability of cowpea wheat biscuits by rural youth in KwaZulu-Natal	T.P Kheswa, M. Siwela, U. Kolanisi, N. Ngobese and S. Zulu	KwaZulu-Natal province, South Africa	Biscuits that were produced from wheat/cowpea blends had higher macro and micro-nutrient levels compared to those made from wheat flour [76]

Table. 2.3 below, illustrates the nutrient quantities of different kinds of ALVs after boiling and draining 100 g of raw ALVs in a study conducted by van Jaarsveld et al., (2014) at Tshwane University of Technology in Pretoria. The ALVs were collected from various places ranging from farmers' fields under irrigation to controlled field trials at the Agricultural Research Council in SA. It is evident from this table, that ALVs are a good source of nutrients especially vitamin A which is largely contained in amaranth and cowpea leaves and iron which is mainly high in Pumpkin leaves, Black nightshade and Bitter melon.

Table 2. 3: Nutritional composition of different ALVs per 100 g of cooked samples (Hedges & Lister, 2007; van Jaarsveld et al., 2014)

Nutrient	Unit	Amaranth	Bitter melon	Black jack	Cowpea leaves	Jew's mallow	Pumpkin leaves	Spider Flower
Energy	kJ/100 g	272	296	162	280	319	222	195
Protein	g/100 g	4.2	3.5	0.5	4.7	3.2	2.9	5.0
Calcium	mg/100 g	421	201	189	378	295	168	220
Magnesium	mg/100 g	230	56	87	59	82	64	72
Phosphorus	mg/100 g	73	107	33	45	106	92	125
Sodium	mg/ 100 g	9	9	8	10	10	11	14
Potassium	mg/100 g	413	234	232	214	366	316	337
Copper	µg/100 g	161	188	152	129	181	196	238
Zinc	mg/100 g	0.66	0.70	0.53	0.40	0.54	0.71	0.99
Iron	mg/100 g	4.9	6.1	6.9	4.5	3.4	8.8	2.0
Manganese	mg/100 g	2.34	0.76	2.08	2.69	0.79	0.54	0.58
Thiamine	mg/100 g	0.03	0.01	0.07	0.06	0.02	0.03	0.05
Riboflavin	mg/100 g	0.05	0.09	0.16	0.08	0.08	0.09	0.20
Folic acid	µg/100 g	49	44	37	68	68	30	79
Vitamin C	mg/100 g	1	6	3	5	5	1	1
Vitamin A	µg/100 g	510	356	401	510	510	309	412

The addition of Aamaranth Leaf powder to provitamin-A biofortified snacks in a study

conducted by Beswa et al., (2016) showed that the amino acid content of these snacks increased with the amount of Amaranthus Leaf powder that was added. However, the popularity and acceptability of these snacks decreased with the increased addition of Amaranthus Leaf powder (Beswa et al., 2016). This is proof of the existing discrimination of underutilised plants by most consumers, which calls for the need for further research on how to change the general negative perception and improve acceptability.

Marula fruit (*Sclerocarya birrea*) is commonly known for its use in producing jellies, jams as well as traditional and commercial juices and wines (Marula-Fruit.Php, 2021). A study was conducted by Ndlovu, (2016) on how Marula fruits can be used to produce fruit leathers to preserve their nutritional quality using different temperature drying methods proved to be acceptable among subjects at which it was tested due to its appealing appearance even after drying. The incorporation of Natal plum (*Carissa carpa*) to produce Mango fruit leathers in one study in the Gauteng province of SA helped to improve the phytochemical content of this food and also increased the intake of these fruit leathers by adolescents and children(Mphaphuli et al., 2020).

In addition, a study was conducted by Ntila et al., (2017) on the addition of *Moringa oleifera* Leaf powder into porridge of 7-12 months old children in two provinces in SA, namely, Gauteng and Limpopo to improve the nutritional quality of porridge. Although the acceptability of the porridge decreased with the increased addition of Moringa Leaf powder which was attributed to its Bitter taste, mothers and caregivers were still willing to incorporate Moringa Leaf powder into the diets of their children (Ntila et al., 2017).

Table 2.4 below illustrates the nutritional composition of different underutilised fruits mainly found in Sub-Saharan Africa. The nutritional composition is per 100 grams of the edible part of the fruit or pods respectively.

Table 2. 4: Nutritional composition of different underutilised fruits

Nutrien	Unit	Monkey Orange (*Strychnos spp.*) et al.,	Kei apple (*Dovyalis caffra*) (Kei Apple, 2018)	Marula (*Sclerocarya birrea*) (Marula-Fruit Bhn, 2021)	*Moring oleifer* (Moringa, 2021)
Energy	KJ	1681	257	2703	154.8
Protein	g/100 g	9.0	0.9	28.3	2.10
Carbohydrates	g/100 g	28.7	14.2	3.7	8.53
Magnesium	mg/100 g	81.2	-	462	45
Phosphorus	mg/100 g	60.3	21.7	808	50
Sodium	mg/100 g	23.3	9.6	3.81	42
Potassium	mg/100 g	1342.4	232	601	461
Copper	mg/100 g	0.62	-	2.81	-
Zinc	mg/100 g	0.5	-	5.19	0.45
Iron	mg/100 g	3.3	2.6	4.87	0.36
Manganese	mg/100 g	-	-	-	-
Thiamine	mg/100 g	-	0.1	0.42	0.053
Riboflavin	mg/100 g	-	0.1	0.12	0.074
Niacin	µg/100g	-	-	0.72	0.68
Vitamin C	mg/100 g	69	347	-	-
Vitamin A	µg/100 g	-	137	-	74

2.3 Recommendations to further improve perceptions towards underutilised plant species

The development of proper packagings, such as offering underutilised plants in chopped packets, can help increase the utilisation of underutilised plants by youth and urban dwellers. Availability of recipe books and providing underutilised foods in a pre-cooked or prepared form in markets would ensure convenience for urban dwellers and youth who have a busy lifestyle and do not want to spend too much time preparing food. Canning underutilised plants can help increase their appeal, raise awareness, and improve perception by the youth since there are already other canned foods in markets currently and would provide a variety of flavours to choose from (Onyeoziri et al., 2018). Canning can reduce the stigma that underutilised foods are food for the olden days. However, there may still be issues of trustworthiness in the nutrition, presence of preservatives and changes in aroma and texture of underutilised plants if canned (Senyolo et al., 2019; Sigaqa et al., 2017). Likewise, the preservation of underutilised fruits and vegetables through the re-adoption of underutilised knowledge systems technologies like drying can assist in extending the shelf-life of these crops and can also help increase their availability even during seasons of scarcity (Nyembe, 2015).

Furthermore, post the Covid-19 pandemic, more households have realised the importance of consuming fruits and vegetables as part of their daily routines to improve their FNS status (Madden, 2021). As a result, there is a call to integrate and adopt nutrition-sensitive local food systems that are promoting the consumption of underutilised fruits and vegetables since these plants proved to be resilient during the Covid-19 pandemic over exotic crops (Madden, 2021). Policymakers need to work hand in hand with researchers and have a common goal in order to achieve effective food systems governance. There is a need for penalties and incentives for big food companies that produce unhealthy, salty, oily and sugary foods and those that produce healthy foods in a sustainable manner respectively.

2.4 Conclusion

The purpose of this review was to evaluate the potential role of underutilised local, indigenous and traditional plant species in addressing (through improving FNS) the adverse effects of the NT, which involves increased use of ultra-processed foods, on the health and nutritional status of current households in SA as well as preventing the same adverse effects affecting future generations. Food security is addressed in terms of four pillars; availability, access, utilisation, and stability. The review shows that while a lot of

attention has been given to food security in terms of availability and access to high-calorie foods, there has been very little focus on food quality. Food quality is addressed in terms of three food security pillars- food access, stability, and utilisation. These pillars are vital in ensuring FNS and should not be neglected. NT has increased globally over the years, but it has mostly been influenced by the food environment, which has made available ultra-processed foods as food for everyday consumption thereby, rendering most households food insecure and susceptible to malnutrition-related health conditions. Big food influences the consumption of unhealthy foods and beverages by consumers since they determine the type of foods that they make available in large quantities to consumers with the aim of generating high-profit margins.

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CHAPTER 3: Research Methodology and Design

3.1 Introduction

This chapter outlines the research procedures, designs and approaches that were followed in this study to provide meaningful results. It comprises the description of the study area, population, sampling methods used, research tools for data collection and analysis as well as ethical considerations.

3.2 Research approach

This study used mixed methods research. Mixed methods research is conducted through the collection of both quantitative and qualitative data within the same study (Shorten & Smith, 2017). Mixed methods research allows researchers to inspect diverse perspectives and relationships that exist to unpack the research questions of the study (Shorten & Smith, 2017). the results obtained from the quantitative data analysis (Shorten & Smith, 2017).

This study adopted an explanatory sequential mixed research method, strategically initiating data collection with quantitative methods before delving into qualitative approaches. The rationale for this sequential design is grounded on the fact that quantitative data, collected through surveys and consumer acceptability tests, allows for the identification of overarching trends and patterns in the youth's knowledge, perceptions, and acceptance of African Leafy Vegetables (ALVs). This initial phase provides a broad understanding of the subject matter. Equally, initiating the research with quantitative data collection is often more resource-efficient. Surveys and consumer acceptability tests, being more structured, can be administered to a larger sample size, providing a statistically significant dataset.

On the other hand, qualitative methods, such as focus group discussions, are particularly adept at elucidating the underlying reasons and meanings behind quantitative patterns. As such, qualitative data collection comes after the initial quantitative phase to provide a deeper contextualization of the quantitative findings. It allows for a more profound understanding of the factors influencing youth perceptions and acceptance of ALVs, offering insights that go beyond mere statistical associations.

In summary, the explanatory sequential mixed research method was chosen to optimize resource utilization, identify patterns and trends efficiently, and allow for a targeted and contextualized exploration of youth perceptions and acceptance of ALVs. The qualitative phase serves to explain, enrich, and provide depth to the quantitative findings, creating a more

comprehensive narrative for the study.

Conducting this study using mixed methods research assisted with gaining in-depth insight into the perceptions, acceptance, and knowledge of the youth towards African Leafy Vegetables (ALVs). It also assisted the researcher to conduct the study on two tertiary institutions to compare the findings between two sample groups. Mixed research methods also allow the researchers to design theories and concepts about the research study before they are implemented. The data collection tools which were used in this study were the survey questionnaire, sensory evaluation and focus group discussions.

Creswell and Plano Clark (2018) support the use of mixed-method research by stating that researchers should employ a technique and philosophy, which attempts to incorporate the insights afforded by the two approaches for breadth and depth of understanding and corroboration. This study opted for a mixed methods research approach to harness the complementary strengths of both quantitative and qualitative data. The choice of mixed methods was strategic and aligns with the complexity of the research questions and objectives. For instance, the survey and consumer acceptability tests yield numerical data, offering a broad overview of trends, patterns, and statistical associations while the focus group discussions provide nuanced insights into the perceptions, attitudes, and experiences of the youth towards African Leafy Vegetables (ALVs). This qualitative dimension helps in capturing the depth and richness of participants' perspectives. This is in line with Migori and Magangi (2011). The mixed methods approach in this study complemented each other, as the results from one inquiry method were used to elaborate on the results from the other. Overall, the mixed methods approach was chosen to capitalize on the strengths of both quantitative and qualitative data, providing a more holistic, validated, and contextually rich exploration of the youth's perceptions and acceptance of ALVs in the study area.

3.3 Description of the study area

The study was conducted at the Owen Sithole College of Agriculture (OSCA) and the University of Zululand KwaDlangezwa campus (UniZulu) at the Faculties of Science & Agriculture as illustrated in Figure 3.1 below. The Owen Sithole College of Agriculture is located 16 km north of Empangeni, on the Old Mtubatuba Road. The institutions are located in a subtropical area with pleasant summers and non- frost winter seasons, which is conducive

to agricultural activities. ALVs have been mentioned to thrive in temperatures of between 29 and 32 degrees Celsius which makes this area a perfect environment for ALVs to thrive (Mmotsa et al., 2021).

Figure 3. 1: Maps illustrating the University of Zululand (left) and Owen Sithole College of Agriculture (right)

3.3 Population

The Owen Sithole College of Agriculture is home to a diverse student body, consisting of 200 students. 99,9% of the students at OSCA are of African descent and 0.1% are of Indian origin. These students come from different provinces of South Africa (SA) with diverse ethnic backgrounds. The OSCA comprises academic clusters focused on: Crop Production, Animal Production, Home Economics (Crop Production) and Home Economics (Animal Production). The UniZulu is composed of two campuses, namely, KwaDlangezwa and Richards' Bay campus. The total student population at UniZulu is 16 118, with female accounting for 10 426 (57.05%) of the student body. The majority of students at UniZulu are of African descent, constituting 99.59% of the student population. Approximately92.37% of the students are pursuing undergraduate studies (UNIZULU-Facts-and-Figures, 2020). The UniZulu offers at least 252 accredited certificates, diplomas, and degree courses, which include Agronomy, Hydrology, Law, Education, Social Work, Sports Science, Microbiology and Biochemistry. UniZulu is a diverse institution, attracting students not only from South Africa but also from neighbouring countries such as Swaziland, Botswana, Zimbabwe, Lesotho, and other African nations (UNIZULU-Facts-and-Figures, 2020). UniZulu prides itself on its academic excellence, with a significant proportion of faculty holding PhDs (49.48%). The institution is home to 14 National Research Fund-Rated researchers, underlining its commitment to research and innovation (UNIZULU-Facts-and-Figures-2020).

3.4 Sampling

For this study, a method of non-probability sampling known as purposive sampling was used. Students from the rural-positioned higher learning institutions participated in the study. These were students who fell under the category of being youth i.e. age group of 18 to 35 years. A purposive sampling was selected because the entire population of university students is laborious to reach, therefore, the students from these disciplines were representative of the entire population of university students and were therefore used as sample units for this study.

Purposive sampling was employed for this study due to several distinctive characteristics of the selected students that align with the research objectives. The choice of purposive sampling was driven by the fact that the study targeted students from rural-positioned higher learning institutions, namely OSCA and UniZulu. This selection was deliberate to ensure that the sample represents the population of interest – youth with an agricultural background or interest in agriculture, providing insights specifically relevant to this demographic.

Purposive sampling focused on the age group of 18 to 35, capturing the youth demographic. This age range is critical for understanding the perceptions and acceptance of African Leafy Vegetables (ALVs) among the target audience, as they are more likely to influence and be influenced by contemporary food trends. In addition, the entire population of university students is often challenging to reach comprehensively. Purposive sampling offered a practical and feasible approach, targeting students from disciplines related to agriculture, who could reasonably be assumed to have an interest in or exposure to ALVs.

In summary, purposive sampling was chosen for its ability to target a specific subset of the population with characteristics that are directly aligned with the research objectives. The selected students, being from agricultural disciplines in rural institutions, brought a contextually rich perspective to the study, ensuring the findings are pertinent to the agricultural youth demographic and facilitating meaningful comparisons between institutions.

3.4.1 Sampling Technique and Size

A random stratified purposive sampling was applied. Sixty (60) students from each institution were recruited to participate in the survey, thus a total of 120 respondents participated. 120 respondents were selected because it was a manageable sample due to resource constraints, i.e. the availability of ALVs for to be used on the study were limited. Respondents were recruited through posting on the WhatsApp groups of their disciplines. Some students were invited while they were attending classes. The inclusion criteria for the study were that participants had to belong to the youth group aged 18 to 35 and study at either OSCA or UniZulu. For the sensory

evaluation recruits, the exclusion criteria were pregnant women, who were excluded because their bodies experience hormonal changes which also lead to food aversions and those allergic to the ingredients used to avoid potential allergic reactions, and those that did not belong to the youth group of 18 to 35 years. A total of 120 respondents (60 from each institution) participated in the sensory evaluation study. There was an invitation to participate in the focus group discussion at the end of the sensory evaluation sheet. Three focus groups of six people each were conducted. The criteria for selecting participants for the focus groups was that they had to have participated in the survey and the sensory evaluation. Participants were invited from the sensory evaluation to participate in the focus group and participation was voluntary.

3.5 Ethical Considerations

Ethical clearance was applied for and granted by the University of KwaZulu-Natal Humanities and Social sciences Research Ethics Committee (HSSREC): the ethical clearance number is HSSREC/00003645/2021. Once the study was approved, letters were written to the Department of Consumer Sciences at the University of Zululand and Owen Sithole College (see Appendix A) requesting permission to conduct the study at their institutions and to use the UniZulu Consumer Sciences lab to prepare the food samples. Students were asked to sign a consent form to participate in the study. An invitation to partake in the focus group discussion was attached to the sensory evaluation sheet.

3.6 Data Collection Methods and Instruments

3.4.2 Assessment of ALVs Knowledge

A survey questionnaire was used to assess ALV knowledge level among youth. The participants were profiled (for demographics) and asked to identify the ALVs which were presented in a photographic booklet. They were asked if they recognised the vegetables in the pictures (see Appendix A, Part II), and to provide the traditional and or English names of the ALVs.

3.6.2Perceptions of ALVs Assessment

A survey questionnaire with a 5-point Likert scale was used (attached as Appendix D) to assess the perceptions of students towards the consumption of ALVs**.** A 5-point Likert scale questionnaire assisted to determine perceptions because it creates symmetric responses, where the position of the "neutrality" answer is exactly between the extremes of "strongly agree" and

“strongly disagree”, providing the respondent with more choices and independence in answering the questions. As a result, the respondents needed not to feel confined to limited responses (Joshi et al., 2015). At the end of the survey questionnaire was an invite asking if a participant would like to participate in the study and focus group discussion which was designed to further measure the knowledge and perceptions of youth towards ALVs.

According to Thomas (2013), the main idea of conducting a focus group is to get the understanding, beliefs, and values of the participants. In this study, the focus group discussions play a pivotal role in capturing nuanced insights into the knowledge, perceptions, and acceptance of African Leafy Vegetables (ALVs) among the selected youth. Unlike surveys that provide structured responses, focus group discussions offer a platform for open dialogue. Participants had the opportunity to express their thoughts, experiences, and opinions in greater detail, allowing for a deeper exploration of their perspectives.

Furthermore, the focus group discussions were designed to clarify and elaborate on findings from the quantitative phase. Specific attention was given to understanding the reasoning behind certain survey responses, identifying any discrepancies, and uncovering the underlying factors influencing participants' perceptions and knowledge of ALVs. Participants for the focus group discussions were invited from those who have already participated in the survey and sensory evaluation. Participation in the focus group discussions was entirely voluntary, and participants were assured of confidentiality. An invitation to join the focus group discussions was attached to the sensory evaluation sheet, providing interested individuals with the opportunity to share their thoughts and contribute to a more in-depth understanding of the study's focal areas. The focus group interview was conducted in the respective target institutions, and lasted between 45 minutes to 1 hr, which is within the guidelines proposed by Ghauri and Gronhaug (2010). The interview process was audio recorded and was later transcribed.

3.6.3 Acceptability of Available ALVs

A consumer-acceptable test, which is a method of sensory evaluation, was utilised for this part of the study. It is used to determine the preference for one product over another (Lawless & Heymann, 2010; Sharif et al., 2017). Sensory evaluation is defined as a scientific discipline used to evoke, measure, analyse and interpret responses to a product through sight, smell, touch, taste and hearing using humans as the measuring instrument (Singh-Ackbarali & Maharaj, 2014). Untrained panellists of between 50 to 120 people can be used in consumer- acceptable tests (Lawless & Heymann, 2010). Consumer-acceptable tests are divided into two, Acceptance tests and Preference Tests.

For the consumer-acceptable test, a method of sensory evaluation, the determination of the panel size was influenced by a combination of research goals, resource constraints, and accepted practices in sensory testing. Sensory evaluation involves untrained individuals providing subjective responses to stimuli. The panel size for consumer-acceptable tests typically ranges from 50 to 120 untrained panellists (Lawless & Heymann, 2010).

Given the availability of resources and logistical considerations, a panel size of 120 respondents was chosen for this study. This size was deemed manageable while still providing a substantial dataset for analysis. Besides, the selected panel size of 120 offers a balance between achieving statistical significance and the practicality of conducting the consumer-acceptable test within the study's constraints. Furthermore, the choice of panel size considers the need for comparative analysis between in-season ALVs (Amaranthus, Blackjack, and Pumpkin leaves) and the control vegetable (Spinach). A sufficiently sized panel allowed for meaningful comparisons in preferences and acceptability.

In this study, the acceptance test was used to determine the appeal of the selected ALVs to youth over conventional vegetables (Lawless & Heymann, 2010). The main objective of conducting a consumer-acceptable test for this study was to determine youth’s acceptance of in-season ALVs compared to EVs.

3.6.2.1 Products to be tested

Three types of ALVs were used in this study, and they were determined by seasonal availability. The ALVs that were in-season during the course of this study which took place during early Spring (in September 2022), were Amaranthus, Blackjack and Pumpkin leaves. Spinach was used as the control for the study. All testing methods and conditions in this evaluation, such as the temperature of food, constant rinsing of mouth after testing each sample and the use of identical containers of the vegetables, were kept rigid to prevent errors caused by psychological factors. All vegetables that were used in this study, were bought from informal traders' markets close to the study area.

3.6.2.2 Sample preparation

Samples of these vegetables were prepared using the most common methods of preparation, i.e. boiling and then frying. A 9-point Hedonic scale questionnaire was used to ask open-ended questions (attached as Appendix D). This questionnaire was vital to present the willingness to consume, the likeability as well as what influences the likeability and willingness of respondents to consume these vegetables. Before the study with respondents commenced, an interview with the key informants was conducted, which in this study, were Indigenous Knowledge experts from the UniZulu on ALVs who were sampled based on their expertise gained from researching ALVs. The reason for the interview was to find out the common methods of preparing ALVs and how the most preferred exotic vegetable was, thus interface the preparation method (i.e., adopting the cooking method and adjusting the method to suit the cooking time of each leafy vegetable). Since Spinach is the competing exotic leafy vegetable that is widely consumed, based on knowledge obtained from the Key Informant's interviews, it was therefore used as the control for the study. Key Informant's interviews also gave an indication to the researcher that the leafy vegetables that were currently in-season during Spring, were Pumpkin leaves, Blackjack and Amaranthus.

In this study, the following recipe was adopted to prepare the various in-season ALVs:

Recipe:

2kg Pumpkin leaves/ Spinach/ Amaranthus/Blackjack

100ml of cooking oil

250g chopped tomatoes

300 g chopped onions

1 Beef stock cube

5 ml salt (1 tsp)

Method:

1. **Leaf Preparation**: Begin by thoroughly washing the leaves under running water. Repeat this process three times to ensure the removal of any soil particles or residue that may be present on the leaves.
2. **Stalk Removal**: To prevent any unnecessary bitterness, carefully remove the stalks from the leaves. Discard these stalks.
3. **Leaf Chopping**: After removing the stalks, proceed to chop the leaves into bite-sized pieces. This step ensures that the leaves are appropriately sized for cooking.
4. **Boiling Process**:
    - **Amaranthus and Spinach**: Place the chopped Amaranthus and Spinach leaves in a pot of boiling water seasoned with salt. Allow them to boil for approximately 10 minutes. This blanching process helps to soften the leaves and enhance their flavor.
    - **Pumpkin Leaves and Blackjack**: For Pumpkin leaves and Blackjack, extend the boiling time to 15 to 20 minutes. This longer boiling time is necessary to achieve the desired tenderness.
5. **Prepare Onion Base**: In a separate pan, heat a small amount of oil or butter. Add finely chopped onions to the pan and sauté them until they become translucent and fragrant.
6. **Tomato and Beef Stock**: Once the onions are cooked, introduce diced tomatoes and beef stock into the pan. Allow these ingredients to simmer together for approximately 2 minutes. This step infuses the dish with rich flavors.
7. **Combine with Boiled Leaves**: After simmering, add the previously boiled and drained leaves to the pan. Incorporate them into the onion, tomato, and beef stock mixture.
8. **Final Cooking**: Continue to cook the combined ingredients for an additional ten minutes, ensuring that all the flavors meld together, and the leaves absorb the delicious broth.

Below is a presentation of the fresh and cooked samples of the ALVs that were used in this study (Figures 3.2, 3.3 and 3.5) and the control (Figure 3.4):

Figure 3. 2: Uncooked (left) and cooked (right) Blackjack leaves

Figure 3. 3: Uncooked (left) and cooked (right)Amaranthus leaves

Figure 3. 4: Uncooked (left) and cooked (right) Spinach leaves

Figure 3. 5: Uncooked (left) and cooked (right) Pumpkin leaves

The recipes that were used to prepare the vegetables were adopted from the Key Informant's interview and the vegetables were prepared in a similar manner, but the Spinach and Amaranthus were cooked for a total of 20 minutes whereas Pumpkin leaves and Blackjack required a longer cooking time of 30 minutes. The preparation of samples for both institutions was conducted in the UniZulu Consumer Sciences laboratory to ensure the safety of the samples and to ensure the accuracy of the recipe. Vegetable samples for UniZulu participants were prepared just before participants tested them at the UniZulu Consumer Sciences lab. For the OSCA, samples were prepared at the UniZulu Consumer Sciences lab and then transported to the institution. The temperature of the vegetables was kept warm throughout the evaluation for all panels by using portable gas stoves. Extra care was taken not to overcook the vegetables by keeping the level of heat very low on the stoves.

3.6.2.3 Seating arrangement

To minimise communication between participants and to observe Covid-19 protocols, the seating plan was in the form of a classroom set up with spaces in between participants. This

arrangement was implemented to mitigate any potential influence that could introduce bias during the evaluation process.

3.6.2.4 Serving of samples

For each panelist, the order of presentation for the samples was randomised from left to right to equalise the effects of tasting (Poste et al., 2001). Furthermore, all activities and interactions with the participants were recorded by a video camera. Activities that were video recorded included tasting and the focus group discussion. A maximum of fifteen people per session was used, which lasted for 60 min per session. The focus group discussion was conducted to expand on participants' views from the questionnaire and the sensory acceptability study as well as to gain participants' insight regarding the acceptability of ALVs.

3.6.3.3 Sample testing

The sensory evaluation method used was the Multiple Paired Preference Test. Four samples (three ALVs and one exotic vegetable) were presented simultaneously, and panelists were asked which one they liked and accepted more according to different attributes (see Appendix E). Only codes were used to identify all vegetables used to reduce bias. The codes used were generated using random numbers adopted from Heymann (1995) whereby the last three digits from those random numbers of 1 to 9 were used to create codes for each sample used. Water and Plain Crackers were used after every taste as a palate cleanser to get rid of residual material from the previous sample (Lawless & Heymann, 2010). Since this study was a consumer acceptance study where preference and acceptability were measured, participants were asked to swallow the samples. Table 3.1 presents a summary of the methodological tools used in this study.

Table 3. 1: Methodological tools summary

Objective	Data collected	Tools	Sampling technique	Method of analysis
1. To assess the knowledge of ALVs among the youth	-Demographics -Known ALVs -Identification of ALVs in photos (traditional and English names)	-Survey questionnaire -Visuals (photos) -5-point Hedonic scale -Open and close-ended focus group questions	-Stratified random purposive sampling for 120 participants	-SPSS version 28, ANOVA, NVivo
2. Determine the youth perceptions towards the consumption of ALVs	-Consumption frequency -Preferred and liked ALVs -Preferred cooking method -Form ALVs are Accessed	-Structured survey questionnaire -5-point Hedonic scale questionnaire - Open and close-ended focus group questions	-Stratified random purposive sampling -Convenience sampling	-ANOVA, Chi-square, NVivo, themes
3. Analyse the acceptability of in-season ALVs dishes among Youth	-Demographics -Preference of Overall appearance, colour, smell, texture, taste, and Aftertaste	-Structured 9-point Hedonic scale questionnaire	-Convenience and purposive sampling	-ANOVA, P-TEST, Chi-Square

3.7 Data analysis

After the data had been collected, they were coded using different characteristics. The codes of different attributes were then transferred to a Microsoft Excel Spreadsheet (Gibbs, 2012). The collected data were analysed using the Statistical Package for the Social Sciences (SPSS) version 28. This statistical tool was chosen because of its versatility in generating different types of analyses and outputs. SPSS used the ANOVA, t-tests and chi- square tests as tools. The outputs like graphs, charts and tables were generated and are presented in the following chapter.

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CHAPTER 4: Results

4. Introduction

The agricultural sector in Southern Africa is dominated by modern exotic vegetables (EV) that originated from countries outside of Africa, which has led to a decline in the knowledge, production and consumption of African Leafy Vegetables (ALVs (Mabhaudhi et al., 2017). This focus on modern EVs means that there is a high demand for water usage, as these crops must be irrigated and require expensive fertilisers to grow. FAO (FAO et al., 2021) also stated that there are micro-nutrient deficiency concerns among the Sub-Saharan population, especially among children below the age of five and women of childbearing age. The ALVs are predominantly available in South Africa (SA), but they are mostly available in the wild or grow as volunteer plants and are thus regarded as weeds. They are not cultivated extensively like EVs are and at a commercial scale. Although they are regarded as weeds and grow mostly in the wild, they are still abundant in essential nutrients that are deficient in most individuals' diets.

This study was conducted to determine the youth's knowledge, perceptions and acceptance of ALVs. Mabhaudhi et al., (2019) asserts that rural areas are more affected by food insecurity to the extent that even government interventions to curb micro-nutrient deficiencies are in vain due to healthcare facilities being too far away for rural households to reach those services. It was therefore imperative to conduct the study at two rural-based tertiary institutions to gain rural youth's insight into ALVs. The youth group were targeted for this study because they are the future consumers of whatever foods will be available in future.

4.1 Socio-demographic characteristics

The data in the table provides insights into the characteristics of the study participants. In terms of age distribution, the majority of the participants, accounting for 73.3%, fall within the age range of 18-22 years. A smaller proportion, 20.0%, falls into the 23-27 years category. The older age categories are less represented, with 5.0% of participants aged 28-32 years and 1.7% aged 33-36 years. In terms of gender, the study includes a larger number of female participants, comprising 72.5% of the total sample, while male participants make up the remaining 27.5%. Regarding the institution of enrollment, the study encompasses two institutions: OSCA and UNIZULU. OSCA represents the majority of participants, accounting for 55.0%, while UNIZULU constitutes 45.0% of the participant pool. The participants' levels of study are diverse, with the largest group being first-year students, making up 49.2% of the sample. Second-year students constitute 28.3%, followed by third-year students at 16.7%, and

postgraduate students at 5.8%.

When considering residence, a substantial majority of participants, or 72.5%, reside in university-managed accommodations, while a smaller contingent of 27.5% lives in private accommodation. Lastly, participants' parents exhibit a range of educational backgrounds. A significant portion, 40.8%, have completed their secondary education. Following this, 18.3% of parents hold a university degree, 13.3% have completed a diploma program, and 5.0% have attained a postgraduate qualification. Additionally, 10.8% have completed primary education, while 11.7% of parents reported having no formal education. This diversity in parents' education levels among the participants' families provides an interesting context for understanding potential influences on the participants' perceptions and preferences in the study.

Table 4. 1: Socio-demographic characteristics

Variable	**Overall (N=120)**
Age	
18-22yrs	88 (73.3%)
23-27yrs	24 (20.0%)
28-32yrs	6 (5.0%)
33-36yrs	2 (1.7%)
Gender	
Female	87 (72.5%)
Male	33 (27.5%)
Institution	
OSCA	66 (55.0%)
UNIZULU	54 (45.0%)
Level of study	
1st year	59 (49.2%)
2nd year	34 (28.3%)
3rd year	20 (16.7%)
Postgrad	7 (5.8%)
Residence	
University Residence	87 (72.5%)
Private Accommodation	33 (27.5%)
Parents' education level	
No formal education	14 (11.7%)
Completed primary	13 (10.8%)
Completed secondary	49 (40.8%)
Completed diploma	16 (13.3%)
Completed university degree	22 (18.3%)
Postgraduate qualification	6 (5.0%)

4.1 Knowledge and Familiarity with ALVs

One of the commonly mentioned barriers that influence the utilisation and consumption of ALVs is the declining knowledge of these vegetables, especially amongst the youth. In this study, the respondents' knowledge, and familiarity with ALVs were examined using the questionnaire composed of socio-demographic data, knowledge of ALVs as well as perceptions (see Appendix A). When the respondents were asked if they are familiar with any traditional leafy vegetables, the majority (95%) answered yes to the question (see Table 4.2).

Table 4. 2: Respondents' familiarity with traditional leafy vegetables

		Frequency	Percent
Are you familiar with any traditional leafy vegetables?	Yes	114	95.0
	No	6	5.0
	Total	120	100.0

Among the respondents (n=114) who are familiar with leafy vegetables, the data in Table 4.3 shows that most (26.3%) were familiar with Amaranthus, Pumpkin leaves, Blackjack and Sweet potato leaves when asked to note down the ALVs that they knew.

Table 4. 3: Type of traditional leafy vegetables respondents are familiar with

		Frequency	Percent
ALVs	Amaranthus	7	6.1
	Amaranthus, pumpkin leaves	9	7.9
	Amaranthus, pumpkin leaves, Blackjack	20	17.5
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves	30	26.3
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves, butternut leaves	4	3.5
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves, butternut leaves, other	1	0.9
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves, other ()	1	0.9
	Amaranthus, pumpkin leaves, Blackjack, butternut leaves	3	2.6
	Amaranthus, pumpkin leaves, Sweet potato leaves	6	5.3
	Amaranthus, pumpkin leaves, Sweet potato leaves, butternut leaves	4	3.5
	Amaranthus, pumpkin leaves, butternut leaves	3	2.6
	Amaranthus, Blackjack	3	2.6
	Amaranthus, Blackjack, Sweet potato leaves	1	0.9

	Amaranthus, Blackjack, Sweet potato leaves, butternut leaves	1	0.9
	Amaranthus, Sweet potato leaves	1	0.9
	Pumpkin leaves	9	7.9
	pumpkin leaves, Blackjack, Sweet potato leaves	1	0.9
	pumpkin leaves, Sweet potato leaves	3	2.6
	pumpkin leaves, Sweet potato leaves, butternut leaves	1	0.9
	pumpkin leaves, butternut leaves	1	0.9
	Blackjack	1	0.9
	Blackjack, Sweet potato leaves	1	0.9
	Blackjack, Sweet potato leaves, butternut leaves	1	0.9
	Sweet potato leaves	2	1.8
	Total	114	100.0

4.3.1 Participants' perceptions towards ALVs

The data presented in the table 4.4 reflects participants' responses to several measurement items related to their perceptions and preferences regarding ALVs. It is evident that a majority of participants are familiar with ALVs, with 50.8% strongly agreeing and 37.5% agreeing. Furthermore, most participants express a positive attitude toward ALVs, as demonstrated by 30.8% strongly agreeing and 40.8% agreeing that they like ALVs.

In contrast, there is a divergence of opinions when it comes to the perception of ALVs being "backwards." While 34.2% of participants are neutral, a significant portion disagrees (30.8%) or strongly disagrees (17.5%) with this notion. Participants' willingness to consume ALVs is generally positive, as 34.2% strongly agree and 35.8% agree that they would love to eat more ALVs. Regarding the stereotype that ALVs are for the elderly, a majority of participants reject this notion, with 32.5% disagreeing and 43.3% strongly disagreeing. Moreover, participants believe that ALVs are more nutritious than exotic vegetables, with 39.2% strongly agreeing and 30% agreeing. Participants also express an interest in modern recipes for cooking ALVs, as 35.8% strongly agree and 37.5% agree with this statement. Lastly, the social aspect is explored, and most participants are unconcerned about being seen by their friends eating ALVs, with 64.2% strongly disagreeing and 27.5% disagreeing with this statement.

In summary, the data highlights a generally positive perception of ALVs among participants, with strong agreement and agreement prevalent in terms of familiarity, liking, willingness to consume, and perceived nutritional value. However, there is resistance to the idea that ALVs are "backwards," and the stereotype that they are for the elderly is firmly rejected. Participants also express an interest in learning modern recipes for cooking ALVs, and most are

unconcerned about their friends' opinions regarding ALV consumption.

Table 4. 4: Youth's knowledge and perceptions towards ALVs

Measurement items		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean (SD)	T	Df	p-value
ALVs are familiar to me	Q1	61 (50.8)	45 (37.5)	10 (8.3)	4 (3.3)	0 (0)	1.64 (0.78)	23.186	119	<,001
I like ALVs	Q2	37 (30.8)	49 (40.8)	25 (20.8)	7 (5.8)	2 (1.7)	2.07 (0.95)	23.823	119	<,001
ALVs are backwards	Q3	12 (10)	9 (7.5)	41 (34.2)	37 (30.8)	21 (17.5)	3.38 (1.16)	31.927	119	<,001
I would love to eat more ALVs	Q4	41 (34.2)	43 (35.8)	25 (20.8)	7 (5.8)	4 (3.3)	2.08 (1.04)	21.905	119	<,001
ALVs are for the elderly	Q5	12 (10)	8 (6.7)	9 (7.5)	39 (32.5)	52 (43.3)	3.93 (1.30)	33.139	119	<,001
ALVs are more nutritious than exotic vegetables	Q6	47 (39.2)	36 (30)	29 (24.2)	7 (5.8)	1 (0.8)	1.99 (0.97)	22.390	119	<,001
I wish I knew of modern recipes for cooking ALVs	Q7	43 (35.8)	45 (37.5)	17 (14.2)	11 (9.2)	4 (3.3)	2.07 (1.08)	20.912	119	<,001
I do not want to be seen by my friends eating ALVs	Q8	4 (3.3)	3 (2.5)	3 (2.5)	33 (27.5)	77 (64.2)	4.47 (0.93)	52.885	119	<,001
I am put off by the monotonous preparation of ALVs	Q9	12 (10)	19 (15.8)	37 (30.8)	32 (26.7)	20 (16.7)	3.24 (1.20)	29.538	119	<,001
ALVs are for the poor	Q10	1 (0.8)	1 (0.8)	4 (3.3)	13 (10.8)	101 (84.2)	47.7 (0.63)	82.677	119	<,001

4.2.3.1 Socio-demographic and Perception of ALVs

The results of the Chi-Square test (Table 4.5) suggest that there are some significant associations between certain demographic variables and perceptions of ALVs. For example, the finding shows that there is a significant relationship between the age group and the belief that ALVs are for the elderly suggesting that younger individuals perceive ALVs as being less relevant to their age group. This finding may have implications for public health campaigns promoting the consumption of ALVs, as it suggests that these campaigns may need to be tailored to different age groups in order to be effective. The statistical analysis of participants' responses to various statements regarding ALVs in relation to different demographic dimensions provides valuable insights into the factors influencing their perceptions and attitudes.

Firstly, when examining the familiarity with ALVs, the data indicates that participants' residence is significantly associated with their level of familiarity. Specifically, participants residing in university-managed accommodations seem to be more familiar with ALVs than those in private housing. This suggests that the physical environment in which individuals live may influence their exposure to and awareness of ALVs. Additionally, there is a marginal

association with gender, implying that there might be gender-related differences in familiarity. On the other hand, participants' liking for ALVs does not exhibit statistically significant associations with any of the demographic dimensions. This suggests that the appeal of ALVs appears to be relatively consistent across different age groups, genders, educational backgrounds, and institutional affiliations.

Similarly, the perception that ALVs are "backwards" does not show significant relationships with any demographic dimensions. This indicates that the belief that ALVs are outdated or regressive is not significantly influenced by participants' demographic characteristics. However, a noteworthy finding emerges regarding the belief that ALVs are intended for the elderly. Gender appears to be a significant factor, suggesting that there may be gender-related stereotypes associated with ALVs. Specifically, participants who identify as female seem to be more likely to associate ALVs with older individuals. This highlights the importance of addressing and dispelling gender-related stereotypes to promote a more inclusive image of ALVs.

Regarding the perception of ALVs being more nutritious than exotic vegetables, the data shows a significant association with the parent's level of study. Participants whose parents have different levels of education tend to have varying perceptions of ALVs' nutritional value. This indicates that family background and parental education may play a role in shaping individuals' beliefs about the health benefits of ALVs. Interestingly, the desire to learn modern recipes for cooking ALVs does not demonstrate significant associations with any demographic dimensions. This suggests that participants' interest in culinary knowledge related to ALVs is not influenced by their age, gender, educational background, or institutional affiliation. The data also reveals a significant relationship between age group and the reluctance to be seen eating ALVs by friends. Younger participants, in particular, seem to be more concerned about the social aspect of consuming ALVs in front of their peers. This finding suggests that different age groups may have varying levels of self-consciousness regarding their dietary choices among friends.

Lastly, the perception that ALVs are intended for the poor is significantly associated with age group. This implies that different generations may hold distinct views on the socioeconomic aspects of ALVs, which could be influenced by societal perceptions and experiences.

In summary, these statistical findings provide valuable insights into the nuanced relationship between demographic dimensions and perceptions of ALVs. Addressing stereotypes,

promoting nutritional benefits, and tailoring educational efforts to different age groups and genders could be essential strategies for fostering more positive attitudes toward ALVs among a diverse population.

Table 4. 5: Chi-Square test of demographic and ALVs perception

Dimension	Age group	Gender	Institution	Level of study	Residence	Parent level of study
ALVs are familiar to me	0.600	0.050	0.199	0.161	0.047**	0.291
I like ALVs	0.409	0.845	0.417	0.472	0.855	0.756
ALVs are backwards	0.480	0.136	0.319	0.503	0.774	0.773
I would love to eat more ALVs	0.195	0.082	0.420	0.362	1.000	0.968
ALVs are for the elderly	0.511	0.036**	0.266	0.178	0.295	0.576
ALVs are more nutritious than EVs	0.105	0.385	0.443	0.953	0.409	0.005**
I wish I knew of modern recipes for cooking ALVs	0.120	0.577	0.483	0.377	0.296	0.317
I do not want to be seen by my friends eating ALVs	0.005**	0.017	0.137	0.103	0.365	0.644
I am put off by the monotonous preparation of ALVs	0.544	0.636	0.325	0.582	0.074	0.624
ALVs are for the poor	<0.001**	0.254	0.558	0.721	0.441	0.970

4.2 Consumption pattern of ALVs

4.2.2 Consumption of ALVs

The data in Table 4.6 indicate the frequency and percentage of respondents who reported consuming any of the ALVs that were mentioned in the survey. Out of the 114 respondents, 105 reported consuming at least one of the ALVs mentioned in the survey, which is a percentage of 92.1%. Only nine respondents reported not consuming any of the ALVs mentioned in the survey, which is a percentage of 7.9%. This suggests that the majority of the respondents

in the survey consume at least one of the ALVs mentioned in the survey. This is a positive indication that ALVs are being consumed by the population surveyed. However, it is important to note that this is only a small sample of the population and may not be representative of the larger population. Further research would be needed to determine the extent of ALVs consumption in the wider population.

It is evident that a majority of the respondents (92.1%) who were familiar with ALVs consumed them. This finding has significant implications for policy, practice and theory related to alternative protein sources.

Table 4. 6: Consumption of ALVs among respondents familiar with them

		Frequency	Percent
Do you consume any of the ALVs you mentioned	Yes	105	92.1
	No	9	7.9
	Total	114	100.0

4.2.3 Consumed ALVs

Table 4.7 provides information on the types of ALVs consumed by the respondents. The most commonly consumed ALVs are a combination of Amaranthus, Pumpkin leaves, Blackjack, and Sweet potato leaves, with 20% of respondents reporting consumption of all four. The next most common combinations were Amaranthus and Pumpkin leaves (11.4%) and Amaranthus, Pumpkin leaves, and Blackjack (19%). The results indicate a diverse range of ALVs consumed by the respondents, with some less common combinations reported, such as Amaranthus, Pumpkin leaves, Sweet potato leaves, butternut leaves, and others (1%). It is interesting to note that some respondents reported consuming only one type of ALV, such as Amaranthus (8.6%) or Sweet potato leaves (3.8%).

Table 4. 7: ALVs consumed by the respondents

		Frequency	Percent
Consumed ALVs	Amaranthus	9	8.6
	Amaranthus, pumpkin leaves	12	11.4
	Amaranthus, pumpkin leaves, Blackjack	20	19.0
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves	21	20.0
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves, butternut leaves	1	1.0
	Amaranthus, pumpkin leaves, Blackjack,, butternut leaves	2	1.9
	Amaranthus, pumpkin leaves, Blackjack, Sweet potato leaves, butternut leaves, other	1	1.0
	Amaranthus, pumpkin leaves, Sweet potato leaves	4	3.8
	Amaranthus, pumpkin leaves, Sweet potato leaves, butternut leaves	3	2.9
	Amaranthus, pumpkin leaves, butternut leaves	3	2.9
	Amaranthus, Blackjack	3	2.9
	Amaranthus, Sweet potato leaves	6	5.7
	Amaranthus, butternut leaves	1	1.0
	Amaranthus, Blackjack, Sweet potato leaves	1	1.0
	pumpkin leaves	6	5.7
	pumpkin leaves, Blackjack	1	1.0
	pumpkin leaves, Sweet potato leaves	1	1.0
	pumpkin leaves, Sweet potato leaves, butternut leaves	2	1.9
	pumpkin leaves, butternut leaves	1	1.0
	Blackjack	2	1.9
	Blackjack, Sweet potato leaves, butternut leaves	1	1.0
	Sweet potato leaves	4	3.8
	Total	105	100.0

4.2.4 Reason for non-consumption of ALVs

Table 4.8 provides information on the reasons why some respondents reported not consuming ALVs. The majority (33.3%) of the non-consumers reported disliking the taste of the ALVs, while 33.3% reported that the ALVs were never cooked at home. 11.1% of non-consumers reported that they were unable to access the ALVs, while 11.1% reported both disliking the taste and being unable to access them.

Table 4. 8: Respondents' reason for non-consumption of ALVs

		Rf	Percent
Reason	Dislike them	3	33.3
	Dislike them, Cannot get them	1	11.1
	Cannot get them	1	11.1

	Cannot get them, They are never cooked at home	1	11.1
	They are never cooked at home	3	33.3
	Total	9	100.0

4.3 Favourite ALVs

Table 4.9 shows the responses of the participants regarding having a favourite ALV. Out of the 114 participants, 88 (77.2%) reported having a favourite ALV, while 26 (22.8%) did not. This result indicates that a majority of the participants have specific ALVs that they prefer over others. The table shows that Amaranthus (Imbuya, Ugobolo) and Pumpkin leaves (Imfino yentanga) are the most preferred ALVs among the respondents, with 22.7% and 21.6% respectively.

Table 4. 9: Response to having favourite ALVs

		Frequency	Percent
Any favourite ALVs?	Yes	88	77.2
	No	26	22.8
	N	114	100.0

Table 4.10 shows the frequency and percentage of respondents' favourite ALVs. Other ALVs such as Blackjack (Ucadolo), Sweet potato leaves (Ubhatata), and butternut leaves (Usolozi) are also preferred by some respondents, but in much smaller percentages.

Table 4. 10: Respondents' favourite ALVs

		Frequency	Percent
Favourite ALVs	1	20	22.7
	1, 2	17	19.3
	1, 2, 3	4	4.5
	1, 2, 3, 4	6	6.8
	1, 2, 3, 5, 6	1	1.1
	1, 2, 4	3	3.4
	1, 2, 5	1	1.1
	1, 3	2	2.3
	1, 3, 5	1	1.1
	1, 6	1	1.1
	1,2	1	1.1
	2	19	21.6
	2, 3	2	2.3
	2, 5	1	1.1
	3	2	2.3
	4	6	6.8
	5	1	1.1
	Total	88	100.0

Note: 1= Amaranthus (imbuya, ugobolo), 2= Pumpkin leaves (Imfino yezintanga); 3= Blackjack (Ucadolo); 4= Sweet potato leaves (Ubhatata); 5= Butternut leaves (Usolozi); 6=Other

Table 4.11 shows the reasons given by respondents for their favourite ALVs. The most common reason given was that the ALVs were tasty (50.6%), followed by being healthy (25%) and culturally important (12.5%). Some respondents also mentioned that their favourite ALVs were easily accessible (10.2%) and were the only ones they cooked (6.8%).

Table 4. 11: Reasons for favourite

		Frequency	Percent
Reasons	Tasty	14	15.9
	tasty, healthy	13	14.8
	tasty, healthy, culture	5	5.7
	tasty, healthy, culture, easily accessible	15	17.0
	tasty, healthy, culture, easily accessible, only ones cooked	6	6.8
	tasty, healthy, culture, only ones cooked	1	1.1
	tasty, healthy, easily accessible	10	11.4
	tasty, healthy, easily accessible, only ones cooked	1	1.1
	tasty, healthy, only ones cooked	1	1.1
	tasty, culture, easily accessible	2	2.3
	tasty, culture, easily accessible, only ones cooked	1	1.1
	tasty, easily accessible	1	1.1

	tasty, easily accessible, only ones cooked	1	1.1
	tasty, healthy, culture	1	1.1
	tasty, only ones cooked	1	1.1
	Healthy	6	6.8
	healthy, culture	1	1.1
	healthy, culture, easily accessible	1	1.1
	healthy, easily accessible	1	1.1
	Culture	2	2.3
	culture, easily accessible	2	2.3
	easily accessible	1	1.1
	only ones cooked	1	1.1
	Total	**88**	**100.0**

4.3.2 Favourite cooking method

Table 4.12 shows the preferred cooking methods for the favourite ALVs among the respondents. Boiling and frying were the most preferred cooking methods for the favourite ALVs, with 55.7% of respondents indicating they preferred this method. This was followed by boiled ALVs alone (4.5%), boiled and fried ALVs (8%), and boiled and fried with other cooking methods such as raw (salad) and mixed with maize meal (9.1%).

Table 4. 12: Respondents' favourite ALVs cooking method

		Frequency	Percent
Cooking method	Boiled	4	4.5
	Boiled, Boiled and fried	7	8.0
	Boiled, Boiled and fried, Raw (salad)	1	1.1
	Boiled, Boiled and fried, Raw (salad), Mixed with maize meal	1	1.1
	Boiled, Boiled and fried, Mixed with maize meal	2	2.3
	Boiled, Raw (salad)	4	4.5
	Boiled, Mixed with maize meal	4	4.5
	Boiled and fried	49	55.7
	Boiled and fried, Raw (salad)	2	2.3
	Boiled and fried, Raw (salad), Mixed with maize meal	1	1.1
	Boiled and fried, Mixed with maize meal	8	9.1
	Raw (salad)	1	1.1
	Mixed with maize meal	4	4.5
	Total	**88**	**100.0**

Table 4.13 shows the preferred method of eating ALVs among the respondents. Raw (salad)

was the most preferred method of eating ALVs (36.8%), followed by mixed with maize meal (36.0%), boiled and fried (14.9%), and boiled (7.9%). A small percentage of respondents (4.4%) preferred other methods of eating ALVs.

Table 4. 13: Respondents' preferred method of consuming ALVs

		Frequency	Percent
Preferred eating method	Boiled	9	7.9
	Boiled and fried	17	14.9
	Raw (salad)	42	36.8
	Mixed with maize meal	41	36.0
	Other	5	4.4
	N	**114**	**100.0**

4.4.3 Frequency of consuming ALVs

Table 4.14 shows the frequency of respondents who consume ALVs. Out of the 110 respondents who provided response, 86 (78.2%) reported consuming ALVs every day, while 22 (20.0%) reported consuming them three times a week. Only 1 (0.9%) respondent reported consuming ALVs once a week, and 1 (0.9%) respondent reported consuming them very seldom.

Table 4. 14: Frequency respondents eat ALVs

		Frequency	Valid Percent
Frequency of consumption	Everyday	86	78.2
	Three times a week	17	20.0
	Once a week	1	0.9
	Very seldom	1	0.9
	Total	**105**	**100.0**

Table 4.15 presents the frequency and percentage of respondents' reasons for consuming ALVs. The most commonly cited reason was taste, with 32.5% of respondents selecting this option. Other frequently cited reasons include health benefits (11.4%), cultural reasons (2.6%), and the fact that the ALVs are easily available (6.1%). Less commonly cited reasons include nutrition (5.3%), being forced to consume ALVs (5.3%), and combinations of taste, culture, health, nutrition, and availability.

Table 4. 15: Respondents' reasons for consuming ALVs

		Frequency	Percent
Reasons	None	5	4.4
	Tasty	37	32.5
	tasty, forced, healthy, nutritious	1	.9
	tasty, culture, healthy, easily available, nutritious	7	6.1
	tasty, culture, health, nutritious	1	,9
	tasty, culture, easily available, nutritious	1	.9
	tasty, culture, nutrition	1	.9
	tasty, healthy	3	2.6
	tasty, healthy, easily available	2	1.8
	taste, health, easily available, nutritious	6	5.3
	tasty, healthy, nutritious	4	3.5
	tasty, easily available, health benefits	1	.9
	tasty, health benefits	4	3.5
	Forced	6	5.3
	Culture	3	2.6
	culture, health benefits, easily available, nutritious	1	.9
	culture, health benefits, nutritious	1	.9
	health benefits	13	11.4
	health benefits, easily available, nutritious	3	2.6
	health benefits, nutritious	1	.9
	easily available	7	6.1
	Nutritious	6	5.3
	Total	114	100.0

Table 4.16 shows the sources of ALVs consumed by the respondents. The most common source of ALVs is from the garden at home, which accounts for 50.0% of the responses. Other sources include informal markets (14.9%), gardens at home with neighbours (5.3%), and gardens at home with the wild (3.5%). Only 4.4% of respondents reported that ALVs were not applicable as a source for them.

Table 4. 16: Source of ALVs consumed by the respondents

		Frequency	Percent
Source	Not applicable	5	4.4
	Garden at home	57	50.0
	garden at home, the wild	4	3.5
	garden at home, the wild, neighbours	4	3.5
	Garden at home, the wild, neighbours, informal market	2	1.8
	garden at home, the wild, informal markets	1	.9
	garden at home, neighbours	6	5.3
	garden at home, neighbours, informal market	3	2.6
	garden at home, informal market	8	7.0
	the wild, neighbours, informal market	1	.9
	Neighbours	3	2.6
	Neighbours, informal market	3	2.6
	informal market	17	14.9
	Total	114	100,0

Table 4.17 provides information on the forms in which ALVs are obtained, with data on the frequency and valid percentage. It can be observed that the majority of African.

Leafy Vegetables are obtained in their fresh form, accounting for 83.6% of the sample. Only a small proportion of the respondents (1.8%) reported obtaining ALVs in their dried form, while 14.5% reported obtaining them in both fresh and dried forms.

Table 4. 17: Forms ALVs are obtained

		Frequency	**Valid Percent**
Forms	Fresh	92	83.6
	Dried	2	1.8
	Both fresh and dried	16	14.5
	Total	110	100.0

4.4 Identification of ALVs

Table 4.18 provides a detailed breakdown of respondents' identification of African Leafy Vegetables (ALVs) in both traditional language and English across different samples.

Sample A and Sample B had relatively high correct identification rates in both traditional language (55.8% and 68.3%, respectively) and English (44.2% and 58.3%, respectively), with more confidence in the traditional language. This suggests that respondents were generally familiar with these ALVs and could identify them accurately in either language.

In contrast, Sample C and Sample D had notably low correct identification rates in both languages (3.3% and 2.5% in traditional language, and 0.8% and 4.2% in English, respectively). The majority of respondents in Sample C chose "I don't know" (65%) in both languages, indicating a lack of familiarity with these ALVs. Sample D had a significant percentage of incorrect responses (92.5% in traditional language and 94.2% in English), suggesting some confusion or misidentification. Sample E showed relatively high correct identification rates in both languages (75.8% in traditional language and 65.8% in English), but a higher percentage of respondents chose "I don't know" (23.3%) in English. This might indicate that while they were familiar with these ALVs, respondents were less confident in their English names.

In summary, the data highlights variations in respondents' ability to identify different ALVs and underscores the influence of language and familiarity. It also suggests the importance of promoting awareness and education about ALVs, especially in English, to enhance accurate identification among respondents.

Table 4. 18: Correct Identification of ALVs by language

Samples	Traditional (%)			English (%)		
	Correct	Incorrect	I don't know	Correct	Incorrect	I don't know
A	55.8	3.3	40.8	44.2	2.5	53.3
B	68.3	5	26.7	58.3	4.2	37.5
C	3.3	31.7	65	0.8	27.5	71.7
D	2.5	5	92.5	4.2	94.2	1.7
E	75.8	0.8	23.3	65.8	1.7	32.5

Table 4.19 shows the mean comparison between traditional and English identification of ALVs. The mean scores for traditional and English identification were calculated for each sample of ALVs, and a statistical test was conducted to determine if there was a significant difference between the means. The results show that for samples A and B, there was a significant difference between the mean scores for traditional and English identification. Respondents were more likely to correctly identify the ALVs when the identification was conducted in a traditional language. For sample C, there was a significant difference, but respondents were more likely to correctly identify the vegetable when the identification was conducted in their traditional language. For samples D and E, there was also a significant difference, but the mean scores for traditional and English identification were relatively similar.

Table 4. 19: Comparison of traditional and English identification of vegetables

Samples	Traditional		English		P
	Mean	Std	Mean	Std	
A	1.85	0.96	2.09	0.987	<0.001
B	1.58	0.885	1.796	0.961	<0.001
C	2.62	0.553	2.71	0.474	0.008
D	2.90	0.376	2.98	0.241	0.010
E	1.48	0.850	1.67	0.938	0.006

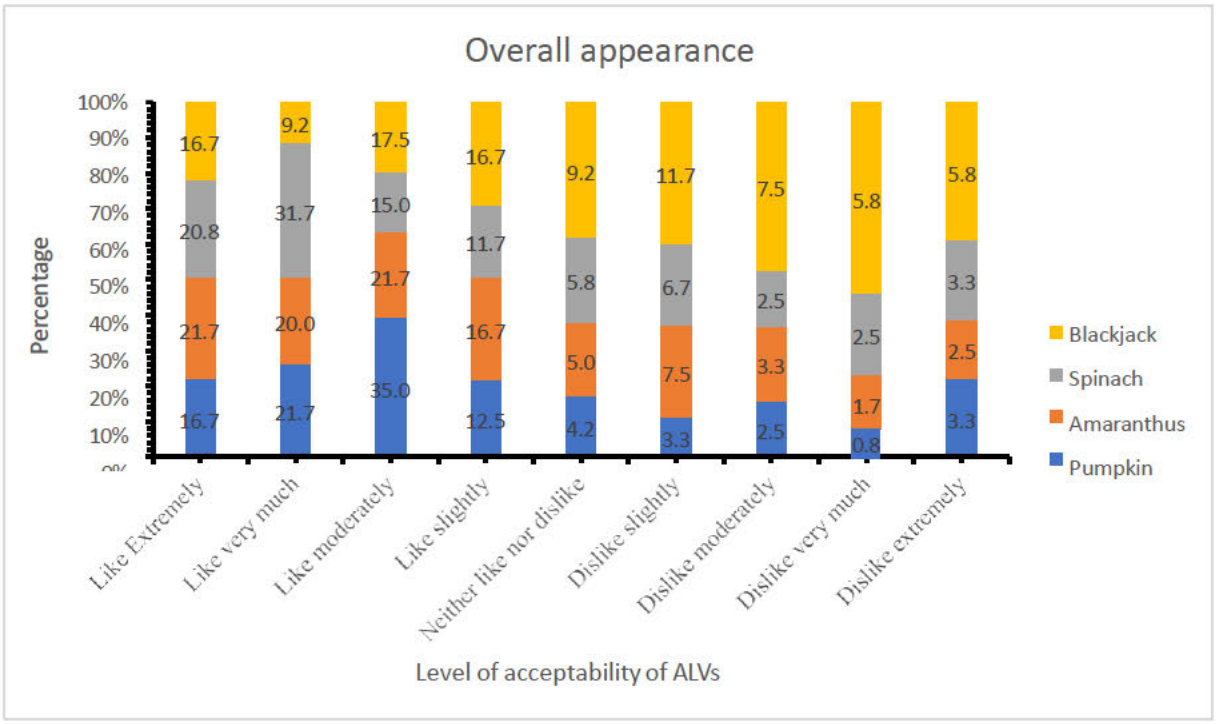

Figure 4. 1: The level of the likeness of the overall appearance of different ALVs

Table 4.20 shows the results of the ANOVA to compare the overall appearance of four different types of ALVs, namely Pumpkin, Amaranthus, Spinach and Blackjack. The table shows the mean scores, standard deviation, 95% confidence interval for the mean, ANOVA values, and Bonferroni test results. The ANOVA test revealed a statistically significant difference in the overall appearance of ALVs ($p<0.001$). The mean scores for each type of ALV were pumpkin (3.10), Amaranthus (3.23), Spinach (3.13) and Blackjack (4.22). The Bonferroni test indicates that the mean score of Blackjack was significantly higher than the mean scores of the other three types of ALVs.

Table 4. 20: ANOVA to compare the overall appearance of different ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferroni test
				Lower Bound	Upper Bound		
Pumpkin	120	3.10	1.817	2.77	3.43	<0.001	$<0.001^{1,4}$
Amaranthus	120	3.23	1.985	2.87	3.58		$0.001^{2,4}$
Spinach	120	3.13	2.085	2.75	3.50		$<0.001^{3,4}$
Blackjack	120	4.22	2.381	3.79	4.65		$<0.001^{4,3}$

Note: the superscript numbers indicate the mean differences between sample groups

4.6.2 Keenness to consume ALVs

The respondents' likeness on their keenness to consume ALVs is given in Figure 4.2. The results indicate that Spinach and Pumpkin leaves were the most liked with 82.5% and 81.6% respectively. Blackjack was still the least liked in this category at 50.8%.

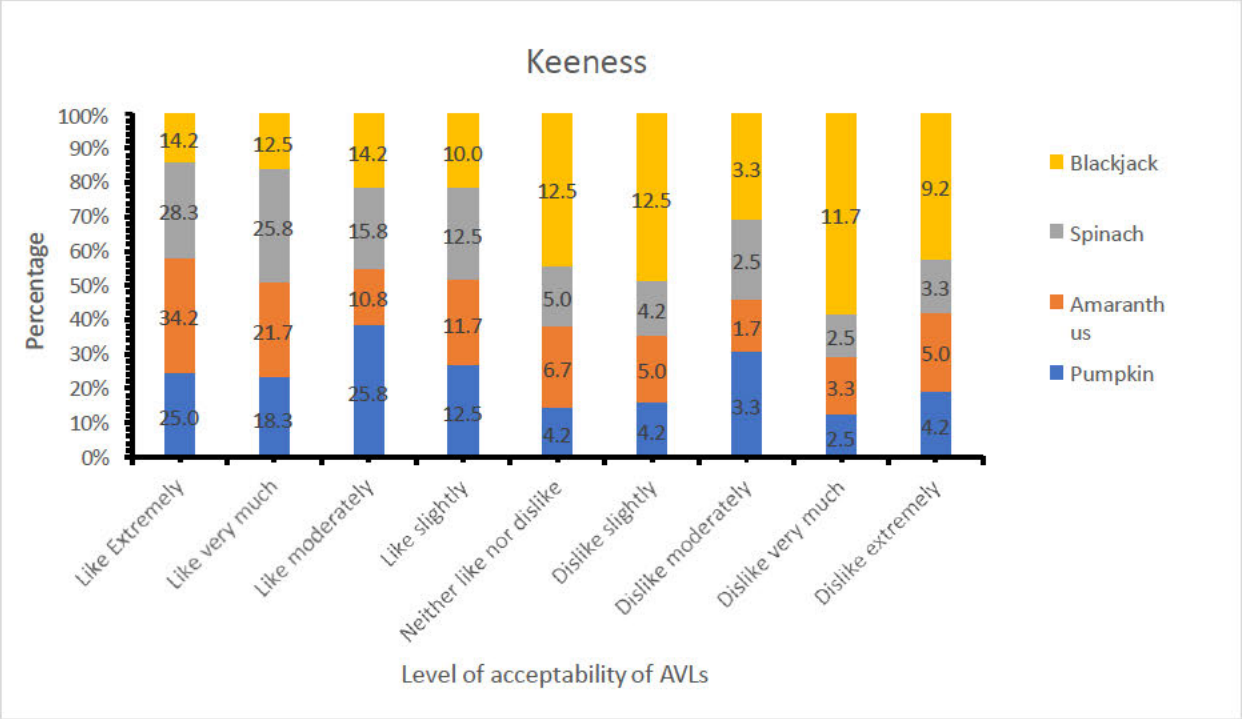

Figure 4. 2: The level of the likeness of the respondents' keenness to consume ALVs

Table 4.21 presents the ANOVA comparison of the keenness to consume ALVs among four different vegetable types. The results indicate that there is a significant difference in the keenness to consume ALVs among the four types of vegetables ($p<0.001$). The Bonferroni post hoc test results showed that the keenness to consume Blackjack was significantly higher than the other three vegetables, while the keenness to consume Pumpkin was significantly lower than the other three vegetables.

Table 4. 21: ANOVA to compare the keenness to consume different ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferro Ni Test
				Lower Bound	Upper Bound		
Pumpkin	120	3.16	2.126	2.77	3.54	<0.001	$<0.001^{1,4}$
Amaranthus	120	3.03	2.315	2.61	3.45		$<0.001^{2,4}$
Spinach	120	2.95	2.086	2.57	3.33		$<0.001^{3,4}$
Blackjack	120	4.58	2.591	4.11	5.05		$<0.001^{4,3}$

Note: the superscript numbers indicate the mean differences between sample groups at 0.05 interval level

4.6.3 Smell of ALVs

The respondents' likeness to the smell of the studied ALVs is given in Figure 4.3. Respondents mostly preferred the smell of Spinach (85.8%) and Pumpkin leaves (82.5%). The smell of Blackjack was less appealing (50%).

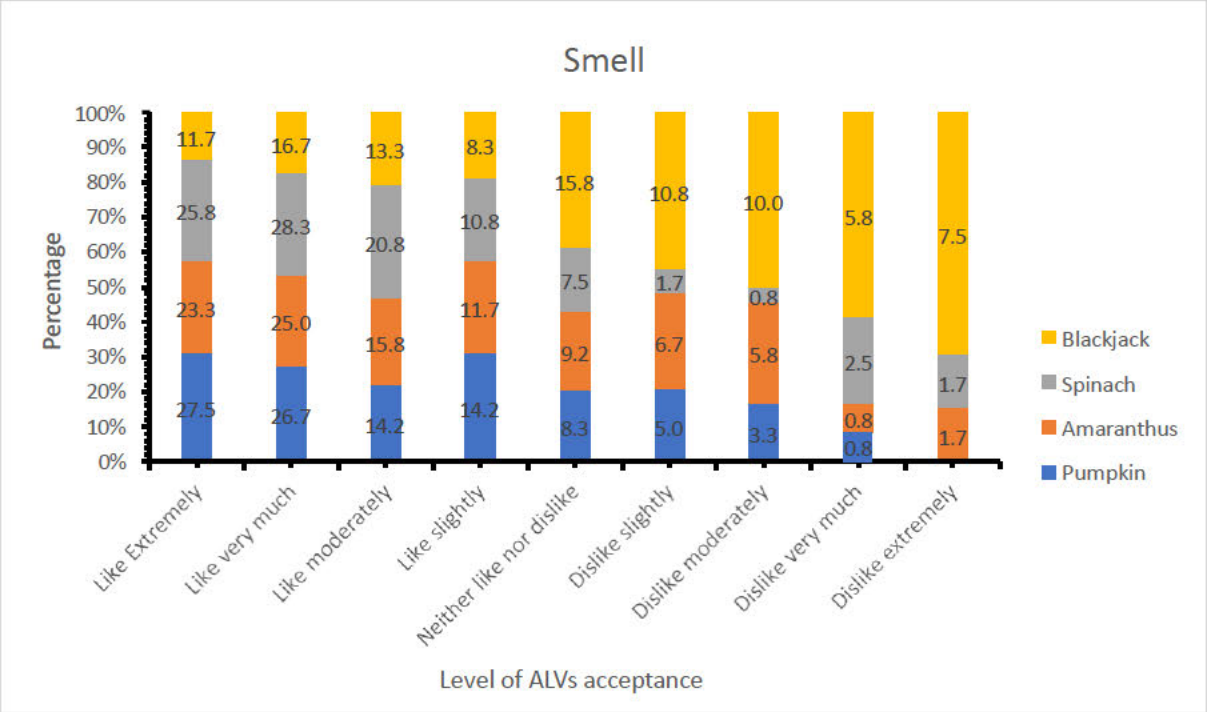

Figure 4. 3: The level of the likeness of the smell of ALVs

Table 4.22 presents the ANOVA comparison of the smell of four types of ALVs, including Pumpkin, Amaranthus, Spinach, and Blackjack. The table reports the sample size (N), mean, standard deviation, 95% confidence interval for the mean, ANOVA p-value, and Bonferroni test results. The ANOVA results indicate that there is a significant difference in the smell of ALVs ($p < 0.001$). The Bonferroni test shows that the mean difference between Blackjack and the other three types of ALVs is significant ($p < 0.001$), with a mean score of 4.47, indicating that the participants disliked the smell of Blackjack to a great extent. In contrast, the mean score for pumpkin, Amaranthus, and Spinach ranges from
2.77 to 3.16, indicating that the participants either like or are neutral about the smell of these ALVs.

Table 4. 22: ANOVA to compare the smell of different ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferroni test
				Lower Bound	Upper Bound		
Pumpkin	120	2.82	1.739	2.50	3.13	<0.001	$<0.001^{1,4}$
Amaranthus	120	3.16	2.004	2.80	3.52		$<0.001^{2,4}$
Spinach	120	2.77	1.790	2.44	3.09		$<0.001^{3,4}$
Blackjack	120	4.47	2.446	4.02	4.91		$<0.001^{4,3}$

Note: the superscript numbers indicate the mean differences between sample groups at 0.05 interval level

4.6.4 Texture of ALVs

The respondents' likeness of the texture of the studied ALVs is given in Figure 4.4. The sample that was most preferred by the respondents based on its texture was Spinach (85%) and Amaranthus (81.7%) while Blackjack was the least liked (52.5%).

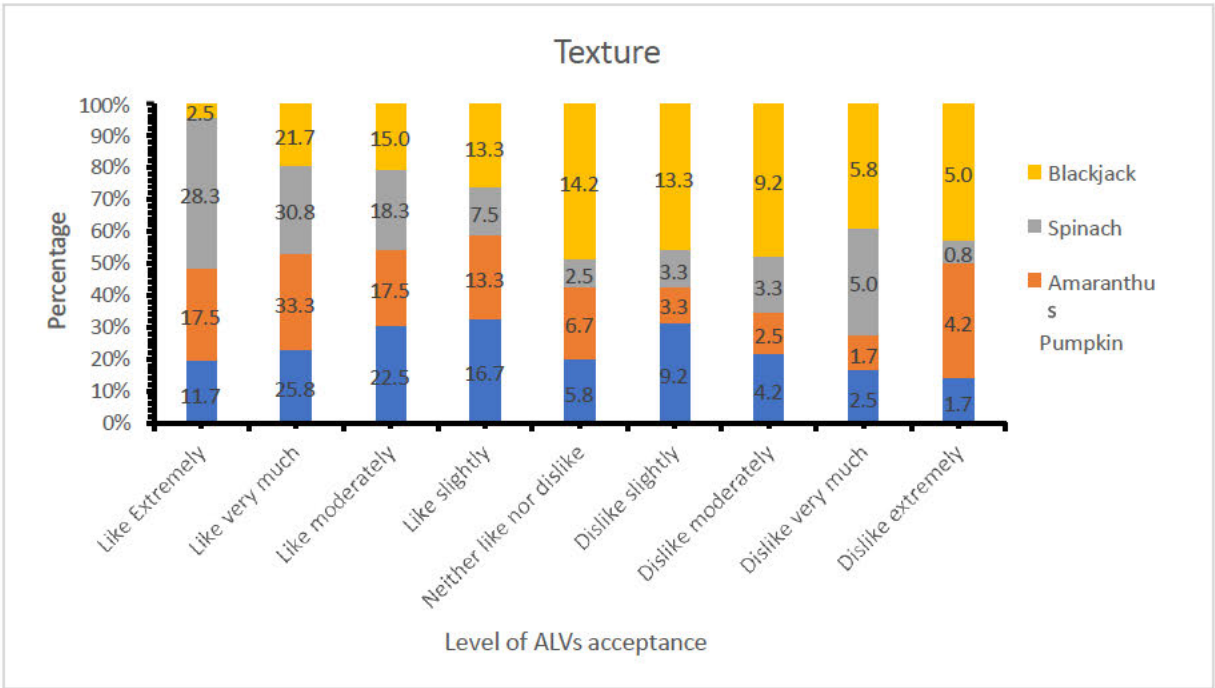

Figure 4. 4: The level of the likeness of the texture of ALVs

Table 4.23 presents the results of the ANOVA comparison of the texture of ALVs among the four types: Pumpkin, Amaranthus, Spinach, and Blackjack. The mean scores for texture ranged from 2.78 for Spinach to 4.51 for Blackjack, with Pumpkin and Amaranthus falling in between. The ANOVA test was significant ($p < 0.001$), indicating that there were significant differences in the perceived texture of the ALVs. The Bonferroni post hoc test showed that the texture of Blackjack was significantly different from the other three types of ALVs, while the texture of Pumpkin and Amaranthus was not significantly different from each other.

Table 4. 23: ANOVA of the texture of ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferroni test
				Lower Bound	Upper Bound		
Pumpkin	120	3.46	1.914	3.11	3.80	<0.001	$<0.001^{1,4}$
Amaranthus	120	3.12	2.018	2.75	3.48		$<0.001^{2,4}$
Spinach	120	2.78	1.997	2.42	3.14		$<0.001^{3,4}$
Blackjack	120	4.51	2.169	4.12	4.90		$<0.001^{4,3}$

Note: the superscript numbers indicate the mean differences between sample groups at 0.05 interval level

4.6.5 Colour of ALVs

The respondents' likeness of the colour of the studied ALVs is given in Figure 4.5. The most preferred colour was that of Spinach leaves where 84.2% of participants liked its colour.

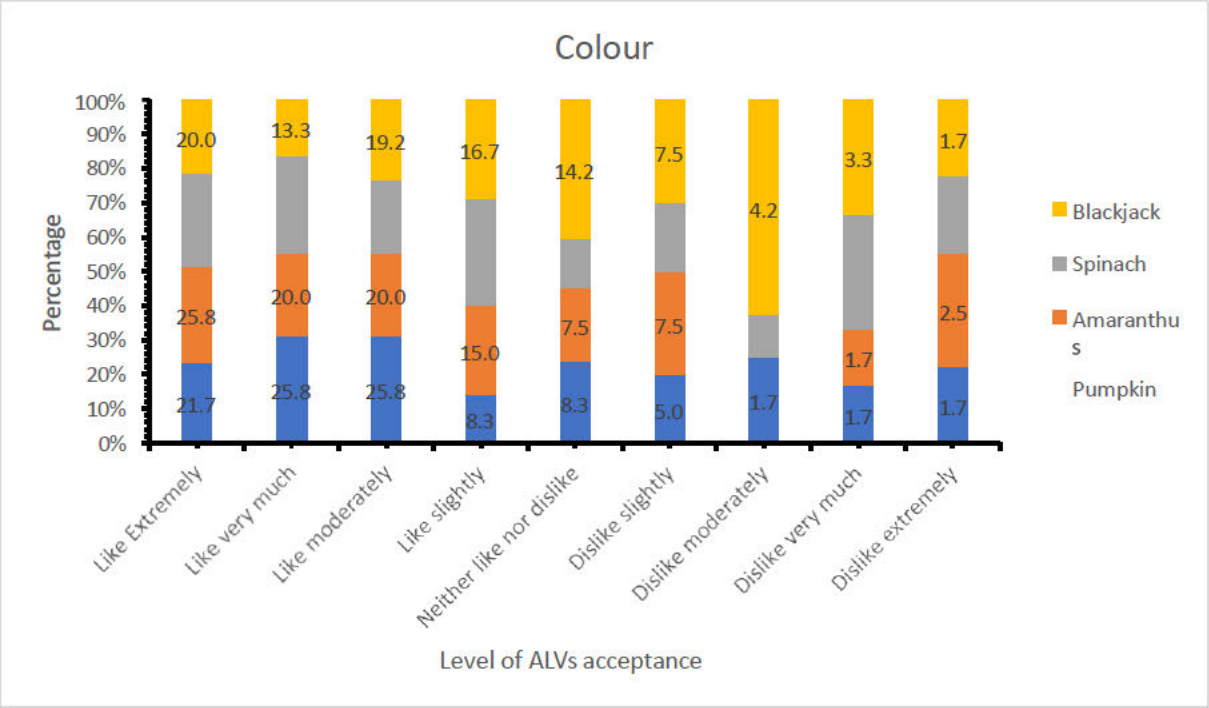

Figure 4. 5: The level of the likeness of the colour of ALVs

Table 4.24 presents the ANOVA comparison of the colour of ALVs. The results show that there is a significant difference in the mean scores for the colour perception of ALVs among the different types of vegetables ($F(3, 476) = 2.693$, $p = 0.044$). The mean score for the colour of Pumpkin (M=2.96) was significantly lower than that of Blackjack (M=3.58), but not significantly different from the mean scores of Amaranthus (M=3.04) and Spinach (M=3.00).

Table 4. 24: ANOVA to compare the colour of different ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferroni test
				Lower Bound	Upper Bound		
Pumpkin	120	2.96	1.817	2.63	3.29	0.044	$0.080^{1,4}$
Amaranthus	120	3.04	1.925	2.69	3.39		$0.194^{2,4}$
Spinach	120	3.00	1.914	2.65	3.35		$0.126^{3,4}$
Blackjack	120	3.58	2.036	3.21	3.94		$0.126^{4,3}$

Note: the superscript numbers indicate the mean differences between sample groups at 0.05 interval level

4.6.6 Taste of ALVs

The respondents' likeness of the taste of the studied ALVs is given in Figure 4.6. The data indicate that Spinach leaves had the most (87.5%) likeness in terms of their taste with the least liked ALVs being Blackjack with only 29.2% of the respondents liking the taste. The dislike of Blackjack could be attributed to its Bitter taste compared to the other ALVs.

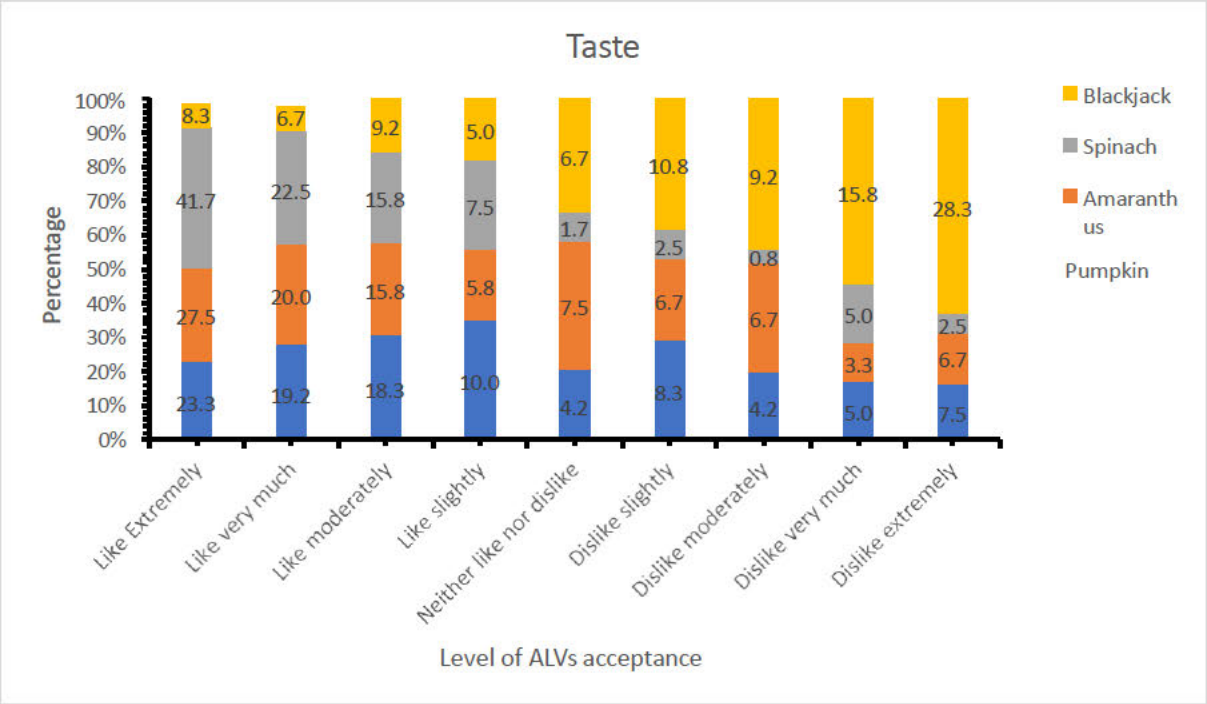

Figure 4. 6: The level of the likeness of the taste of ALVs

Table 4.25 presents the results of the ANOVA comparison of the taste of ALVs. The mean scores for taste dislike were highest for Blackjack (6.13) and lowest for Spinach (2.56), with Pumpkin (3.64) and Amaranthus (3.49) falling in between. The ANOVA results indicate a significant difference in taste dislike scores across the different types of ALVs ($p < 0.001$), and the Bonferroni test suggests significant differences in taste scores between certain pairs of ALVs ($p < 0.05$).

Table 4. 25: ANOVA to compare the taste of different ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferroni test
				Lower Bound	Upper Bound		

Pumpkin	120	3.64	2.530	3.18	4.10	<0.001	0.005[1,2]
Amaranthus	120	3.49	2.524	3.04	3.95		0.023[2,3]
Spinach	120	2.56	2.094	2.18	2.94		<0.001[3,4]
Blackjack	120	6.13	2.750	5.64	6.63		<0.001[4,2,1]

Note: the superscript numbers indicate the mean differences between sample groups at 0.05 interval level

4.6.7 Aftertaste of ALVs

The respondents' level of the likeness of the aftertaste of the studied ALVs is given in Figure 4.7. Respondents disliked the aftertaste of Blackjack the most (35.8%) and the most liked aftertaste was that of Spinach (80.8%).

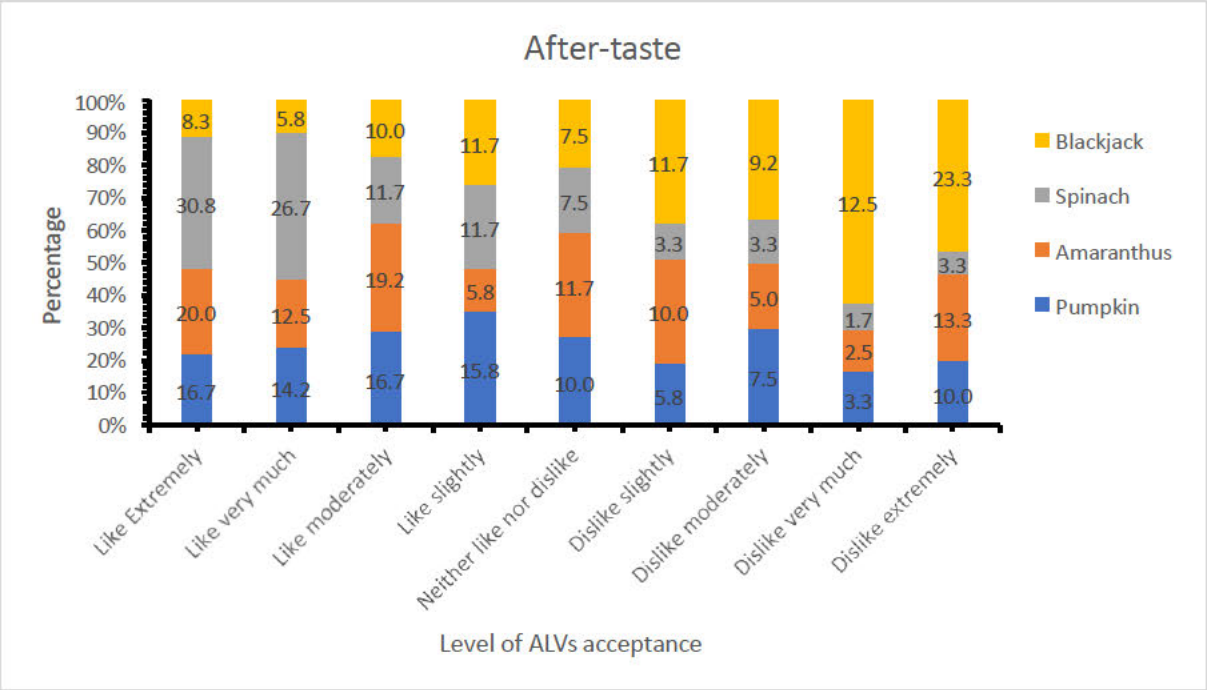

Figure 4. 7: The level of the likeness of the aftertaste of ALVs

Furthermore, ANOVA was computed to compare if there was a statistical difference in the respondents' likeness of the aftertaste of studied ALVs. The mean, standard deviation and ANOVA values are given in Table 4.26. The ANOVA value indicates that there were statistically significant differences in the likeness of the aftertaste of the studied ALVs ($p<0.001$). The mean value measured for Spinach (2.90±2.09) was the lowest while the highest

were measured for Blackjack (5.78±2.68), implying that Spinach was the most liked based on the aftertaste and Blackjack the least liked. The post hoc test indicates that the likeness of the aftertaste of Pumpkin was significantly higher when compared to Blackjack (P<0.001). The likeness of the aftertaste of Amaranthus was significantly higher than Blackjack (p<0.001). The likeness of the aftertaste of Spinach was significantly higher than Blackjack (p<0.001), Pumpkin (p<0.001), and Amaranthus (p<0.001).

Table 4. 26: ANOVA to compare the aftertaste of different ALVs

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		ANOVA	Bonferro Ni Test
				Lower Bound	Upper Bound		
Pumpkin	120	4.10	2.528	3.64	4.56	<0.001	$0.001^{1,3}$
Amaranthus	120	4.19	2.686	3.71	4.68		$<0.001^{2,3}$
Spinach	120	2.90	2.096	2.52	3.28		$<0.001^{3,4}$
Blackjack	120	5.78	2.676	5.30	6.27		$<0.001^{4,2,1}$

Note: the superscript numbers indicate the mean differences between sample groups at 0.05 interval level

4.7 Focus group discussion

Theme: Familiarity and perceptions towards ALVs

Three focus groups were conducted, two were conducted on 12th September 2022 and one on 13th September 2022 with six participants per group which totaled 18 participants overall. The data transcribed from the three different focus group discussions was about knowledge and perceptions towards ALVs. The participants in the three groups were asked about their knowledge and consumption of ALVs, their opinions on the importance of consuming them, and their perceptions of the nutritional value and health benefits compared to exotic vegetables (EVs). They were also asked about their willingness to purchase ALVs if they were more widely available in formal supermarkets.

Subtheme 1: Type of ALVs familiar with

The focus group participants were familiar with ALVs such as Blackjack, Amaranthus, and Pumpkin, and also thought that Spinach was an ALV.

"Yes, Blackjack, Amaranthus" (Participant 1, FG1)

"Pumpkin, Spinach" (Participant 2, FG1)

“Pumpkin leaves and Blackjack” (Participant 2, FG3)

Subtheme 2: Consumption and Importance of ALVs

The participants consumed some of these vegetables such as Amaranthus, Blackjack and considered them to be nutritious and important for their diets.

"Yes, Amaranthus, Blackjack" (Participant 1, FG1).

"Yes, they are nutritious” (Participant 1, FG1).

"Yes, they serve as an essential feed on a meal as they provide green colour in a meal plan” (Participant 1, FG1).

"for nutrient consumption” (Participant 1, FG1).

"They provide better health and energy to life" (Participant 1, FG1).

“Yes, they make digestion easier” (Participant 2, FG2).

“for health benefits” (Participant 2, FG3).

Subtheme 3: Perception of ALVs

The participants also acknowledged that there is a debate about whether Spinach should be classified as a vegetable or an ALV, as it is commonly adopted in African culture. After tasting the vegetables in an exercise, some participants stated that they have changed their perception of ALVs and now view them as tasty.

"I thought they tasted bad" (Participant 1, FG1).

“Yes, when I looked at their colour and smell, I liked it” (Participant 2, FG1).

“Yes, I got an education on their benefits during the study, and now I like them” (Participant 2, FG2).

“I am going to start eating them to embrace my culture” (Participant 3, FG3).

However, some participants revealed to still not like the ALVs even after the testing exercise.

“No, I still do not like them” (Participant 3, FG2).

Some participants also mentioned that they used to think that ALVs were only for older people and were used for medicinal purposes, but then after the sensory tasting exercise, they understood that they can be consumed by anyone and provide health benefits.

"I used to think they are for old people because my grandmother uses some, like Blackjack for diabetes and high blood pressure. But now I feel like anyone can eat them coz they taste nice and can help with health benefits as well" (Participant 2, FG1).

Subtheme 4: Comparison of ALVs and Exotic Vegetables (EVs)

The participants in the focus group preferred eating both ALVs and EVs, as they believed both are healthy.

"Both, because they are both healthy" (Participant 1, FG1.

"I like ALVs more" (Participant 2, FG1).

However, some others expressed a preference for EVs due to their accessibility and familiarity.

"EVs because they are easily accessible at home" (Participant 1, FG2).

Equally, some participants seem to suggest that EVs are mostly recommended by doctors, and another believed that ALVs are rich in fibre.

"EVs are mostly recommended by doctors" (Participant 2, FG3).

"ALVs because they are rich in fibre" (Participant 3, FG3).

It is thus reasonable to assume that the lack of knowledge of ALVs among doctors might have contributed to the lack of recommendations.

Subtheme 5: Nutritional value of ALVs

Some of the participants from the focus group acknowledged that ALVs provide high nutritional value such as iron and other essential nutrients with a lot of health benefits such as aiding in digestion and control of diabetes.

"They give us high nutritional value" (Participant 1, FG1).

"They provide carbohydrates and other nutrients" (Participant 2, FG1).

"Yes, they help with digestion and add nutritional value" (Participant 3, FG1).

"ALVs have more nutrients" (Participant 4, FG1).

"ALVs are rich in Iron" (Participant 5, FG1).

"They possess Iron and minerals that increase blood levels" (Participant 2, FG3).

"Yes, they help with diabetes" (Participant 3, FG3).

Subtheme 6: Availability of ALVs in formal supermarkets

Some participants expressed that they would buy ALVs if they were made available in formal supermarkets, while others stated that they would not because they lack information on how to cook them properly to gain their nutritional benefits.

"Yes, for health benefits and nutrients like proteins" (Participant 1, FG1).

"No, because there's not enough info on how to cook them properly in order to gain their nutritional benefits" (Participant 2, FG1).

"No, because I do not know how to prepare them"

CHAPTER 5: Discussion

This chapter interprets the findings reported in Chapter 4.

In the year 2013, the FAO developed an updated version of the South African (SA) food-based dietary guidelines to promote the inclusion of indigenous and traditional foods into people's diets (Mbhenyane, 2017; Vorster et al., 2005). Mbhenyane, (2017) confirmed that in a study conducted in the Eastern Cape that youth and men lacked knowledge about wild vegetables and this study sought to confirm the knowledge, perceptions, and acceptability of African leavfy vegetables (ALVs) by youth. As stated earlier, there is a noticeable slow pace towards the inclusion of ALVs in household diets and commercial markets thus low utilisation, which is concerning due to micro-nutrient deficiencies faced by SA. The research question for this study was: what knowledge, perceptions and acceptance of ALVs are held by the youth? The objectives of this study were to determine knowledge of ALVs by youth and to assess their perceptions and acceptance of ALVs.

5.1 To determine knowledge of ALVs among the youth

The results from the quantitative data analyses in Chapter 4 provide insight into various aspects related to ALVs and their consumption in different contexts. The finding that 95.0% of respondents are familiar with traditional leafy vegetables is an interesting and important one, as it highlights the widespread knowledge and potential utilisation of these nutrient-rich foods. Furthermore, it was uncovered that the main sources of ALVs are home gardens and informal markets. This finding is consistent with other studies that have reported home gardens and informal markets as important sources of vegetables in low-income settings (Sambo et al., 2022). Additionally, the majority of respondents prefer fresh ALVs over dried ones, with the perception that fresh vegetables are more nutritious and of higher quality.

A study by Faber et al., (2010) found that indeed, drying vegetables can lead to higher nutrient losses. However, a study by Nyembe, (2015), suggested that the appropriate use of indigenous knowledge-based drying technologies could assist in ensuring the availability of ALVs in areas where they are not cultivated as well as during seasons of scarcity. It was found that the majority of the participants were familiar with ALVs, such as Blackjack, Amaranthus, Pumpkin leaves etc. This was also supported by the focus group results which showed that participants were generally familiar with three ALVs, namely Blackjack, Pumpkin leaves and Amaranthus. This is a positive finding as it suggests that ALVs are not entirely alien to the youth and could be integrated into consumers' diets easily. More so, the

familiarity with these vegetables could be leveraged to promote the consumption of other less well-known ALVs, which have been reported to have high nutritional value (Maseko et al., 2017).

The relationship between geographical area and familiarity with ALVs has also been previously studied. In this study, the study population originated from the rural areas. According to (Maseko et al., 2017) individuals who lived in rural areas were more likely to consume traditional vegetables, including ALVs, compared to those who lived in urban areas. Similarly, the findings showed that there is a significant relationship between residence and familiarity with ALVs which suggests that individuals who live in certain geographical regions may be more familiar with ALVs than others.

There is an argument brought forth by a study conducted by (Tchuenchieu et al., 2020) emerging from a study conducted on participants who were attending clinics due to the management of noncommunicable diseases such as diabetes - that age, gender, educational level, income and living area played no significant role in determining whether a respondent had knowledge of indigenous foods, nor in whether they consumed them. This was not the fact in the study. Such demographic details should still remain the point of concern and focus for planning the interventions relating to the promotion and awareness creation towards the consumption of indigenous/indigenised vegetables.

As proposed by Elliott (2014), indigenous or indigenised vegetables not only possess valuable nutritional properties but are also intricately intertwined with a 'social matrix of meaning' that significantly influences consumption patterns. This demographic factor plays a pivotal role in shaping perceptions, formulation, and reflection. Consequently, it holds potential implications for marketing campaigns aimed at promoting the sale of ALVs, as it hints at varying levels of receptiveness in different regions.

The implications of these findings suggest that familiarity with the language plays an important role in the accurate identification of ALVs. Respondents were more successful in identifying the vegetables in their traditional language, indicating the importance of cultural familiarity. In practical terms, this means that educational programmes aimed at increasing the awareness and consumption of these vegetables should prioritise teaching in the respondent's traditional language. Additionally, the results highlight the importance of considering cultural context when developing educational materials about healthy eating

habits.

The findings suggest that language may have an impact on the correct identification of ALVs Respondents were more likely to correctly identify the vegetables when the identification was conducted in traditional language for some samples, while for others, they were more likely to correctly identify the vegetables when the identification was conducted in English. This highlights the importance of considering language when conducting research or interventions related to ALVs.

Equally important, the findings reveal that traditional names of ALVs are more commonly known and recognised than their English counterparts. This could be linked to the fact that the respondents were Zulu speaking and since the ALVs indigenous knowledge comes from the elderly population, who are to some extent custodians of these vegetables. This finding suggests that there is a need for more education and awareness campaigns to promote the use and recognition of English names for ALVs, particularly in urban areas where English is commonly spoken. ALVs are consumed differently by different communities, It may happen that in northern KwaZulu-Natal, other ALVs such as black nightshade are not common or widely consumed. Mbhenyane (2017) also confirms that in SA consumption patterns of wild vegetables vary by geographic location. The implication of the findings is that there is a need for more education and awareness campaigns to promote the consumption and recognition of ALVs in both traditional and urban contexts. This could be achieved through targeted messaging and marketing campaigns that highlight the nutritional value of ALVs and their cultural significance in local diets. Additionally, efforts should be made to promote the cultivation and availability of a wider variety of ALVs in home gardens and informal markets. This could be achieved through initiatives such as community gardens and farmer training programmes, which may be effective in promoting the cultivation and consumption of vegetables in low-income settings.

Although there is not much information available about the youth's knowledge of ALVs, one scholar, suggests that the loss of indigenous knowledge about ALVs is caused by insufficient knowledge by youth (Maseko et al., 2017). There was somewhat of a positive perception towards ALVs because most youth disagreed that ALVs are for the poor and the elderly and they were not embarrassed to be seen by their friends consuming ALVs. There seems to be a major shift in the perception of ALVs. Although some of the youth (18-22) were embarrassed to be seen by their friends consuming ALVs, generally, the youth were not embarrassed to be seen consuming ALVs. A study by (Senyolo et al., 2014) mentioned that youth and the urban population regard ALVs as weeds which is mainly due to these crops' poor and unhygienic

displays at informal markets as well as contradictory information about where they are sourced.

Furthermore, the monotonous preparation of ALVs did not make youth completely dislike ALVs, though they still wished there were more modern ways of preparing ALVs. Sigaqa et al., (2017) stated that youth were disinterested in ALVs due to monotonous preparation and further stated that youth prefer tasty foods and variety. The youth whose parents/caregivers completed high school were more aware of the nutritional and health benefits of ALVs

compared to those whose caregivers did not complete high school. There were reports that people from urban areas and who are high-income earners do not perceive ALVs as food for the poor, and possibly the same population could be aware of the nutritional value of ALVs and thus pass it on to their children (Sigaqa et al., 2017). However, Senyolo et al., (2019) reported that negative perceptions towards ALVs were particularly true among the youth and modernised people.

5.2 To determine youth's perceptions towards the consumption of ALVs

There seems to be a commendable shift from negative perceptions towards the ALVs. The current findings presented a different perspective from what has been reported in previous studies that found that there are generally negative perceptions about ALVs, which included that ALVs are 'backward food for the poor' and 'food for the elderly' (Modi et al., 2006; Maseko et al., 2017; Sigaqa et al., 2017). According to Sigaqa et al., (2017), one of the reasons for the negative perception towards these vegetables was the monotonous preparation methods. Hence in this study, about 73.3% of the respondents indicated a desire to know modern cooking and preparation methods that could be utilised to improve the ALVs consumption. O'Kane & Pamphilon, (2020) assert that although preservation and cooking methods from the past may be appealing to elderly and rural dwellers, it may be a different narrative with the younger generation and urban dwellers who are impressionable to aesthetics. Moreover, David & Darwin, (2014), also reported that young people have a specific preference in appetite and style, thus close interest towards young people's palate preference and food preference during food preparation must be prioritised when referring to interventions aimed at the promotion of the utilisation of these foods. This perspective is in line with the argument raised by Sigaqa et al., (2017), which affirms the urgent need for recipe development to enhance the utilisation and consumption of these vegetables.

Interestingly, the results also indicate that most of the respondents were mostly not embarrassed to consume ALVs around their friends, which contrasts a former study by Modi et al., (2006) which stated that 'wild vegetables' were generally ranked in low esteem by the younger generation and the supposedly more modern members of the community. The stigmatisation and low ranking of ALVs could also have been previously linked to the fact that the young generation has been a potential market for fast foods (David & Darwin, 2014). It is argued that most individuals including youth had transitioned to consuming these foods which are very low in micro-nutrients but have been popular due to their availability

and convenience to prepare (Dandala, 2018). According to Tchuenchieu et al., (2020), the labelling of indigenous food crops as being the food of poor people is slowly diminishing.

The relationship between age and perception of ALVs has been previously mentioned in literature. For example, a study by Senyolo, (2018) found that older individuals had a more positive attitude towards traditional vegetables. Similarly, a study by Mbhenyane (2017) stated that younger individuals and men were less likely to consume traditional vegetables, due to lack of knowledge of ALVs. Generally, older people hold the indigenous knowledge that they received from their parents be it culinary, cultural etc. in high sovereignty and believe in preserving that knowledge and hence, a positive attitude towards ALVs. In previous generations, women have always been mostly involved in the preparation of food and were custodians of family recipes and they may have gathered more knowledge of ALVs in the process compared to men and youth. In this study, the younger population had a different perspective which was more positive, and this could be on the fact that they were more knowledgeable about ALVs. Mbhenyane (2017) confirmed that knowledge is one of the influential determinants of the utilisation and consumption of ALVs. Moreover, the findings reported by David & Darwin, (2014) highlight the perception of young people is important to promoting nutritional education in youth, and they further suggest that future dietary patterns may be changed by the opinion of young people, to influence daily meals and indigenous meals.

One plausible interpretation of the results regarding ALV consumption is the evident trend toward increased acceptance among youth, aligning with earlier research findings (Gido et al., 2017). Similarly, Senyolo et al., (2014) reported that although westernisation has negatively affected the overall use of ALVs, there was a growing spread of their utilisation in SA. Another interpretation could be that the respondents who were familiar with ALVs were more likely to be interested in sustainable and ethical food consumption practices.

The findings of this study suggest that there is a wide variety of ALVs consumed by youth in the study area, with some consuming multiple types of ALVs in combination. This is consistent with previous research that has found that many African communities have a diverse range of traditional vegetables in their diets which are however still reportedly consumed in lower quantities than required to sustain them. Modi et al., (2006). These vegetables provide important nutrients and have been shown to have various health benefits, including reducing the risk of chronic diseases such as cancer, diabetes, and heart disease

(Oelofse et al., 2012). However, it is worth noting that the specific types of ALVs consumed by people in different regions may vary depending on factors such as availability, cultural preferences, and socioeconomic factors (Mbhenyane, 2017). Thus, it is important to conduct studies on the consumption of traditional vegetables in different regions to better understand the patterns of consumption and to identify potential barriers to consumption.

Regarding the reasons for not consuming ALVs, the results indicate that the primary factors are limited access to ALVs and a dislike for their taste. These findings are consistent with previous studies that have identified factors such as lack of availability and preference for taste and the stigma attached to ALVs as barriers to the consumption of traditional foods (Matenge et al., 2012; Nyembe, 2015; Odukoya et al., 2022). Furthermore, the revelation that some respondents never prepared ALVs at home underscores the significance of household food practices and cultural norms in molding dietary choices. With regard to cooking methods, the results suggest that boiling and frying are the most common cooking methods for ALVs among the study population. This is consistent with the common cooking practices in many African households, where boiling and frying are commonly used for most vegetables (Nguni & Mwila, 2007). Boiling is preferred as it softens the tough leaves and makes them more palatable, while frying is preferred for the crisp texture and flavour. Raw (salad) and mixed with maize meal were also indicated as preferred cooking methods for some respondents. The findings of this study have important implications for the promotion and utilisation of ALVs. The preferred cooking method identified in this study can be used to develop recipes and cooking methods that encourage the consumption of these nutrient-rich vegetables. Promoting different cooking methods that incorporate the use of ALVs in various dishes may help to increase their consumption and improve the nutritional status of populations.

The high preference for boiled and fried as well as mixed with maize meal could be attributed to the fact that these are common and traditional methods of eating ALVs in SA. Although raw ALVs have been reported to have high nutritional value as they contain essential vitamins and minerals that are destroyed when cooked, they were not very much preferred (van Jaarsveld et al., 2014). On the other hand, mixing with maize meal provides a balanced diet and makes the ALVs more filling. The preference for raw ALVs was lower than expected, given that the most common method of cooking ALVs in many African countries is boiling and frying. The low preference for fried ALVs by some, may be due to certain health conditions that avoid foods cooked with oil.

This is because naturally, vegetables are a great source of vitamins and minerals. Vegetable vitamins can also be divided into water-soluble and fat-soluble categories. Water-soluble vitamins, such as vitamins C and B vitamins, are more easily damaged by cooking than fat-soluble vitamins, which include vitamins A, D, E, and K (Kosewski et al., 2018). In this regard, the preparation and consumption type (i.e. raw or cooked) should also be given attention, as there is a contestation also about the cooking methods. In some studies, traditional cooking methods are found to have a beneficial effect on the increase in the antioxidative potential as compared to raw vegetables (Kosewski et al., 2018). The study highlights the importance of understanding the preferred methods of preparing and eating ALVs among the target population to promote their consumption and improve nutrition.

The high percentage of respondents consuming ALVs every day indicates a strong preference for plant-based alternatives to animal-based foods. This finding is consistent with the growing trend of consumers seeking out plant-based options for ethical, environmental, and health reasons (Deloitte, 2019). Moreover, the relatively low percentage of respondents consuming ALVs once a week or very seldom suggests that plant-based diets are becoming more mainstream and are no longer just a niche preference. However, it is important to note that this interpretation is based solely on the data provided in this study, and it may be helpful to examine the results in the context of a larger study or research project. Nonetheless, the data presented suggest a positive trend towards plant-based alternatives to animal-based foods, which has important implications for food production, agriculture and public health.

In the case of this particular study, it can be noted that taste is the most commonly cited reason for consuming ALVs. This suggests that the flavour of ALVs may be an important factor in encouraging people to consume them. Health benefits were also frequently cited, indicating that people may be motivated to consume ALVs for their potential health benefits. Cultural reasons were cited by 5.0% of respondents, suggesting that cultural attitudes and beliefs may play a role in ALV consumption. Finally, the fact that ALVs are easily available was cited by 5.0% of respondents, which could indicate that accessibility may be an important factor in promoting ALV consumption. Overall, these findings provide insight into the reasons why people choose to consume ALVs and can be used to inform interventions or campaigns aimed at increasing ALVs consumption.

The findings suggest that home gardens are an important source of ALVs for many people. This is consistent with other studies that have highlighted the potential of home gardens to contribute to household nutrition and food security (Adekunle et al., 2013; Shisana et al., 2013). The prevalence of informal markets as a source of ALVs also highlights the importance of these markets in providing access to nutritious foods for many people, particularly in low- income semi-urban areas. However, it is important to note that the sample in this study is likely not representative of the wider population, and the results may not be generalisable to other settings. Nonetheless, the findings provide valuable insights into the sources of ALVs consumed by respondents in this particular study and highlight the potential importance of home gardens and informal markets as sources of nutritious foods.

In relation to the preferred fresh form of obtaining ALVs, it is important to note that the preference for fresh African Leafy Vegetables aligns with their traditional use in African cuisine as fresh produce. It is also common to find ALVs in their fresh form due to the absence of processing equipment in most SAn provinces (Senyolo, 2018). Moreover, the preference for fresh produce of ALVs can create challenges for transportation, preservation and distribution, particularly in areas where African Leafy Vegetables are not locally grown. Therefore, there is a need to explore options for extending the shelf-life of fresh ALVs, through improved packaging techniques, storage methods, and post-harvest handling as well as their cultivation through urban agriculture. Additionally, the small proportion of the sample that reported obtaining ALVs in their dried form may suggest the potential for value addition through drying, which can extend the shelf-life of produce and increase their nutritional value through the retention of nutrients. Overall, this highlights the predominant form of ALVs and potential areas for value addition and improvement in preservation and distribution methods.

5.3 To analyse the acceptability of in-season ALVs dishes among youth

Amaranthus and pumpkin leaves were the most preferred ALVs according to this study. The preference for Amaranthus and pumpkin leaves can be attributed to their taste, nutritional value, and availability in the study area. Amaranthus is a rich source of protein, fibre, and essential vitamins and minerals such as iron, calcium, and vitamin C (Makobo & Mtaita, 2010; Sarker et al., 2020). Pumpkin leaves are also a good source of vitamins and minerals, particularly vitamin A and iron (Schönfeldt & Pretorius, 2011). These nutritional benefits may explain why they are popular among the respondents. The preference for these ALVs has important implications for promoting their consumption in the study area. It is essential to promote the consumption of ALVs as they are known to have a range of health benefits. Some vegetable species including ALVs have been shown to reduce the risk of chronic diseases such as obesity, cancer, diabetes, and heart disease (Kumar et al., 2021). Encouraging the consumption of these nutritious foods could, therefore, help improve the health outcomes of the population in the study area.

Having a preference for certain ALVs may also lead to increased consumption and incorporation into daily diets. The finding that a significant proportion of respondents have favourite ALVs is consistent with previous studies that have reported the importance of taste, texture, and cultural familiarity in food choice and consumption (Ntila et al., 2019; Qumbisa et al., 2020). The implication of this finding is that efforts to promote the consumption of ALVs should take into account the preferences and tastes of the target population. By identifying and promoting the ALVs that are already popular and well-liked among the population, it may be possible to increase consumption and ultimately improve health outcomes.

The participants had varying reasons why they have a particular favourite ALV, which were mostly taste and health benefits. According to Senyolo et al (2018), there are myriad factors that influence and determine the utilisation of these vegetables this included seasonality which affects their availability, and the authors emphasised that there was the willingness to pay but that this was also dependent on mainly socioeconomic factors such as income, age of children and access to information on food safety. These current findings suggest that taste and health benefits are important drivers of ALVs consumption, but cultural importance and availability also play a role. The findings also highlight the potential for promoting ALVs consumption by emphasising their taste and health benefits, while also

recognising their cultural significance and availability.

Furthermore, Senyolo, (2018) argued that if perceptions of ALVs are to be shared with the general population as a strategy for promoting and raising awareness of the utilisation of indigenous/indigenised leafy vegetables, further scientific studies on the nutritional advantages of ALVs should be conducted to support this perspective. This could be done through various strategies such as; recipe development, cooking demonstrations, portion, serving versus nutritional value research and education campaigns. These activities could bring scientific value and information to the consumers to make better-informed choices. Overall, the findings suggest that there is a need for more research and interventions aimed at increasing the consumption of ALVs in order to promote healthy diets and enhance food security in Africa.

These findings have important implications for the promotion and marketing of ALVs. In particular, the results suggest that consumers may have different preferences for different types of ALVs, which should be taken into consideration when promoting these vegetables. For instance, if marketers focus solely on promoting pumpkin as an ALV, they may miss out on consumers who prefer Amaranthus or Blackjack. Understanding the factors that influence consumers' willingness to consume ALVs can help in developing effective strategies to promote their consumption, thereby contributing to improved public health outcomes.

The findings from this study suggest that the smell of ALVs could be an important factor affecting consumer acceptance and consumption of these vegetables. A strong unpleasant smell, as found in the case of Blackjack, may significantly decrease the likelihood of consumers incorporating these vegetables into their diet. Therefore, efforts to improve the sensory quality of these vegetables, such as through breeding or post-harvest treatments, could help to increase consumer acceptance and consumption. Furthermore, the study highlights the importance of considering sensory factors, such as smell, in developing and promoting healthy diets that include traditional and underutilised crops such as ALVs.

The perceived texture of Spinach was significantly different from that of the other three ALVs. The texture is an important attribute of food that affects its palatability and consumer acceptability (Qumbisa, 2019). The results of this study suggest that the texture of ALVs can vary significantly depending on the type of vegetable. Consumers may have preferences for certain textures, which could, in turn, affect their willingness to consume ALVs. Thus, food producers and policymakers should consider the texture of ALVs when developing and promoting these vegetables.

These results also suggest that different types of ALVs may have varying levels of acceptability based on their appearance. Pumpkin was found to be the most visually appealing, while Blackjack was found to be the least appealing. The overall appearance of a food product is an essential factor in determining consumer acceptability and willingness to purchase (Qumbisa, 2019). These findings are consistent with previous research on the importance of appearance in food acceptability studies (Nyembe, 2015; Qumbisa, 2019). It is important to note that the study was conducted with a specific group of participants and in a specific setting and therefore, the generalisation of the findings to other populations or settings should be made with caution.

The differences in the colour perception of ALVs could be attributed to the presence of different pigments in the vegetables, such as chlorophyll, carotenoids and anthocyanins, which are responsible for their green, orange/yellow, and purple/red colours, respectively. The colour of food plays an important role in determining consumer preferences and acceptability, as it can influence their expectations of the taste, aroma and texture of the food (Grunert, 2011). Therefore, the findings of this study suggest that the colour of ALVs could be an important factor to consider in promoting their consumption, especially for those vegetables that are perceived to have less appealing colours.

The findings suggest that taste is an important factor influencing consumers' preferences for ALVs. The high taste dislike scores for Blackjack and the low scores for Spinach may be attributed to differences in the chemical composition of the different types of ALVs. For example, Blackjack has been found to contain high levels of tannins and flavonoids, which can give it a bitter taste and may contribute to its lower taste scores compared to other ALVs (Mbokazi, 2014). Overall, the results of this study may be useful for food producers and policymakers to better understand consumers' preferences for different types of ALVs and develop strategies to promote their consumption. For example, efforts could be made to

develop new varieties of ALVs with improved taste profiles or to promote the use of different cooking methods to improve taste.

5.4 Follow-up focus group discussion

Equally relevant, the survey results indicate that the majority of respondents consume ALVs frequently, highlighting the importance and relevance of these vegetables in the African diet. Leafy vegetables are an important source of vitamins, minerals, and other beneficial compounds, and incorporating them into one's diet has been linked to a range of health benefits, including reduced risk of chronic diseases such as cardiovascular disease and some cancers. This is consistent with the focus group discussion where the participants acknowledged the importance of consuming ALVs for their nutritional value and health benefits. There was also a perception that some ALVs help in reducing diseases like diabetes and regulating blood pressure. These findings are similar to a previous study conducted by Makuse & Mbhenyane, (2005) in Limpopo where people based their consumption of ALVs and other indigenous foods on the assumption that they will help prevent or cure them from certain diseases. Some participants also shared that they had changed their perceptions of ALVs after tasting them, previously thinking they tasted bad. The group also discussed the role of ALVs in their diet and their preference for eating them over EVs. However, some participants still preferred EVs like Spinach and carrot over ALVs as they were more familiar with them. Similarly, Mbhenyane (2017) mentioned a preference for EVs like cabbage and Spinach by most individuals due to familiarity.

The findings from the focus group discussion suggest that the focus group participants had some knowledge of ALVs, with some mentioning specific types such as Blackjack, Amaranthus, Pumpkin leaves, and Spinach. However, there was also some confusion about whether Spinach is classified as an ALV or not, highlighting the need for further education on ALVs. It is important to note that ALVs have been found to be rich in vitamins, minerals, and other nutrients that are essential for human health (Mbokazi, 2014; Modi et al., 2006; Shisana et al., 2013) For example, Amaranthus has been found to contain high amounts of calcium, iron, and protein (Odhav et al., 2007), while Blackjack has been found to have high antioxidant activity and may have potential health benefits in preventing chronic diseases (Mbokazi, 2014). The familiarity of the participants with some types of ALVs may suggest that these vegetables are already incorporated into their diets to some extent. This shows that there is a need to increase awareness and knowledge about the benefits of ALVs to

encourage their consumption and promote their cultivation and availability in local markets and supermarkets.

The consumption of ALVs is recognised as important by the participants in the focus group. ALVs are perceived as nutritious and essential for a healthy diet, as they provide important nutrients, aid in digestion and contribute to overall health and well-being. This perception is consistent with research on ALVs, which have been shown to be essential especially in the food security of households in rural areas in a study conducted in Limpopo, and they are also rich in vitamins, minerals, and antioxidants, with potential health benefits such as reducing the risk of chronic diseases like heart disease, cancer, and diabetes (Senyolo et al., 2014). The recognition of the importance of ALVs is particularly significant in the context of food and nutrition security in Africa, where the consumption of traditional foods, including ALVs, has been declining in favour of more Westernised diets that are often high in fat, sugar, and processed foods (Senyolo et al., 2019). Promoting the consumption of ALVs could help improve the nutritional status of individuals and communities and contribute to food and nutrition security by diversifying diets and increasing the availability and demand for these crops. Having said that, the low awareness and availability of ALVs in formal markets, as discussed in Subtheme 6, can hinder their consumption and appreciation. Addressing these barriers through education, marketing, and improved availability could help increase the intake and appreciation of ALVs in African diets.

The participants in the focus groups had varying perceptions of ALVs. Some participants previously believed that ALVs were only for medicinal purposes and were only consumed by older people, but after the sensory testing exercise, they understood that they can be consumed by anyone and provide health benefits. This suggests that there may be a need to educate the public on the health benefits of ALVs and to dispel any misconceptions that they are only meant for certain age groups or for medicinal purposes. On the other hand, some participants changed their perception of ALVs after tasting them, and now view them as tasty. This also suggests that sensory testing exercises can be an effective way to change people's perceptions of ALVs and encourage them to incorporate them into their diets. Overall, changing people's perceptions of ALVs is important for increasing their consumption and reaping the health benefits that they offer. Educating the public and conducting sensory testing exercises can be effective strategies for achieving this goal.

The comparison between ALVs and exotic vegetables (EVs) in terms of preference and accessibility among participants in the focus groups suggests that both types of vegetables are valued for their perceived health benefits. This is consistent with previous studies that have mentioned ALVs to have potential health benefits such as reducing the risk of chronic diseases and diabetes (Oelofse et al., 2012). Similarly, exotic vegetables such as Broccoli and Cauliflower, have also been found to have health benefits (Porter, 2012)). However, the preference for EVs over ALVs among some participants in the focus groups may be attributed to their accessibility and familiarity. Previous research has found that familiarity with a food item can influence food choice and accessibility can also play a role in food consumption (Mbhenyane, 2017). This highlights the need for increased availability and accessibility of ALVs in local markets and stores, as well as greater education on the health benefits of ALVs to increase their popularity.

The statement by some of the participants that EVs are mostly recommended by doctors, while ALVs are rich in fibre, suggests a potential gap in knowledge among healthcare providers regarding the nutritional benefits of ALVs. In conclusion, the comparison between ALVs and EVs in terms of preference and accessibility highlights the need for increased availability, accessibility, and education on the nutritional benefits of ALVs. Additionally, the potential gap in knowledge among healthcare providers regarding traditional foods such as ALVs suggests a need for greater education and awareness in this area.

The focus group participants' recognition of the high nutritional value of ALVs, including iron and other essential nutrients, suggests that these vegetables could be an important source of nutrition in their diets. Some studies in Limpopo reported that people were consuming some ALVs like Blackjack to control diabetes and high blood pressure (Mokganya & Tshisikhawe, 2019). Despite the health benefits of ALVs, their consumption remains relatively low compared to other vegetables, partly due to a lack of awareness and knowledge of their nutritional value. Therefore, there is a need for more education and awareness campaigns to promote the consumption of ALVs, especially among vulnerable populations who may have limited access to a variety of nutritious foods.

The availability of ALVs in formal supermarkets is a crucial factor in promoting their consumption, particularly among urban populations. The results of this study suggest that some participants are willing to purchase ALVs from formal supermarkets if they were available.

However, others may refrain from buying them due to a lack of information on how to prepare them. Therefore, increasing awareness and knowledge about ALVs and their nutritional benefits could enhance their acceptability and utilisation among consumers. A study conducted by Gido et al., (2017a) in Kenya also reported that the availability of ALVs in formal markets was limited due to inadequate supply and low demand. The study recommended that strategies such as increasing awareness through nutrition education programmes and encouraging farmers to produce ALVs could increase the availability and consumption of these vegetables. Another study conducted in SA by Nyembe, (2015) reported that the limited availability of ALVs from formal markets and being sold in informal markets influenced consumers' choice in the consumption of ALVs. The study recommended promoting the production and marketing of ALVs by providing incentives to farmers and encouraging formal supermarkets to stock them.

In summary, the availability of ALVs in formal supermarkets is a critical factor in promoting their consumption among urban populations. The lack of information on how to cook them properly may hinder their acceptability, which calls for increased awareness and education about ALVs and their nutritional benefits. Strategies such as encouraging farmers to produce ALVs and incentivizing formal supermarkets to stock them could increase their availability and consumption.

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CHAPTER 6: Conclusion and Recommendations

6.1 Conclusion

The objectives of this study were to assess the knowledge of the ALVs among the youth, to determine youth perceptions towards the consumption of ALVs and to analyse the acceptability of in-season ALVs dishes among youth. There is still a need for improvement to make ALVs more available and accessible to everyone. In the same vein, there is still a need for modern and appealing methods of preparation or incorporation of ALVs to further improve their acceptability by youths. There is no loss of indigenous knowledge yet of ALVs judging by the way the youth were able to name the types of ALVs that they know. Conversely, there is a need for more education in terms of being able to identify them as they could not identify some of the ALVs that were presented to them, especially in the English language. Most youth do not dislike ALVs, they do not see them as food for the poor and they also do not feel embarrassed to consume ALVs. The youth are also aware of the nutrition and health benefits of consuming ALVs. ALVs should be incorporated into the daily food consumption of youths.

6.2 Recommendations

The Departments of Health, Agriculture, and Education should also develop awareness campaigns through the development of posters and other media to make the youth aware of the different types of ALVs and how they look, their benefits, as well as modern cooking methods of these vegetables. There is an evolution of the latest consumer trends where consumers prefer food that is ethically produced, nutrient-rich and yet convenient. This evolution provides an opportunity to integrate ALVs into diets, through the provision of pre-packed, as well as canned ALVs in supermarkets which can significantly contribute to addressing the issue of transition to unhealthy, ultra-processed foods.

Policymakers could use such information to encourage investment in the development of ALVs as a sustainable and ethical alternative to traditional animal protein sources. On the other hand, industry practitioners could use this information to market their ALV products to consumers who are already familiar with them. Finally, this finding has theoretical implications for the study of consumer behaviour and preferences related to alternative protein and micro-nutrient sources other than meat. Overall, the study provides important

insights into the current state of consumer behaviour related to ALVs. Further research is needed to explore the reasons behind this trend and to investigate whether it is likely to continue in the future.

Results from the current study bring the hope of reversing the NT that has occurred since youth are now 'woke' enough to make smarter food choices and have better perceptions towards ALVs. Better perceptions by youth mean that there is a generation of future consumers that could be much healthier, active with higher life expectancy and less prone to nutrition-related diseases. Furthermore, a better understanding of the palate taste preferences that reside amongst the youth could help in the promotion of the utilisation and consumption of indigenous/indigenised vegetables as an alternative that provides healthy choices that foster a satisfying, positive relationship with food. Efforts to promote the consumption of ALVs should focus on addressing the barriers to access and taste preference. This could involve interventions such as promoting the cultivation and availability of ALVs, as well as education and awareness-raising campaigns that highlight the nutritional benefits and potential culinary uses of ALVs. Additionally, efforts should be made to incorporate ALVs into existing food practices and cultural norms to increase their acceptability and consumption.

Restaurants and fast-food outlets have become popular due to their convenience and provision of tasty foods. They can contribute to countering the unhealthy dietary trend stated in literature by including ALVs in their menus. This can be achieved through the development of versatile and aesthetic underutilised dishes in the form of salads, relishes, stir-fries, noodles, fresh smoothies, etc. The findings from this study show that youth are slowly changing the narrative that there are still strong beliefs and taboos about underutilised plant foods, like being considered "wild foods or weeds", "food for the poor", etc. This can be further improved by supermarkets and restaurants through appropriate marketing strategies. There is a need for a lot of investment into commercialising the farming of ALVs to ensure adequate and constant supply all year round. Currently, most underutilised plants currently grow as volunteer plants. If cultivated, it is done on a very small scale. The existing hidden hunger can be eradicated only if underutilised local, indigenous and traditional plant foods are given the value that they deserve.

Appendix A: Ethical Clearance letter

14 January 2022

Precious Sanelisiwe Shembe (205514993) School of Agriculture, Earth & Environmental Sc Pietermaritzburg Campus

Dear PS Shembe,

Protocol reference number: HSSREC/00003645/2021
Project title: THE YOUTH'S KNOWLEDGE, PERCEPTIONS AND ACCEPTANCE OF AFRICAN LEAFY VEGETABLES GROWING IN NORTHERN KWAZULU-NATAL PROVINCE
Degree : Masters

Provisional Approval – Expedited Application

This letter serves to notify you that your application received on 21 October 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC). The protocol has been provisionally approved, subject to the following conditions set out below being addressed:

1. Has data collection (pilot study/fieldwork) already started / occurred? If not, please revise timelines.
2. Description of the sample size is confusing. Some statements refer to 120 (60 at each institution), and others

   60 (30 at each institution).

3. Please provide details of how the focus group discussion will occur (specifically COVID-19 protocols).

4. The Project Investigator (PI) is encouraged to provide feedback to all participants, simply having the study online on in an online database is not sufficient feedback for participants. There are options that may be useful, eg, a short meeting to provide an overview of the result.

5. It is unclear how the ballot sheet will be used if there are multiple samples. To this end, it is unclear how preferences and participant characteristics and perceptions will be linked, which is one of the objectives.
6. Consent form should be attached to application.
7. Title must be written in sentence case.

Kindly upload your response on Tab eight of the Research Information Gateway (RIG) online system as soon as possible. Please do not submit a new revised application.

This approval is granted provisionally and the final clearance for this project will be given once the above- mentioned condition(s) has been met. Note that data collection may not proceed until final ethics approval letter has been issued after the remaining conditions have been met and approved by the research ethics committee.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).
Yours faithfully

.....

Professor Dipane Hlalele (Chair)

Appendix B: Gatekeepers' letters

PO Box 61192
Bishopsgate
4091
03 August 2021

Owen Sithole College of Agriculture
Private Bag X 20013
Empangeni
3880

Dear Sir/Madam,

Permission to Conduct Study at Owen Sithole Agric College (OSCA)

My name is Precious Sanelisiwe Shembe (205514993), a Master of Agriculture in Food Security student at the University of KwaZulu-Natal Pietermaritzburg campus at the College of Agriculture, Earth and Environmental Science.

The topic of my study is: **The youth's knowledge, Perceptions and Acceptance of ALVs Growing in Northern KwaZulu-Natal**. The objectives of the study are to: assess the knowledge of the ALVs among the youth, determine youth perceptions towards the consumption of ALVs and to analyse the acceptability of in-season ALVs dishes among youth. A total of one hundred and twenty (120) students that belong to the youth group is expected to participate in this study. The researcher wishes to conduct the study at two tertiary institutions, therefore a total of sixty participants from each institution will be needed. The study will use a survey questionnaire (with sixty students per institution).

The estimated total time to fill the questionnaire is 30 minutes. The study also seeks to conduct a sensory evaluation where sixty (60) students from each tertiary institution will be asked to taste the samples of cooked ALVs and rate them on a 9-point Hedonic scale questionnaire according to their preference. The sensory evaluation session is expected to take at least one to two days day, where five students will taste the ALVs every 30 minutes to an hour, which should not exceed more than 3 hours to complete if two groups consisting of thirty students each, per day to complete the survey for two days.

Students will be asked to fill a consent form before they participate in the study and will be asked to indicate if they are allergic to any of the ingredients used to prepare the ALVs, those that are allergic will not participate in the study. This research study has been provisionally approved by the University of KwaZulu-Natal (UKZN) Humanities and Social Sciences Research Ethics Committee (HSSREC) and the approval letter is attached. The study is self-funded.

Should you have any concerns, comments and suggestions regarding this study, please do not hesitate to contact the Researcher at email: sanelisiwe@kuyameka.org and Supervisor, Professor Unathi Kolanisi at kolanisiu@unizulu.ac.za.

Yours Sincerely,

Precious Sanelisiwe Shembe

PO Box 61192
Bishopsgate
4091
03 August 2021

The Registrar
University of Zululand
Private Bag X 1001
KwaDlangezwa
3886

Dear Sir/Madam,

Permission to Conduct Study at University of Zululand- Dlangezwa Campus

My name is Precious Sanelisiwe Shembe (205514993), a Master of Agriculture in Food Security student at the University of KwaZulu-Natal Pietermaritzburg campus at the College of Agriculture, Earth and Environmental Science.

The topic of my study is: **The youth's knowledge, Perceptions and Acceptance of African Leafy Vegetables (ALVs) Growing in Northern KwaZulu-Natal**. The objectives of the study are to: assess the knowledge of the ALVs among the youth, determine youth perceptions towards the consumption of ALVs, and to analyse the acceptability of in-season ALVs dishes among youth. A total of one hundred and twenty (120) students that belong to the youth group is expected to participate in this study. The researcher wishes to conduct the study at two tertiary institutions, therefore a total of sixty participants from each institution will be needed. The study will use a survey questionnaire (with sixty students per institution).

The estimated total time to fill the questionnaire is 30 to 60 minutes. The study also seeks to conduct a sensory evaluation whereby sixty (60) students from each tertiary institution will be asked to taste the samples of cooked ALVs and rate them on a 9-point Hedonic scale questionnaire according to their preference. The sensory evaluation session is expected to take at least one to two days, where five students will taste the ALVs every 30 minutes to an hour, which should not exceed more than 3 hours to complete with two groups consisting of thirty students each, per day to complete the survey for two days. Alternatively, depending on the venue size, ten students will complete the survey every 30 minutes, which will take one day and will not exceed more than three hours in total for all sixty students.

Students will be asked to fill a consent form before they participate in the study and will be asked to indicate if they are allergic to any of the ingredients used to prepare the ALVs, those that are allergic will not participate in the study. This research study has been provisionally approved by the UKZN Humanities and Social Sciences Research Ethics Committee (HSSREC) and the approval letter is attached. The study is self-funded.

Should you have any concerns, comments and suggestions regarding this study, please do not hesitate to contact the Researcher at email: sanelisiwe@kuyameka.org or alternatively, contact my Supervisor Professor Unathi Kolanisi at kolanisiu@unizulu.ac.za.

Yours Sincerely,
Precious Sanelisiwe Shembe

Approved by Supervisor
Professor Unathi Kolanisi

_____

Supervisor Approval

Appendix C: Consent form

I,_____ agree that I have been informed about details of this study titled: The youth's knowledge, perceptions and acceptance of ALVs that grow well in Northern KwaZululu-Natal by Sanelisiwe Shembe. I understand that the study entails answering a survey questionnaire and a sensory evaluation whereby I will be required to test and taste samples of ALVs and give feedback.

I have been informed that participation in this study is completely voluntary and that I may withdraw at any time without prejudice.
I also hereby consent for my participation to be audio recorded and photos taken for the consumption of the University of KwaZulu-Natal.

I also understand that If I have any questions or concerns about the study, I may contact the Researcher and the Supervisor for the study at: sanelisiwe@kuyameka.org and kolanisiu@unizulu.ac.za. With regards to my rights pertaining to the study, I may contact the :
Humanities & Social Sciences Research Ethics Administration
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000

Tel: +27 31 260 4557.
Email: HSSREC@ukzn.ac.za

Participant signature Date

Appendix D: Survey questionnaire

- **This research study is on African Leafy Vegetables ALVs). ALVs are defined as plant species which are either genuinely native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection (Maseko et al. 2017). These species are also referred to as wild leafy vegetables because of their ability to grow as volunteer plants and without cultivation.**

Instructions for filling this form:

- **Please use a tick (✓) to indicate your selection**
- **Please answer all the questions**
- **Please answer truthfully**

Knowledge, Perceptions and Acceptance of ALVs

Part I: Socio-Demographic Data

1. **Age:**

1.		
2.		
3.		
4.		

2. **Gender**

1.	Female	
2.	Male	

3. **Institution:**

1.	OSCA	
2.	UNIZULU	

4. **Level of study:**

1.	1st year	
2.	2nd year	
3.	3rd year	
4.	Postgrad	

5. **Do you stay at:**

1.	Home	
2.	University Residence	
3.	Private Accommodation	

6. **Which of the following best describe the highest level of your parent's education?**

1.	No formal education		
2.	Completed Primary education		
3.	Completed Secondary education		
5.	Completed diploma		
6.	Completed university degree		
7.	Postgraduate qualification		

Part II: Knowledge of ALVs

1. Are you familiar with any ALVs?

1.	Yes		
2.	No		

2. If yes above, please tick the one that applies to you. If no, please proceed to the next question.

1.	Amaranthus (imbuya, ugobolo)		
2.	Pumpkin leaves (imfino yentanga)		
3.	Blackjack (ucadolo)		
4.	Sweet potato leaves (ubhatata)		
5.	Butternut leaves (usolozi)		
6.	Other (please list them below)		
7.			
8.			
9.			

3. Do you consume any of the ALVs you mentioned?

1.	Yes		
2.	No		

4. If you answered yes, please list the ALVs that you have consumed.

5. If No why?

1.	Dislike them		
2.	Cannot get them (not available)		
3.	They are never cooked at home		
4.	Do not know them		

5.	Other (specify)		

6. Do you have ALVs that you like eating?

1.	Yes		
2.	No		

7. If yes, please name them? If you answered no to question 6, please proceed to question 9.

8. Please give reasons why you prefer these ones?

1.	They are tasty		
2.	They are healthy		
3.	They are part of my culture		
4.	They are easily accessible		
5.	They are the only ones that are cooked at home		
6.	Other (specify)		

9. Which of the following best describe your answer? How do you prefer eating ALVs?

1.	Boiled		
2.	Boiled and fried		
3.	Raw (salad)		
4.	Mixed with maize meal		
5.	Other		

10. How often are ALVs prepared at home or place of residence?

1.	Everyday		
2.	Three times a week		
3.	Once a week		
4.	Very seldom		
5.	Never		

11. When ALVs have been prepared, how often do you eat them?

1.	Every time		
2.	Very seldom		
3.	Never		

12. If you eat ALVs when they are prepared, which one of these best describes the reason for your answer?

1.	I like the taste		
2.	I am forced to eat them		
3.	They are part of my culture		
5.	They have many health benefits		
6.	They are easily available		
7.	They are nutritious		
8.	Other (specify)		

13. How do you access the ALVs that you consume?

1.	Garden at home		
2.	The wild		
3.	Neighbours		
4.	Informal market		
5.	Other (specify)		

14. In what form do you mainly acquire ALVs?

1.	Fresh		
2.	Dried		
3.	Both fresh and dried		
4.	Other		

15. If the ALVs have never been cooked at home, have you consumed them elsewhere?

1.	Yes		
2.	No		

16. If yes to question 15, where did you consume them? If no to Q.15, proceed to Q.17

1.	At a friend's house		
2.	At a relative's house		
3.	At school		
4.	Other, please specify		

17. Please provide the names (in your home language and the English name, if you know it) of the vegetables in the photos below, please feel free to state if you don't know the name:

Specimen A

Traditional name	English name

Specimen B

Traditional name	English name

Specimen C

Traditional name	English name

Specimen D

Traditional name	English name

Specimen E

Traditional name	English name

Part III: Perceptions
Please tick the most appropriate number of each statement which corresponds with your response.

Measurement Items	**Strongly Agree**	**Agree**	**Unsure/Neutral**	**Disagree**	**Strongly Disagree**
	1	2	3	4	5
ALVs are familiar to me					
I like ALVs					
ALVs are backwards					
I would love to eat more ALVs					
ALVs are for the elderly					
ALVs are more nutritious than exotic vegetables					
I wish I knew of modern recipes for cooking ALVs					
I do not want to be seen by my friends eating ALVs					
I am put off by the monotonous preparation of ALVs					
ALVs are for the poor					

Thank you for your participation ☺

Please tick your selection below:
I would like to participate on the Sensory Evaluation of this study

1.	Yes	
2.	No	

Appendix E: Sensory Evaluation Sheet

ALVs: Acceptability Date:

- Please rinse your mouth with water before starting.
- Please rinse your mouth with water after tasting each sample.
- Please taste the two samples presented, from left to right. You may drink as much water as you would like, but you must consume at least half the sample provided.
- Please make sure that you are not allergic to *Amaranthus*, Spinach and/ pumpkin leaves.
- Please do not communicate with other respondents during the period of the sensory evaluation. You may communicate with the server if you need assistance.

Part I: Socio-Demographic Data

1. **Questionnaire code**:

2. **Age:**

1.	18-22	
2.	23-27	
3.	28-32	
4.	33-36	

3. **Gender**

1.	Female	
2.	Male	

4. **Institution:**

1.	OSCA	
2.	UNIZULU	

5. **Level of study:**

1.	1st year	
2.	2nd year	
3.	3rd year	
4.	Postgrad	

6. **Do you stay at:**

1.	Home	
2.	University Residence	
3.	Private Accommodation	

Part II: Acceptability of ALVs
Please look at the samples presented from left to right and tick your selection according to the trait:

Trait	**Like**				**Indifferent**	**Dislike**			
	Like Extremely	**Like very much**	**Like moderately**	**Like slightly**	**Neither like nor dislike**	**Dislike slightly**	**Dislike moderately**	**Dislike very much**	**Dislike extremely**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Appearance									
Are you keen to consume it?									
Smell									
Texture									
Taste									
Aftertaste									

Thank you for your participation. Please return your ballot to the server.

Appendix F: Focus group questionnaire

1. Do you know of any ALVs?

2. Amongst those, how many do you consume?

3. Do you think it is important to consume ALVs?
   Why?

4. If not, why not?

5. After tasting the vegetables on the previous exercise, do you feel that you have changed the way you see ALVs?

6. Between ALVs and exotic vegetables (EVs), which ones do you prefer eating?

7. Is there any role that you think is played by ALVs on your diet?

8. What role is that?

9. Which is healthier than the other? ALVs or EVs?

10. Why?

11. If ALVs were to be sold in formal chain market stores, would you be willing to purchase them?

12. Is there anything that you feel should be included in this discussion?

Thank you for your participation.