DOCUMENTATION AND NUTRITIONAL EVALUATION OF SOME WILD EDIBLE FRUIT PLANTS AND TRADITIONAL VEGETABLES OF THE VHEMBE DISTRICT MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

By

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Documentation and nutritional evaluation of some wild edible fruit plants and traditional vegetables of the Vhembe District municipality, Limpopo Province South Africa

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DECLARATION

I Mokgaetji Georginah Mokganya hereby declare that the thesis for the Doctor of Philosophy in Botany at the University of Venda, hereby submitted by me, has not previously been submitted for a degree at this or any other university, and that it is my own work in design and execution and that all reference material contained therein has been duly acknowledged.

………………………………	12 August 2019
Mokgaetji Georginah Mokganya	Date

DEDICATION

This work is dedicated to my late mother, Macheba Asnath Molotja, who always guided and inspired me to be a hard-working person. May her soul rest in peace. Mma, you will forever be my heroine.

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ABSTRACT

Wild plants have been used since time immemorial by native people all over the world. In many sections of the rural areas, people traditionally harvest wide range of leafy vegetables, roots tubers and fruits from the wild because of their taste, cultural practices, as food supplements or to tide over food shortage. It has been reported that wild plants have been recognized to have potential that satisfies the needs on household food and income security. Millions of people in many developing countries do not have adequate sources of food to meet their daily nutritional requirements and furthermore, many people are suffering from malnutrition due to lack of one or more micronutrients. Thus, in most situations, rural communities rely on wild resources including edible vegetables and fruits to meet their daily food requirements.

Relatively little research projects conducted in the Vhembe District paid attention on wild edible plants and their nutrients. Therefore, the aim of this study was to further document wild edible plants and to evaluate nutritional status of some of these plants. To achieve this, an investigation was conducted in the four local municipalities of the Vhembe District municipality. Ten homesteads from four villages of each of the four local municipalities were randomly sampled to select respondents of this project. A total of 160 informants were interviewed through semi-structured questionnaires to firstly check the knowledge transfer from elderly members to youth members of Vhembe communities.

This study demonstrated the major indigenous debility among the youth members who live in urban villages. Secondly, information concerning other different use categories was gathered through interviews with the 160 informants. Documented use categories mentioned during the interviews include food, medicine, beverages, construction, firewood, cosmetic, dye and artifacts. *Sclerocayra birrea* had eight use categories as compared to other edible fruit plant species. The list of documented wild edible plants includes trees, herbs, creepers, climbers and shrubs. Leaves of the mentioned growth forms were mostly used as compared to plants parts such as fruits, rhizomes, tubers, seeds and flowers. Some of the plants were mentioned to be available during certain seasons, therefore they were preserved using the sun drying method. Some edible parts can either be collected and sun dried or collected, cooked and then sun dried.

Micronutrients are essential for the normal growth of children; however, there is disturbing reports of low intake of micronutrients rich foods eaten by children residing in poor rural areas. Some reports showed the low intake of Vitamin A in black children younger than 10 years of ages. Vitamin A deficiency continues to be a major public health problem in South Africa; therefore, this study also evaluated Vitamin A and C statuses from selected vegetables. Plants that received attentioned were selected based on their frequency of use and availability. Leaves of *Amaranthus thunbergii* and *Amaranthus hybridus* had outstanding Vitamin C concentration of 69.106 mg/100g and 43.299 mg/100g respectively. Majority of the wild edible vegetables (i.e. six out of eight) evaluated contain substantial quantities of β-carotene. Exceptionally, leaves of *Solanum retroflexum* contained high level of 10.905 β-carotene. The study therefore recommends an urgent need for the documentation and promotions or awareness campaigns as a way of dealing with the loss of indigenous knowledge. Moreover, researches related to cultivation of wild edible plants must be considered. Nevertheless, despite the rich indigenous knowledge on the medicinal use of the wild plants which is well documented; more research particularly to serve the concern on socio-economic, pharmacological and nutritional aspects still require satisfactory attention.

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LIST OF ABBREVIATIONS

AIDS	=	Acquired Immune Deficiency Syndrome
Anova	=	Analysis of Varience
CDHS	=	Cameroon Demographic and Health System
FAO	=	Food and Agriculture Organization
FAOUN	=	Food and Agriculture Organization of the United Nations
FC	=	Frequency of Citation
FNB	=	Food and Nutrition Board
GLM	=	Generalized Linear Model

GISD	=	Global Invasive Species Database
HPLC	=	High Performance Liquid Chromatography
HPLC-PDA	=	High Performance Liquid Chromatography Photodiode Array
IKS	=	Indigenous Knowledge Systems
LSOER	=	Limpopo State of Environment Report
MSc	=	Master of Science
NFCS	=	Nationwide Food Consumption Survey
PIC	=	Prior Informed Consent
RDA	=	Recommended Dietary Allowance
RFC	=	Relative Frequency of Citation
SANBI	=	South African National Biodiversity Institute
SA	=	South Africa
SACRACG	=	South African Comperative Risk Assessment Collaborating Group
SANHANES	=	South African National Health and Nutrition Examination Survey
SANNSS	=	South African National Nutritional Status Survey Group
SASAS	=	South African Social Attitudes Survey
SAVACG	=	South African Vitamin A Consultative Group

Stats SA = Statistics South Africa

UNESCO = United Nations Educational Scientific and Cultural Organization

UV = Ultra Violet

VDM = Vhembe District Municipality

WHO = World Health Organization

CONFERENCE CONTRIBUTIONS

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Chapter 1

GENERAL INTRODUCTION

This is the introductory section to the study which introduces the topic of the documentation and nutritional evaluation of some wild edible fruits and vegetables from Vhembe District Municipality (VDM), Limpopo Province, South Africa. The background and motivation of the whole study is outlined in this chapter. Problem statement, significances of the study, rationale and objectives of the study are also described.

1.1 BACKGROUND AND MOTIVATION

It is imperative that the inhabitants of a particular section of the land be able to identify and know the vegetation surrounding them. This vegetation comprises of wild edible plants with high dietary and nutritional benefits to inhabitants. However, some wild plants are poisonous to an extent that they may pose danger to the lives of people hence good knowledge about plants is imperative to the community.

Wild edible plants are very beneficial to the inhabitants of the poor rural villages for many reasons. Two reasons worthy of noting are as follows: i) there are wild edibles growing near villages no matter what part of the world the village is. Therefore, chances of getting a large number of wild edibles where inhabitants live are very good. Some of these plants are even likely to be plentiful. ii) Secondly, many wild edibles are highly nutritious compared to those vegetables that are easily accessible in many commercial stores.

Wild plants have been used since time immemorial by native people all over the world. In many sections of the rural areas, people traditionally harvest wide range of leafy vegetables, roots tubers and fruits from the wild because their taste, cultural practices, as food supplements or to tide over food shortage (Mahapatra et al., 2012). It has been reported by Guinand and Dechassa (2000) that wild plants have been recognized to have potential to satisfy the needs on household food and income security. According to Food and Agriculture Organization of the United Nations (FAOUN), millions of people in many developing countries do not have adequate source of food to meet their daily requirements and furthermore, more and more people are suffering from malnutrition of one or more micronutrients (FAOUN, 2004). Thus, in most situations, rural communities rely on wild resources including edible vegetables and fruits to meet their daily food requirements.

Wild plants, more especially vegetables, are an important source of food mainly, in the rural parts of South Africa (Shackleton 2003; Modi et al., 2006; Jansen van Rensburg et al., 2007; Vorster et al., 2007; Vorster et al., 2008). Such plants also play a paramount role; used as relish which supplements the staple carbohydrate-based diets. They are generally reported to be rich in micronutrients. Although wild vegetables may be consumed in small quantities, they manage to reduce hunger and play a vital role in household food security for the poor rural groups. Zemede (1997) provides detailed knowledge of edible wild plants in different locations in Africa. It also showed that wild edible plants are essential components of many Africans' diets, especially during the periods of seasonal food shortage. Similarly, Maundu et al. (1999) indicated that many wild edible plants are nutritionally rich and can supplement nutritional requirements, more especially vitamins and micronutrients. Nutritional analyses of some wild food plants demonstrate the nutritional quality of wild plants as comparable and in some cases even superior to the domesticated varieties (Kabuye, 1997).

1.2 DEFINATION OF THE WILD EDIBLE PLANTS

'Wild edible plant' is the term used many times in the ethnobotanical literature to describe species that are neither cultivated nor domesticated but are available for use as sources of food from their natural habitat, usually agricultural fields (Molla et al., 2011). Some ethnobotanical researchers use other similar terms such as traditional and indigenous plants (Van der Hoeven et al., 2013); wild food species (Shrestha & Dhillion, 2006), and useful wild plants (Tardio & Pardo-de-Santayana, 2008). On the other hand, the term 'wild' simply refers to a kind of environment inhabited by these species. They are therefore expected to grow and establish well in their natural habitat or simply are found in the wild. The local Venda translation of the word wild vegetables and fruits is (*miri ya daka* or *miroho ya daka*) meaning plants of the wild or plants growing in the wild.

1.3 ADVANTAGES OF WILD EDIBLE PLANTS

There are several inventoried revelations of the importance of consideration of wild edible plants as everyday food. Those significance include the provision of high nutritional value and they can thrive under harsh conditions (Nesamvuni, 2000; Lephole, 2004). Most importantly, these plants species require less chemical fertilizer and pesticides since they have adaptations of surviving well in their local environmental conditions (Van Vuuren, 2006).

1.4 PROBLEM STATEMENT

Some studies on wild edible plants have been conducted and findings are also recorded. For example, researchers such as Bhat and Rubuluza (2002) and Megrino (2004) attempted to record potential uses of wild edible vegetables in South Africa. Additionally, Maanda and Bhat (2010) studied and documented the marginal utilization of 40 wild edible vegetables species in Venda area of Limpopo Province, South Africa. However, this investigation aimed at reinforcing the already gathered information by focusing on knowledge transfer, additional uses of traditional edible plants, preparation and preservation methods of traditional vegetables, nutritional analysis of some traditional edible plants and quantification of the traditional edible plants. This study serves as a wake-up call to the people of Vhembe District Municipality to start taking into cognizance the value of wild plants, as the knowledge of their precious vegetation will be documented.

The documentation of the wild edible plants is important as it was realized that many valuable wild food plants are familiar in certain areas or certain communities but not to others. Given the rapid decline of traditional knowledge about wild edible plants and increased reliance on processed food, documentation and evaluation of the traditional knowledge related to the diversity usage and status of wild edible plants is very crucial. Some of the local people cannot afford to buy food from the markets for their nutrient's intake balance; however, the study would bring awareness amongst the rural people about the nutritional contents of the wild edible plants they rely on. The wild edible vegetables are generally viewed by urban populations as nutritionally inferior and of low prestige (Megrino, 2004).

The present study addressed the issue by gathering information about the use and nutritional values of some traditional edible vegetables. There is a problem with the commercial vegetables associated with the presence of high pesticide residues (Megrino, 2004). Consequently, if consumers become aware of the fact that wild edible plants are pesticide free, it can result into a major shift for them to opt for wild edible plants.

Steenkamp (2003) shows that much of the ethnobotanical research undertaken in Limpopo Province and Vhembe District in particular, focused largely on indigenous plant species with ethno-medicinal use. Nevertheless, despite the rich indigenous knowledge on the medicinal use of wild plants which has been well documented (Mabogo, 1990; Tshisikhawe, 2002; Tshikalange et al., 2005; Samie et al*.,* 2010; Mulaudzi et al., 2011; Mahwasane et al., 2013; Masevhe, 2015), more research; particularly to serve the concern on socio-economic, cultural, traditional and nutritional aspects of wild edible plants still require adequate attention.

Reports by Hart and Vorster (2006); Modi et al. (2006); Jansen van Rensburg et al. (2007); Lewu and Mavengahama (2010) and Taleni et al. (2012) agree with the decline of the knowledge and consumption of wild edible vegetables. Steenkamp (2003) also revealed the nutritional importance of certain wild food plant species with protein, minerals, and vitamin content, thus highlighting the role they could play in enriching the diets of vulnerable rural populations. In addition to Steenkamp (2003)'s findings, Nesamvuni et al. (2001); Steyn et al. (2001); Bvenura and Afolayan (2014) and Odhav et al. (2007) studied the nutritional values of some wild plants consumed in rural populations of South Africa and Ethiopia. From their accounts, it is evident that the studied vegetables were good source of nutrients such as protein, fibre, carbohydrates, Ca, Mg, Vitamin C and Fe. Furthermore, Berti et al. (2014) and Modi et al. (2006) predicted that by considering the inclusion of wild edible species in the diets could bring an improvement in micronutrient deficiencies.

The problem of drastic diminishing of traditional knowledge is not experienced by South Africans only; however, it also affects many other nationals and global communities. Kassim (2009) states that the information about the contribution of the wild food plant species to world nutrition is still very limited. Additionally, Kalemba (2007) found that the promotion of utilization and commercialization of indigenous wild food plants, especially in arid and semi-arid regions of Africa including Southern Africa is somehow been ignored.

Pardo-de-Santayana et al*.* (2007) are reinforcing the importance of checking traditional knowledge on wild edible plants used in the northwest of the Iberian Peninsula (Spain and Portugal), due to the noticeable dramatic loss of traditional knowledge about the Wild Edible Plants in that area. Figure 1.4.1 shows the conceptual framework about the driving forces detected from local, international and national researchers on conducting of wild edible plants evaluation related researches. The figure attempts to show communal motivations that drove worldwide researchers towards embarking on the study of wild edible plants.

There is ample historical evidence that indicates the impact of severe food shortages to almost all regions inhabited by humans (Whiting, 1958; Gaulin & Konner, 1977). Due to this disturbing food shortage amongst different societies, the development of an array of strategies for combatting hunger emerged. One of the most common useful strategies for coping with food shortage (whether of short or long term) is consumption of wild plants.

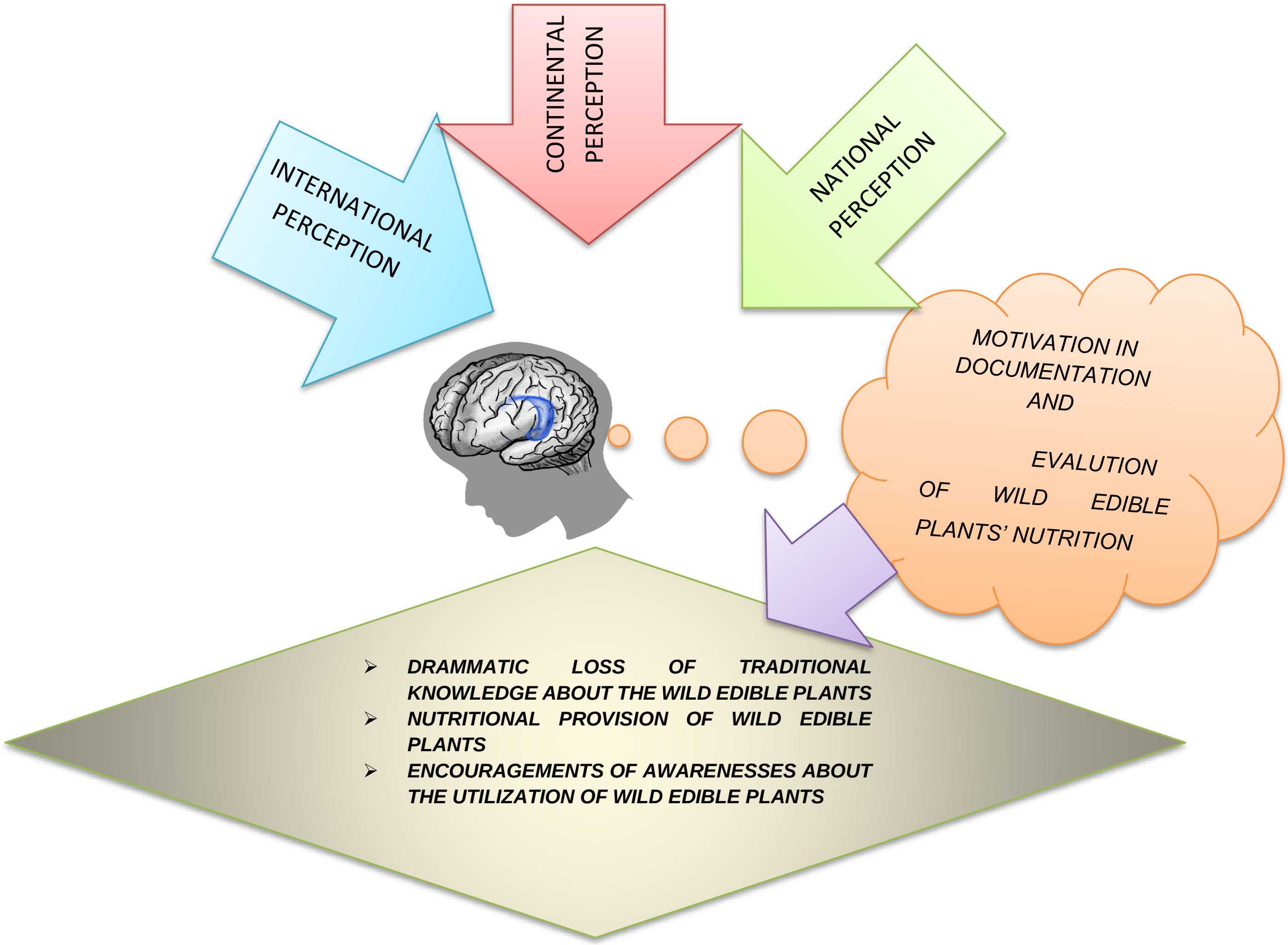

Figure 1.4.1: The conceptual framework to depict the common drive towards studying the wild edible plants from local, international and global perceptions (Whitting 1958; Gaulin and Konner 1977; Kalemba 2007; Pardo-de-Santayana et al. 2007; Kassim 2009).

1.5 RESEARCH QUESTION

Which wild plants of Vhembe district municipality are edible and what are their nutritional values?

1.6 HYPOTHESIS

Mahapatra et al. (2012) noted the presence and abundance of useful nutrients in wild fruits. More edible plants will be documented in the current study. Trace elements that wild edible plants and fruits contain will be relatively comparable with that of commercial fruits and vegetables.

1.7 AIM AND OBJECTIVES OF THE STUDY

The aim of the present investigation was to explore further documentation of information on the wild plants' use by the VhaVenda of Vhembe district municipality. Furthermore, the study aimed at exploring the nutritional values of the commonly used wild vegetables and fruits. To achieve the aim, the set objectives were as follows:

1.7.1 To document the wild edible vegetables and fruits used by Vha-Venda inhabitants of the Vhembe District Municipality, Limpopo Province.

1.7.1.1 To compile a list of all collected wild edible vegetables and fruits.

1.7.1.2 To evaluate the wild edible fruit plants with additional other uses.

1.7.1.3 To evaluate the wild edible vegetables with other uses.

1.7.1.4 To check the traditional preparation of some selected wild edible vegetables.

1.7.2 To quantify the use patterns of some wild edible plants of the Vhembe District Municipality.

1.7.3 To explore knowledge transfer between elders and youth members of the Vhembe District.

1.7.4 To analyze the nutritional values of some of the documented wild edible vegetables and fruits.

1.8 SIGNIFICANCES OF THE STUDY

Vhembe District Municipality is rich in biodiversity; however, from the entire beautiful rich vegetation much focus was given to the medicinal plants. The current study, therefore documented the wild edible vegetables and fruits which are useful to VDM communities and other researchers. Furthermore, the study encouraged the usage of the wild edible vegetables and fruits as their importance is been indicated by many researchers. Wild vegetables and fruits are indispensable as they are better adapted to the local ecology. They are also easier to grow and have few pests and diseases as compared to the introduced varieties.

The utilization of the wild edible vegetables and fruits seems to drop gradually amongst the rural inhabitants due to lack of knowledge. This trend is likely to continue since the information about the use of wild plants is not passed to the young generations. According to Dweba and Mearns (2011), the traditional knowledge of wild vegetables and fruits is largely un-documented in South Africa and it is disappearing at a fast rate. Nevertheless, there is a fear of disappearing information on the use of wild edible vegetables and fruits by young ones; it is believed that elders and other knowledgeable community members are the key sources of plant lore. Conducting research on wild edible vegetables and fruits may help prevent the loss of knowledge on potential dietary sources for needy households.

Some wild fruits have been identified to have better nutritional value than the cultivated fruits (Maikhuri et al. 1994) as a result, a growing interest has recently emerged to evaluate various wild edible plants for their nutritional features (Glew et al., 2005, (a study conducted in Niger); Musinguzi et al.,2007, (a study conducted in Uganda); Nkafamiya et al., 2007, (a study conducted in the Northern region of Nigeria); Aberoumand & Deokule 2009, (a study conducted in Iran and India); Nazarudeen, 2010, (a study done in Kerala)).

World Health Organization (WHO, 1996) found that Calcium, Magnesium and Potassium are essential for worn out cells, building of red blood cells and maintaining body mechanisms, and their absence in diet might result in weak, stunted growth and poor bone development (Effiong & Udo, 2010).

1.9 STRUCTURE OF THE THESIS

This thesis composed of ten chapters. Chapter 1 outlines the general introduction, aims, objectives, motivation and significances of the study. The second chapter represents literature review which gives the background information pertaining wild edible plant use and their nutritional status. Nutritional status of the South African population is also addressed in this chapter. Information on the use of wild edible plants to combat nutritional deficiencies is provided in chapter 2. Chapter three outlines the study area, materials and methods of the study. Six of the ten chapters (chapters 4-9) contained in this thesis address the objectives mentioned above and are written in the format of scientific papers for publication. Chapters 4-9 are written as stand-alone papers with some, repetition of certain aspects that has been unavoidable. Chapter 4 compares the knowledge of wild edible plant use of elderly and youth members of the study area. Evaluation of wild edible fruit plants with additional uses was addressed in chapter 5. Ethnobotanical survey of wild edible vegetables with additional uses was addressed in chapter 6. Chapter 7 gives the information about the preparation and preservation methods used by the informants of the current study. Nutritional status of some selected wild edible vegetables is addressed in chapter 8. Quantification of wild edible plants use patterns was outlined in chapter 9. Chapter 10 outlines the summary, general conclusion and recomendations.

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Chapter 2

LITERATURE REVIEW

This chapter gives an overview of the available literature on wild edible plants. This Chapter deals with literature review on international, national and local use of the wild vegetables and fruits, health status and nutritional problems. It also discusses conceptual framework of this study.

2.1 GLOBAL UTILIZATION OF WILD EDIBLE VEGETABLES AND FRUITS

Millions of people in developing countries do not have enough food to meet their daily requirement and furthermore are deficiet in one or more nutrients (Food and Agricultural Organization (FAO) 2004). Results of the study conducted by Aberoumand (2011) suggests the consumption of fruits of *Momordica dioica* to meet human nutritional requirement for normal growth against malnutrition and adequate protection from diseases caused by infectious microorganisms. Some scholars in Nepal develop an interest to document wild edible plants and their livelihood as well as the conservation potentials since from time immemorial to recent (Shrestha & Shrestha, 2004; Shrestha & Dhillion, 2006; Bhattarai, 2009; Acharya & Acharya, 2010). This initiative was provoked by lack of documentation of wild edible plants as compared to the vast attention on the documentation of medicinal plants. On the other hand, Bhattarai (2009) and Haddad and Oshaug (1999) reported the ignorance on the issue of inclusion of wild edible plants in land use planning and implementation as well as in biodiversity conservation.

In Europe, wild edible plants are regarded as imperative dietary supplements providing trace elements, vitamins and minerals (Pieroni et al., 2002; Lentini & Venza, 2007). To this note, results of researches conducted in Calabria, South of Italy; Southern Italy, Spain and Greece; Western Thailand; Valsesia, Northern Italy; Bosnia-Herzegovina and Canada reported the satisfying renewed or increasing interest in consuming wild edible plants by local people (Heinrich et al., 2006 (study conducted in Local Meditterranean); Delang 2006; Vitalini et al. 2006 (study done in Northern Italy); Redzic 2006 (study conducted in Bosnia-Herzegovina). Kim and Oh (1996) found that about 280 wild plant species with cultural and nutritional aspects consumed in Korea. In other parts of the globe, for example, in India, Malaysia and Thailand, about 150 wild plant species were identified to play paramount roles as emergency foods (Burlingame, 2000).

2.2 UTILIZATION OF WILD PLANTS WITHIN THE AFRICAN CONTINENT

According to the Food and Agriculture Organization (FAO 2009), around 30 000 plant species around the world are edible, but of the said number, only 7000 are used as human food resources. Utilization of the wild edible plants is also practiced in various sections of the African continent. For example, Adenkule (1999) argues that amongst the gathering and hunting communities in the Congo forests and amongst the Wasandawe in Tanzania, wild foods, especially leafy vegetables are used on a year-round basis. The unique aspect about the wild edible plants is that they provide the diversity and flavor of the people's diet. Campton (2008) articulates that some pastoralists in South Sudan do not store and carry food over long distances; hence they rely on the seasonal wild food resources from the forests.

Cameroon Demographic and Health System (CDHS) (2011) attest about the prevalence of under nutrition experienced by Cameroon and much of other sub Saharan countries. This unaccepted malnutrition prevalence status resulted mainly from the shift from diversified traditional food consumption to consumption of simplified and nutrition compromised food such as rice and wheat products (Pingali, 2007; Frison et al*.,* 2011; Penafiel et al., 2011).

The development of most sub-Saharan countries brings into play a drastic change in lifestyles of inhabitants which is associated with the great loss of indigenous African knowledge of the use of wild edible plants. Fungo et al. (2016) concurred that precious indigenous knowledge is drastically vanishing. The reason for their consent is that results of the reaserch conducted in rural Cameroon recorded only 21 forest food species which are very fewer as compared to forest food species reported by researchers from other parts of the African continent. For example, Boedecker et al. (2014) reported 61 wild plants used by locals from Benin, 34 plant species known as traditional vegetables and fruits by residents of south western Rukungiri district of Uganda (Musinguzi et al., 2006). In addition, 40 wild edible plants of Kara and Kwego semi pastoralist people of Tower Omo River Valley, Debub Omo Zone of Ethiopia were reported (Teklehaymanot & Giday, 2010).

Many other studies of the same kind conducted in other parts of Africa still speak the same language as the ones mentioned above. They all report utilization of wild edible plants as the integral part of food source for indigenous people who dwell in different regions of Africa like Kenya, Zimbabwe and Ethiopia (Zinyama et al., 1990; Asfaw & Tadesse, 2001). In Ghana, over 300 wild plant species were also identified (Burlingame, 2000).

2.3 UTILIZATION OF WILD PLANTS IN SOUTH AFRICA

The use of indigenous wild edible vegetables in South Africa was initially documented and used for nutrition and diet fortification by the Khoi and the San populations which were regarded as the first group of people to inhabit the modern-day South Africa (Schapera, 1965). The Khoi and the San are historically known to be gatherers of wild foods. In addition to the records of that era, Wehmeyer (1986) documented nutritional values of over 300 wild species of the Southern African parts. A decline of wild edible plants uses suddenly emerged due to introduction of exotic vegetables. Exotic vegetables gained more scientific research attention than the traditional edible plants and as an awareness of wild edible plants use was massively blown away.

More recently, Bvenura and Afolayan (2015) reviewed the consumption of wild vegetables in South Africa and pointed out the extensive focus of nutritional composition of these plant species. The authors then realized that apart from the well inventoried nutritional information of wild plants, there is still a need for filling the gap concerning the ethnobotanical survey of different provinces of South Africa. Some attempts of documenting wild plants' use in various provinces were initiated. For example, in 2010, Maanda and Bhat (2010) documented 40 wild edible vegetables used in the Venda region of the Limpopo province.

In the Eastern Cape province, Bhat and Rubuluza (2002) and Bvenura and Afolayan (2014) reported 36 and 22 species respectively. Thirty-six wild plant species mentioned by Bhat and Rubuluza (2002) included both wild vegetables and fruits. The study of Nesamvuni et al*.,* (2001) reported 24 wild green leafy plants of Limpopo province, whereas 20 were reported in the North West province by the study conducted by Quin (1964). Thirthy-two species were identified in some parts of the North West and Limpopo province (Steyn et al*.,* 2001). Results of the research conducted in the Northern KwaZulu-Natal reported a total number of 72 traditional vegetables of wherein 34 were naturalized aliens and 38 were native (Ntuli et al. 2012). The total number of the reported wild edible plants of South Africa is very unsatisfactory hence more research must be conducted to fill the gap and to circumvent the loss of transfer of knowledge to future generations. Recently, Welcome and Van Wyk (2019) reviewed and presented a comprehensive inventory of 1740 edible plants of southern Africa. The information was gathered from 13 indigenous languages spoken in South Africa.

2.4 CONCEPTUALIZATION OF WILD EDIBLE PLANTS USE FROM THE INTERNATIONAL, CONTINENTAL AND NATIONAL PERSPECTIVES

The conceptual framework presented in Figure 2.4.1 is a combination and comparison of wild edible plants use from international, continental and national perspectives. There is generally a very strong correspondence around what people of different regions of the globe use the wild plants for.

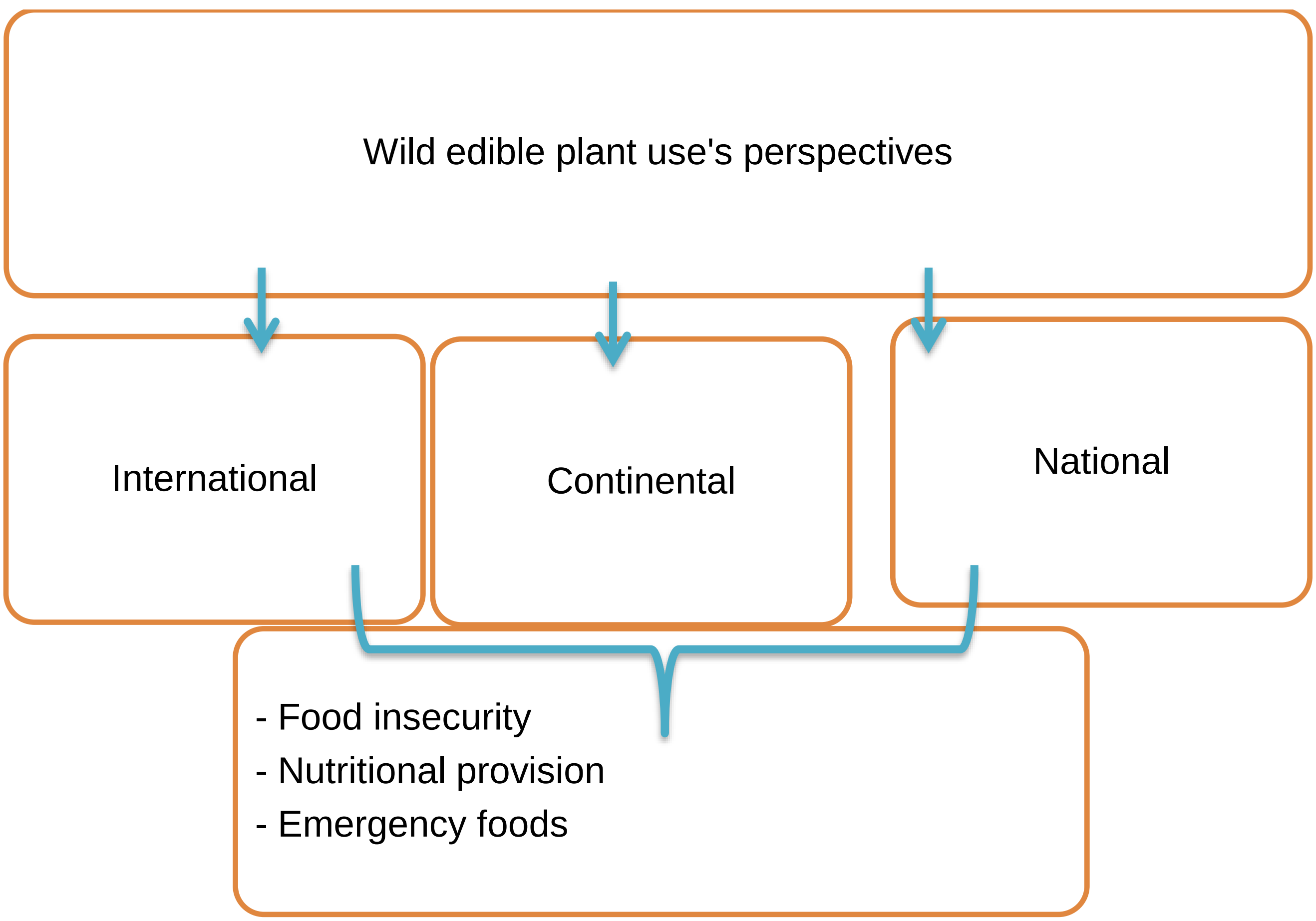

Figure 2.4.1: Illustration of the three common uses of wild edible plants from the international, African continent and South African perceptions.

2.5 NUTRITIONAL STATUS OF SOUTH AFRICA

Nutritional status can be defined as the state of the body in relation to the consumption and utilization of nutrients (Faber & Wenhold, 2007). Nutritional status can be assessed by application of the dietary, anthropometric, biochemical and clinic methods (Faber & Wenhold, 2007). In instances of poor dietary intake, malnutrition condition results. Malnutrition is divided into two categories namely: under-nutrition and over-nutrition (Figure 2.5.1). Under-nutrition refers to poor intake of nutrients which results to two different health conditions called protein-energy malnutrition and micronutrient deficiencies (Faber & Wenhold, 2007). On the other hand, over-nutrition simply refers to excessive intake of energy and or macronutrients such as proteins, carbohydrates and lipids (Figure 2.5,2 (a). Energy may be plentiful in the diets of obese people due to the intake of foodstuff indicated in figure 2.5.2 (a).

Rapid globalization and urbanization in many of the developing countries yielded great emergence of obesity and diet-related chronic diseases such as hypertension, diabetes, cardiovascular and anaemia (Eckhardt, 2006). These diseases which are the end results of micronutrients deficiencies are emerging as crucial health concerns. Recent estimates indicated that over two billion people from the globe are at risk of Vitamin A, Iodine and iron deficiency, despite of the efforts taken to prevent and control these deficiencies (Ramakrishnan, 2002). Diseases such as anaemia can be very dangerous as it occurs when the body does not produce enough red blood cells to transport oxygen to various parts of the body.

The way forward to prevent anaemia is the consumption of diet rich in iron. Scenario of diets higher in energy which are also marked to be poor diet quality is associated with obesity. Regular intake of fiber and micronutrient-rich foods such as fruits and vegetables results into a fit body (Figure 2.5.2 a. On the other hand, figure 2.5.2 b shows the obese body which resulted from the consumption of unhealthy diet (Ludwig et al., 2001).

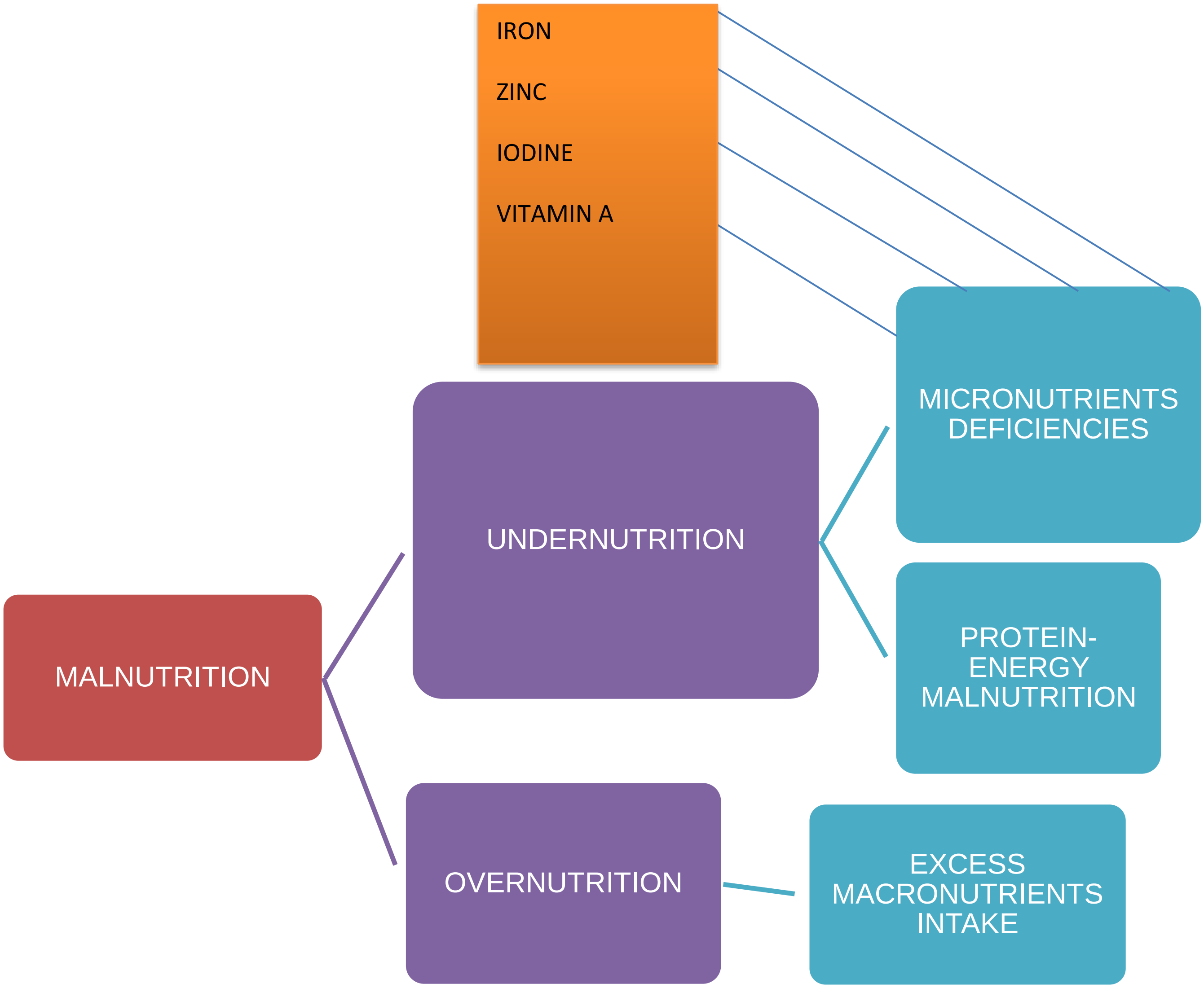

Figure 2.5.1: Classification of malnutrition caused by poor dietary intake (adopted from Faber and Wenhold 2007).

Figure 2.5.2 (a and b): Different body sizes resulted from the type of the diet (Ludwig et al., 2001).

2.6 NUTRITIONAL STATUS OF SOUTH AFRICAN CHILDREN

Research conducted by Labadarios et al. (1995, 2000) compared data on anthropometric children of South Africa. The data revealed low prevalence of wasting, low to medium prevalence of underweight and medium prevalence of stunting. Causes of these results include inadequate food intake and other factors such as poor feeding practices and various diseases (Cogill, 2003). Other findings from Labadarios attest that rural children are mostly affected than the urban based children.

Moreover, the South African Vitamin A Consultative Group (SAVACG) survey revealed that growth deficits in general were more prevalent in rural communities as compared with urban communities. Study by Mamabolo et al. (2005) concur with the findings of SAVACG which revealed that a 48% prevalence of stunting amongst 3-year-old children in central rural areas of Limpopo province. Of the factors discovered during their survey, food insecurity was found to contribute immensely to increasing levels of stunting and underweight conditions. Accordingly, food insecurity was found to be directly related to an inadequate dietary intake.

Recently, results obtained by South African National Health and Nutrition Examination Survey (SANHANES, 2013) revealed that the prevalence of food insecurity was high with 37% in households of rural informal setups (Figure 2.6.1). Results emerged from comparison of prevalence of food insecurity in all provinces of South Africa placed the Limpopo province in the second highest food insecured with 30.8% (Figure 2.6.2). These findings are indeed eye openers for researchers in the Limpopo province to come up with mitigating strategies towards this ongoing food insecurity.

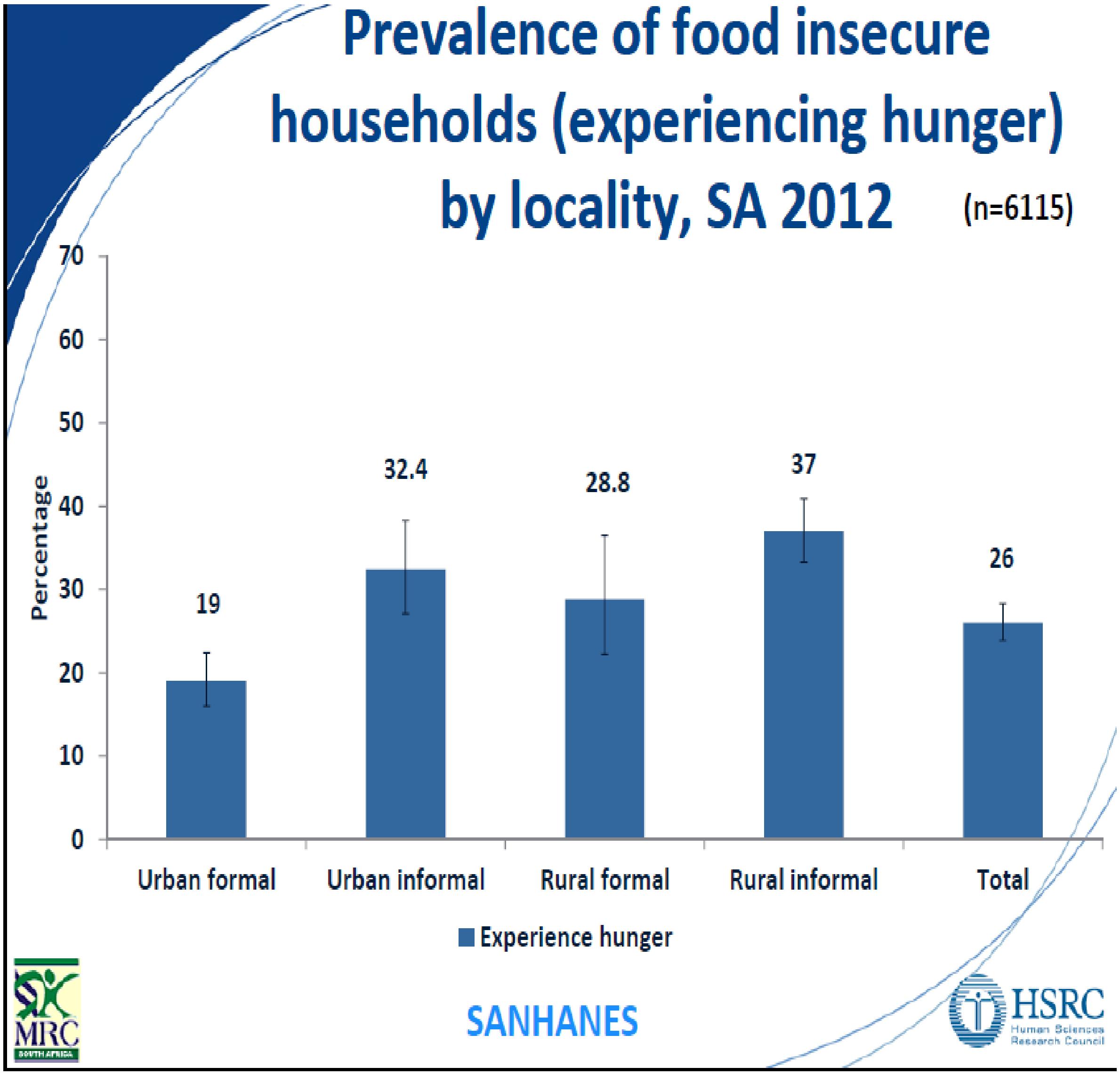

Figure 2.6.1: Prevalence of food insecure households (experiencing hunger) by locality, SA 2012 (Shisana et al., 2013).

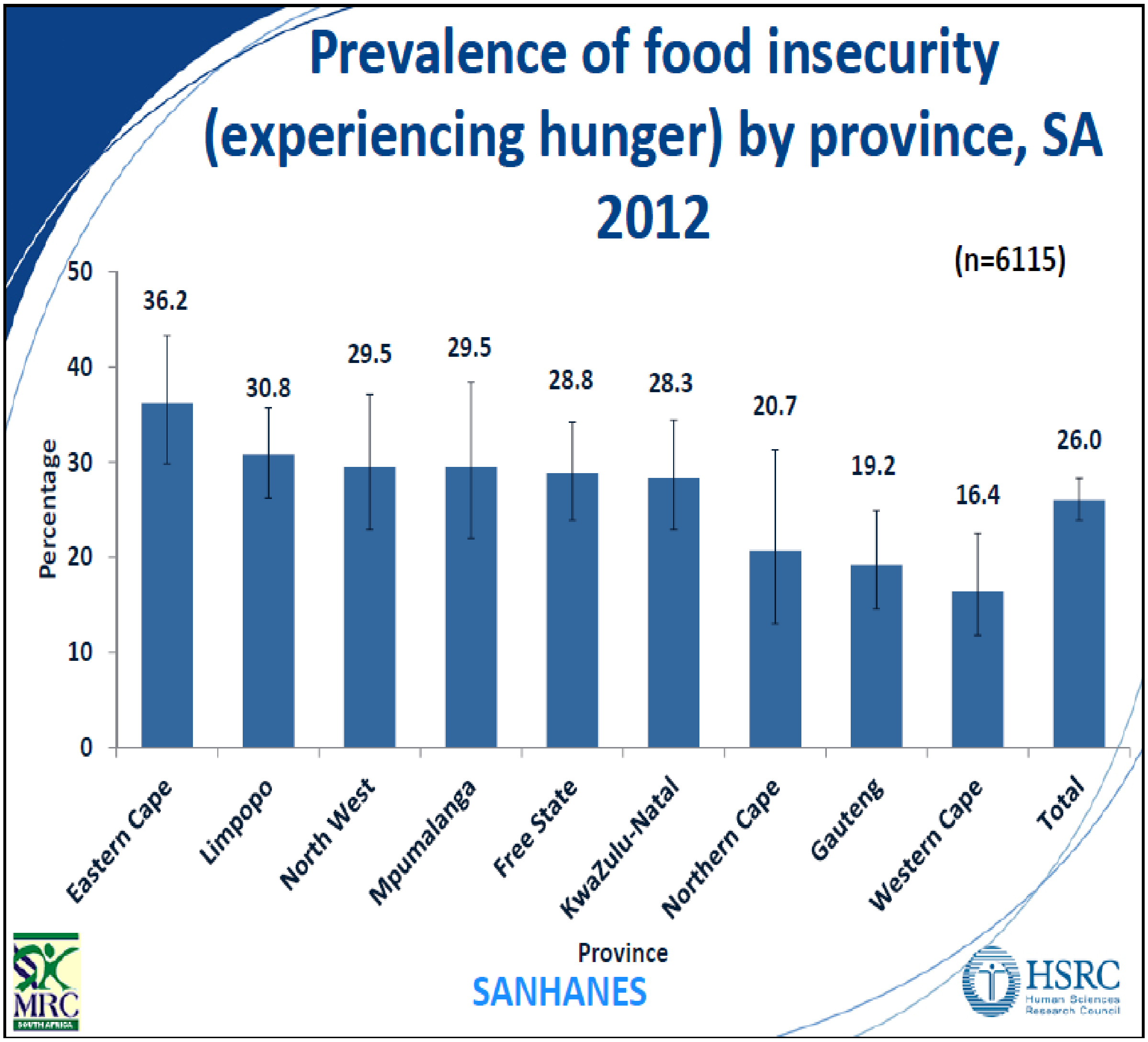

Figure 2.6.2: Prevalence of food insecure households (experiencing hunger) by province, SA 2012 (Shisana et al., 2013).

Reports provided by Nationwide Food Consumption Survey (NFCS), South African Social Attitudes Survey (SASAS) and SANHANES indicate fluctuating percentages of food security, people at risk of hunger and people experiencing hunger (Table 2.6.1).

Table 2.6.1: Trends in Food Security status: SA 1999 - 2012 (Shisana et al. 2013).

Trends in Food Security status: SA 1999-2012

Variable	NFCS 1999	NFCS 2005	SASAS 2008	SANHANES-1, 2012
	(n = 2735)	(n = 2413)	(n = 1150)	(n = 6306)
	%	%	%	%
Food Secure	25	19.8	48	45.6
At risk of hunger	23	27.9	25	28.3
Experiencing hunger	52.3	52	25.9	26.0

Nevertheless, many suggestions on mitigation strategies towards the poor nutritional status of South African children were discussed. According to Faber and Wenhold (2007), consumption of indigenous foods can be regarded as one strategy to address micronutrient malnutrition (Figure 2.6.3).

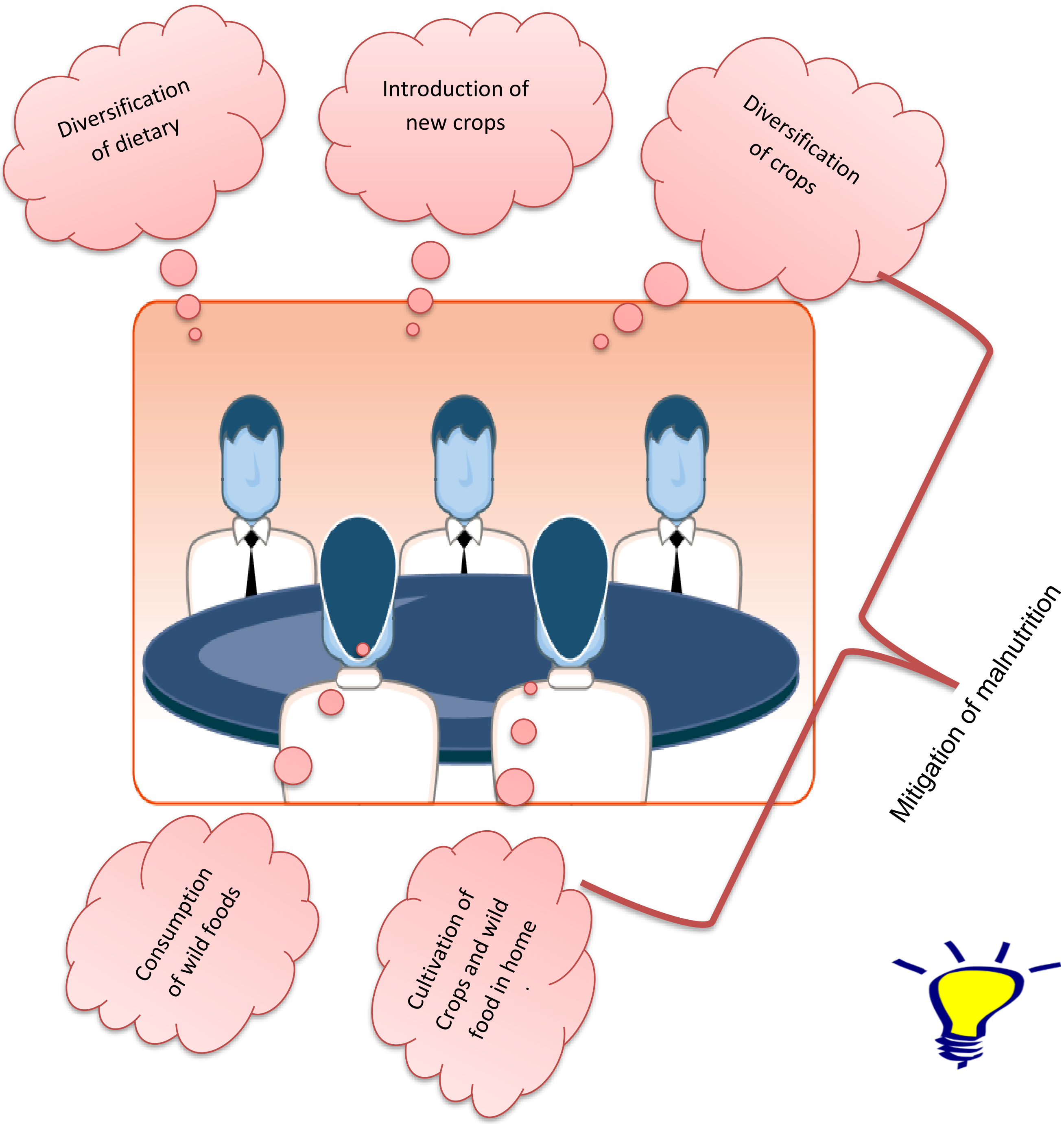

Figure 2.6.3: Conceptual framework of the strategies used to combat malnutrition (Faber and Wenhold 2007).

Indigenous wild foods are advantageous as they require minimum production input, and people know how to prepare them. Other benefits of indigenous foods are that they have capabilities of 1) growing quickly and harvesting happening within a short period of time, 2) growing on less fertile soils thus requiring neither fertilizers nor pesticides (Shiundu, 2002). Other strategies explained by Faber and Wenhold (2007) include dietary diversification, diversification of crops, introduction of new crops, and cultivation of crops and wild plants or indigenous food plants in the home gardens.

2.7 MICRONUTRIENTS OF HEALTH CONCERNS

According to World Health Organization (WHO, 2010), micronutrients are regarded as magical sticks that enable the body to produce essential enzymes, hormones and other substances needed for proper growth and development. Amazingly, these nutrients are needed in trace proportions, but one could not believe the devastation their deficiencies could produce. WHO (2010) agree that micronutrients may be amongst the most devastating causes of various diseases caused by their deficiencies. Results of micronutrient deficiencies are amongst the most widespread health issues of today (WHO, 2010).

More interest of micronutrients studies has increased extensively mainly due to the recognition of burden diseases caused by micronutrient deficiencies (Allen et al. 2006). Micronutrients deficiencies are caused by multitude of factors which include poverty, level of education, climate and cultural practices related to production and consumption (Igbal et al., 2012). Amongst these factors, poverty appears to be the chief factor as it is clearly contributing to malnutrition by inhibiting an access to nutrient rich food. Figure 2.7.1 portrays an understanding that the disease can also be another cause of micronutrient deficiencies and furthermore infectious disease contribute to deficiencies since the body requires increased micronutrients when combating these diseases (Muller & Krawinkel, 2005).

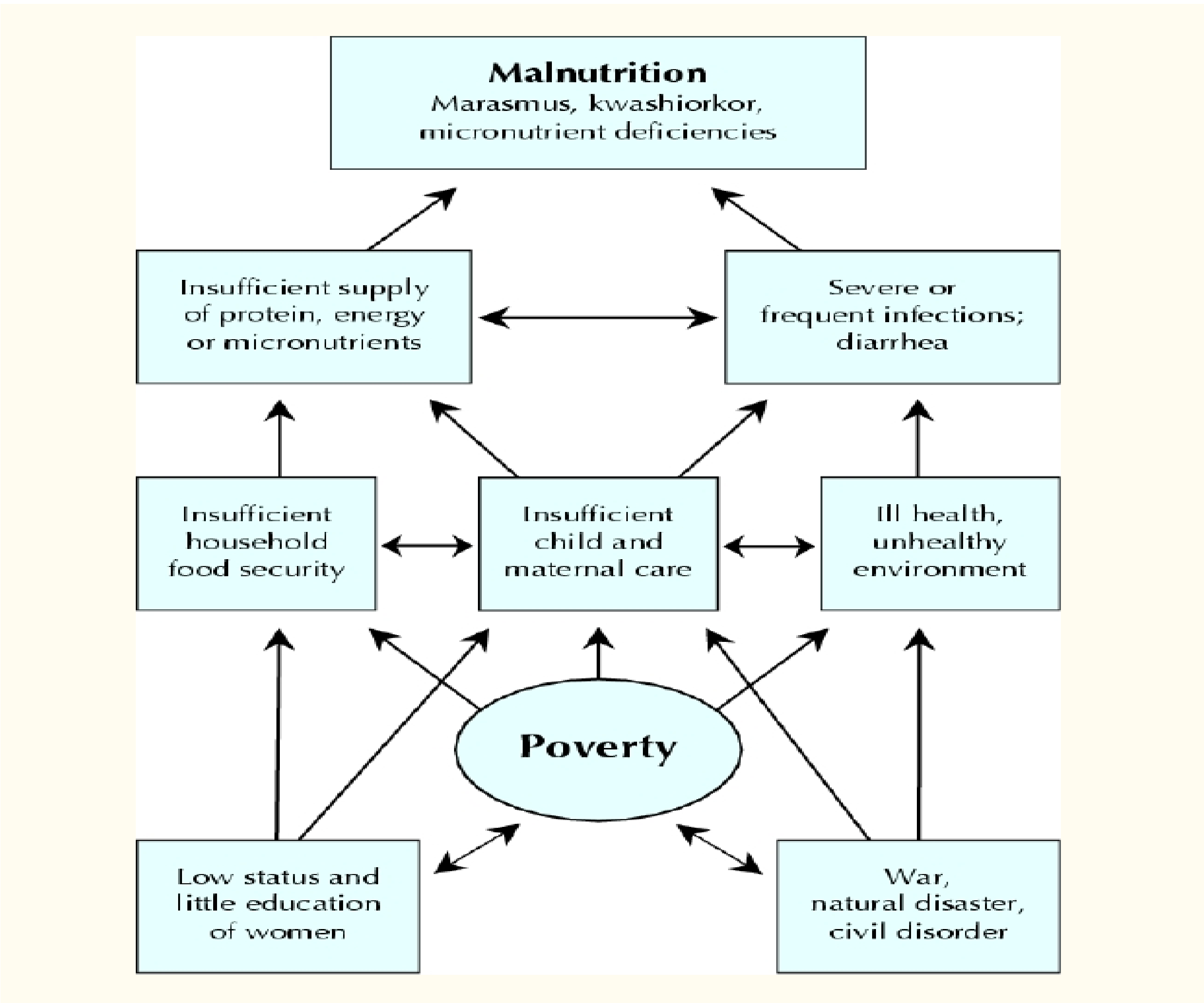

Figure 2.7.1: Direct and Indirect Causes of Malnutrition/Micronutrient Deficiencies (Muller and Krawinkel 2005).

Micronutrients such as Iron (Fe), Zinc (Z), Iodine (I), Folate, Vitamin A, B vitamins (Thiamine (B1) and Niacin (B3), Vitamin C and Vitamin D are considered of imposing paramount health benefits (Igbal et al. 2012).

2.8 EFFECTS OF NUTRITION TRANSITION TO NUTRITIONAL STATUS OF SOUTH AFRICAN POPULATION

According to Statistics South Africa (1999), the burden of diseases suffered by both urban and non-urban inhabitants emanated from the abandonment of the traditional diets. It is therefore highly notable that traditional diets are associated with low prevalence of diseases although on the side of westernized diets, diseases are predominantly rising (Bourne et al. 2002).

Types of diseases caused by this drastic shift are quite different. Related diseases include constipation, dental caries (Abraham, 1991), diabetes, hypertension, and ulcers. The main cause remains the shifting from traditional to Western lifestyles. For example, the study conducted by Rossouw (1990) in Cape Town showed children aged 11 to have higher levels of atherosclerotic risk factors than their counterparts. As interpreted in the discussions by Bourne et al*.* (2002), the prevalence of these diseases was virtually absent. South Africa is then compelled to find ways of dealing with the increasing onset of these chronic diseases. The reasons for these findings simply lie on the westernized diets that lead to over-consumption of fats and sugars and low consumption of fiber which impose negative impacts on health (Abraham, 1991). In contrast, rural-based children consume maize- and greens or traditional vegetables-based dishes which are nutritionally rich.

The useful mitigation strategy could be the use of indigenous or traditional vegetables and fruits which have therapeutical properties. In the study conducted by Aregheore (2012), *Vernonia amygdalina* was found to be utilized for both nutritional and therapeutic purposes. Additionally, Nwachukwu et al. (2010) attested for the important attributes of therapeutic constituents of *Vernonia amygdalina* to patients suffering from hyperglycemia (excessive sugar) as in diabetes mellitus and diabetes insipidus. Another good example of a traditional vegetable with therapeutic qualities in *Ipomoea batatas* (Sweet potato). According to Islam et al. (2002), leaves of *Ipomoea batatas* were found to be an excellent source of anti-oxidative polyphenolics as compared to other commercial vegetables. Leaves of this plant species possess a significant amount of nutrients that contribute to health requirements (Antia et al., 2006).

2.9 NUTRITIONAL SIGNIFICANCE OF WILD EDIBLE PLANTS

Throughout history, edible wild plants were used by human populations in each of the inhabited continents (Grievetti & Britta, 2000). However, quite disturbingly agricultural practices created a major shift in the human food provision (Grievetti, 1980), thus resulting in a significant reduction in dietary diversity. The fact of the matter is that wild edible plants play an important role in the diets of rural communities. The only problem is that humans focused more on domesticated cultivars and gave less attention to wild spices, plants that once offered important flavours and texture satisfaction and supplied essential nutrients to the diet declined in popularity (Grievetti and Britta, 2000). According to Shackleton (2003), Agte et al. (2000) and Legwaila et al. (2011), the wild edible plants are regarded to be pivotal because they are dietary supplements and source of trace elements. Results of the research conducted by Legwaila et al. (2011) further reveals that wild edible fruit plants have potential in terms of nutrients provision as compared to their domesticated counterparts. In addition, results research on studies of chemical composition and utilization of the wild edible vegetable (*Momordica tuberosa*) conducted by Parvathi and Kumar (2002) in India and results of the importance of African traditional vegetables in nutrition and employment of people of urban and peri-urban households of Yaounde, Cameroon (Gockowski et al., 2003) are in concurrence with the findings of Legwaila (2011).

Additionally, Nesamvuni et al. (2001) analyzed ten wild edible leafy vegetables consumed by VhaVenda and all of them were found to consist macro- and micro-nutrients required in proper dietary of human population (Table 2.9.1). Availability of required micro and macro-nutrients from the wild vegetables agree with the suggestion of implementation of wild foods consumption as one strategy to alleviate malnutrition.

Table 2.9.1: Nutritional results of the ten selected leafy vegetables consumed by VhaVenda (Nesamvuni et al. 2001).

Plant name		Nutrient content per 100 g of plant								
Botanical	Local	Energy (kJ)	Protein (g)	Fibre (g)	Beta-carotene (mg)	Folate (µg)	Vit. C (mg)	Calcium (mg)	Iron (mg)	Zinc (mg)
Amaranthus esculentus	*Delele mandande*	40.0	1.13	3.08	0.21	24.3	2.4	0.94	0.46	0.36
Amaranthus hybridus	*Thebe*	79.0	3.15	3.33	6.23	40.8	2.7	3.00	9.77	0.80
Amaranthus standleyanus	*Vowa*	85.0	3.06	3.03	4.81	65.3	22.3	2.66	4.78	0.32
Bidens pilosa	*Mushidzhi*	89.0	2.98	3.77	5.81	12.6	2.9	1.05	4.22	0.78
Cleome gynandra	*Murudi*	191.0	6.82	4.48	9.22	417.6	37.0	206.0	9.70	1.29
Cleome monophylla	*Mutohotoho*	73.0	2.99	2.70	3.98	50.5	13.2	1.90	9.24	0.43
Corchorus tridens	*Delele lupfumo*	33.0	1.63	2.08	3.20	6.0	2.5	0.98	11.50	0.28
Cleome maxima	*Phuri/Thanga*	112.0	3.11	4.01	4.63	9.3	24.4	1.30	6.86	0.61
Mormordica foetida	*Nngu*	94.0	3.30	3.15	5.41	40.6	20.6	1.06	3.38	0.42
Solanum retroflexum	*Muxe*	81.0	3.65	2.73	7.56	5.2	7.5	1.48	9.34	0.55
Tomato & onion (35 g)[a]		45.9	0.42	0.60	0.10	4.5	6.3	3.50	0.18	0.05
Peanuts (15 g)[a]		364.7	3.96	1.32	0	18.9	0	13.20	0.27	0.99
Tomato + onion + peanuts[a]		410.6	4.38	1.92	0.10	23.5	6.3	16.70	0.45	1.04
RDA[b]	Child 4–6 years	7560	24.00			75.0	45.0	800	10.00	10.00
RDA[b]	Women 25–50	9240	50.00			180.0	60.0	800	15.00	12.00

SUMMARY OF THE LITERATURE REVIEW

Related literature has shown that millions of people in developing countries do not have enough food to meet their daily requirements. This scenario results in deficiencies of one or more nutrients. Furthermore, current literatures debate that utilization of traditional vegetables and wild edible fruits can serve as resolution to global food insecurity. The information on utilization of these plants resides with elderly people of different communities. This alarming problem needs to be resolved by considering documentation of this information as the first step. Documentation of indigenous knowledge assists in ensuring transfer from elderly members of communities to youth members.

Wild edible fruits and traditional vegetables are used not only to combat hunger or emergency foods or for nutritional provision; they are however, also helpful in the health sector. Research by South African National Health and Nutrition Examination Survey (SANHANES) has shown that prevalence of food insecurity was high with 37% in households of rural informal setups. Micronutrients deficiencies resulting from lack of minerals such as iron, zinc, iodine and vitamin A lead to malnutrition amongst children. Most importantly, the South African Vitamin A Consultative Group (SAVACG) results have shown that growth deficits in general are more prevalent in rural communities as compared to urban communities. Other researchers had nevertheless suggested mitigation strategies to employ towards poor nutritional status of the South African children. Consumption of indigenous or traditional foods is regarded as one strategy to be considered when addressing micronutrient deficiencies. Nutrition education awareness should be a vital exercise which will create increase in indigenous vegetables and fruits use. Evidence of nutritional status of traditional vegetables and wild edible fruits can be used to promote the comprehensive usage of these plant species.

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Chapter 3

STUDY AREA, MATERIALS AND METHODS

This chapter outlines the detailed description of the study area. Overall methodologies are also explained.

3.1 DESCRIPTION OF THE STUDY AREA

The study was conducted in the Vhembe District Municipality region in the Limpopo province of the Republic of South Africa. Limpopo is the northern most province in South Africa and shares borders with Zimbabwe and Botswana. To the East, Limpopo is bordered by the Kruger National Park and Mozambique (Figure 3.1.1). The climate is variable with temperate and subtropical areas, and most of the population live in rural villages and survive by farming maize and livestock. The Vhembe district is named after Limpopo river in the region. Vhembe is one of the five district municipalities of the Limpopo province. It is the north most district of the country and shares its northern border with Beitbridge district in Matabeleland south, Zimbabwe. It also shares boarders with Botswana in the north-west and Mozambique in the south-east through the Kruger National Park. The Limpopo river valley forms the border between the district and its international neighbours (Figure 3.1.1).

Figure 3.1.1: (A) A map of South Africa Showing Limpopo Province and its bordering countries, (B) Location of Vhembe District Municipality in the Limpopo Province.

Vhembe District Municipality comprises of four local municipalities namely: Makhado, Musina, Mutale and Thulamela. Amongst the four local municipalities, there is the racial makeup of the Black Africans, Coloured, Indians/Asians and Whites. There are four main home languages spoken in the Vhembe region. Venda is the most spoken with a population of 67%, Tsonga the second with population of 25% followed by Sepedi with 2% of the total population. Afrikaans is spoken by 1% of the population and lastly only 5% of the population speaks other languages (Stats SA 2011) (Figure 3.1.2).

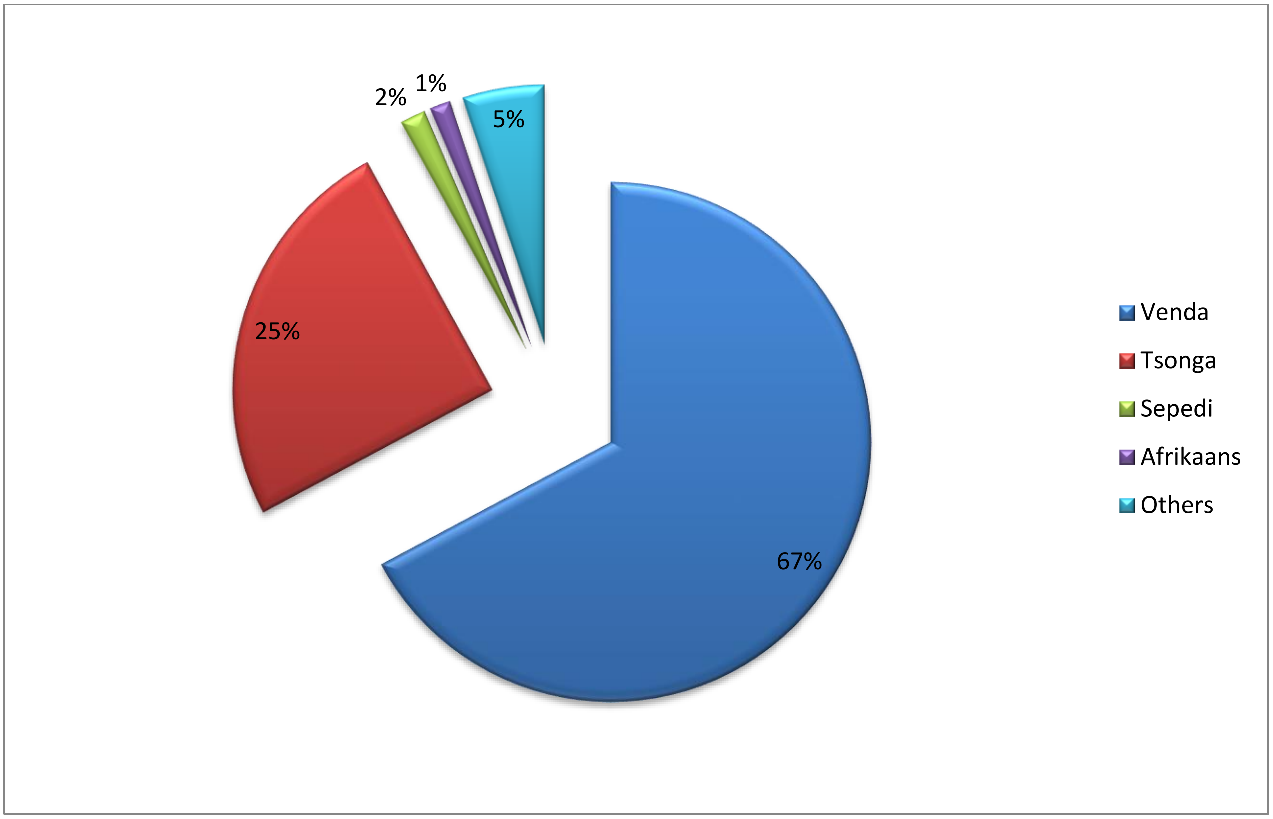

Figure 3.1.2: Representations of languages spoken in the Vhembe District Municipality (information retrieved from Stats SA 2011).

The district has a total population of 1 302 113 with 53.3% females and 46.7% males (Figure 3.1.3). The graph details the distribution of the population across age groups. The age group of 10 - 19 years is significantly higher than all other age groups placing emphasis on the need for health education for the youth (Stats SA, 2011).

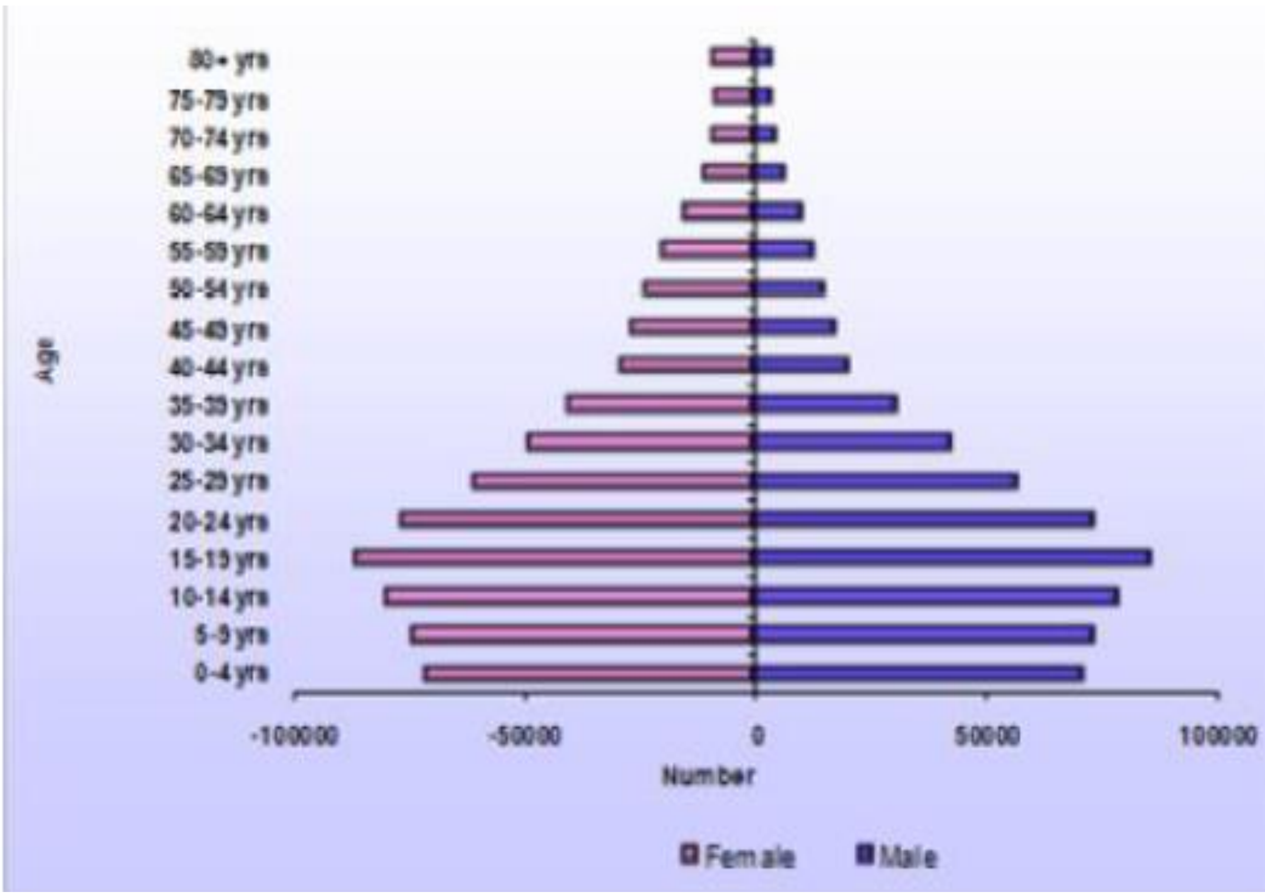

Figure 3.1.3: The graph representing details of the distribution of the population of Vhembe region across age groups (Stats SA 2011).

The current study focused on four deep rural villages of each of the four local municipalities of the Vhembe district municipality depicted in Figure 3.1.4. The general vegetation of Vhembe district is classified as Mopani Bushveld (Low & Rebelo, 1998). This vegetation type is characterized by *Colophospermum mopani* (mopani) shrubs. In Makhado Local Municipality, there are two biomes namely: grassland and savanna.

Twelve different vegetation types stretch through this municipality. The twelve vegetations include granite lowveld, gravelotte rocky bushveld, Limpopo-Ridge bushveld, Limpopo sweet bushveld, Makhado sweet bushveld, Musina mopane bushveld. The humidity of the area is ±40%. The average temperatures range from 28ºC in January and 15ºC in July.

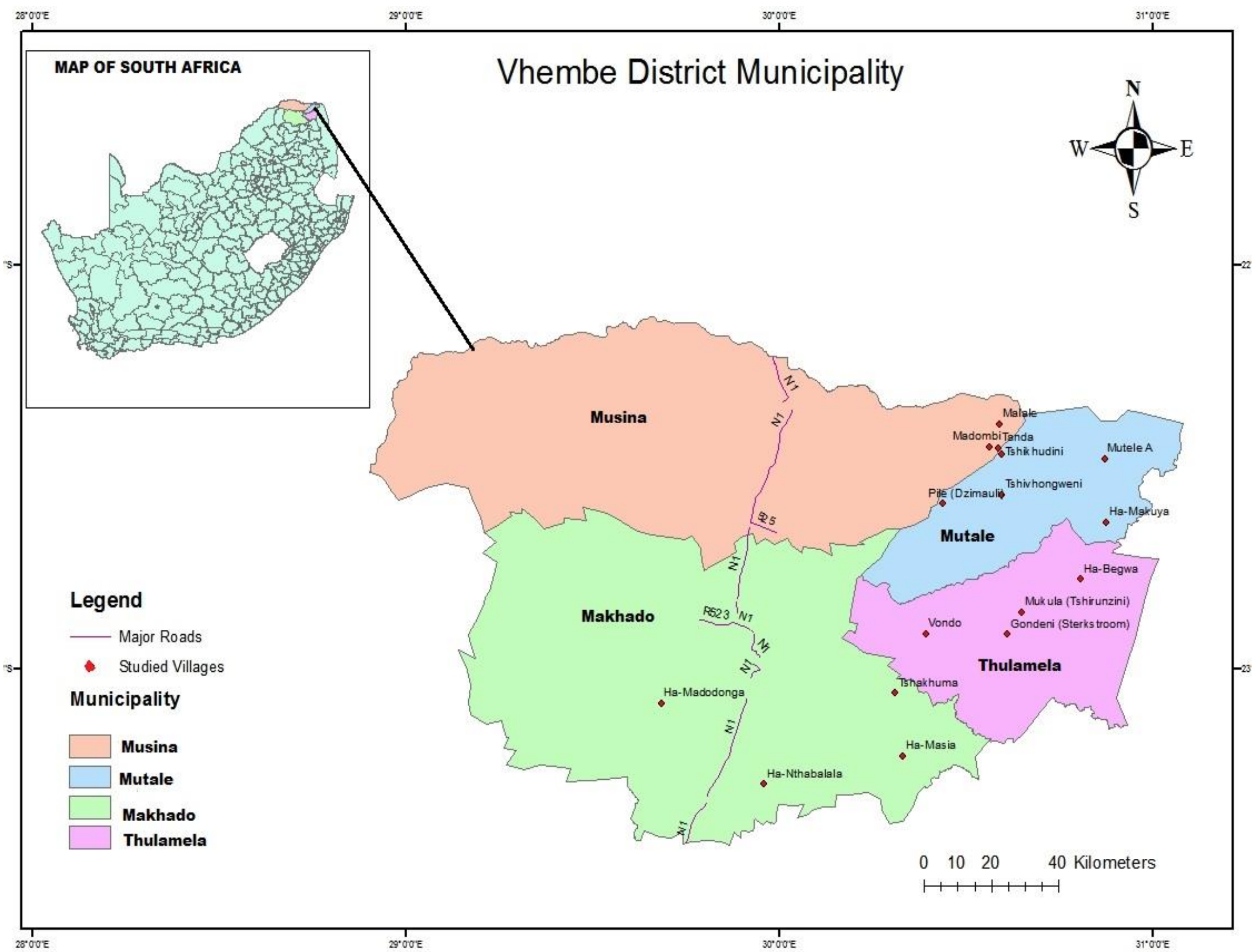

Figure 3.1.4: Geographical locations of the villages per local municipalities.

3.2 RESEARCH METHODOLOGIES

3.2.1 RESEARCH TYPE(S)

According to Kothari (2004), there are many basic types of research such as descriptive, analytical or experimental, applied, fundamental, quantitative, qualitative, conceptual, empirical and some other more types. For this study, it is clearly outlined by the objectives that the study was both descriptive and experimental. The reason for this study to be descriptive is that it included surveys wherein information about the wild edible vegetables and fruits will be documented. At the same time, the study was analytical or experimental because during the survey some of the documented vegetables were collected for nutritional analysis. In this part, experiments were conducted in the laboratory.

3.2.2 STUDY DESIGN

The current study paid attention on Venda speaking inhabitants of the selected deep rural villages within the four local municipalities of the Vhembe District; therefore, an ethnographic field study was conducted. The word ethnography is simply defined as a way of attempting to understand knowledge, culture and behaviour by going out and talking to people wherever they are (Shava, 2000). The most precious advantage of the ethnography research is that the investigator or the researcher is much closer to participants and spends time with them in their natural environments.

During pilot study, participants who took part in the main research were identified and approached to get permission from them. All the identified participants signed the consent form (Appendix 2). Fields trips were also taken during the time of visits wherein available samples were collected for herbarium purposes.

3.2.3 POPULATION OF THE STUDY

Due to enormous changing of lifestyles in most of the rural areas that are gradually becoming urbanized, the purposive sampling technique was employed in this study. Purposive sampling allows comprehensive focus on issues significant to the study because of the belief that the deep rural areas' inhabitants are still using the wild edibles or rather edible vegetables and fruits of the wild. The other imperative reason for choosing purposive sampling is because it may also be used with both qualitative and quantitative researches (Tongco, 2007).

Purposive sampling has been used throughout the years (Campell, 1955; Godambe, 1982) and is recently still actively employed in different ethnobotanical researches (McFoy, 2004; Orozco & Lentz, 2005; Lewis & Sheppard, 2006). Purposive sampling method was used in the study entitled 'Indigenous and traditional plants: South African parents' knowledge, perceptions and uses and their children's sensory acceptance conducted by van der Hoeven et al. (2013) in the North West Province of South Africa. Furthermore, this sampling technique was used in the study conducted by Faber et al. (2010), wherein semi-structured interviews with key informants and focus group discussions prevailed. The study's focus was on informants from rural and urban sites of the Limpopo Province as well as informants from urban site of the KwaZulu Natal Province, South Africa.This sampling technique can be functional in research in several ways: 1) ensures sampling informants with a specific type of knowledge or skill (Li et al., 2006) and 2) can also be very powerful in comparisons of cultural practices (Neupane et al., 2002).

Subsequently, a mixture of elderly members that are believed to be knowledgeable on wild edibles and young generations were sampled in each community of the selected villages. Preferably, the sampled population included both females and males. The reason for sampling females and males is simply that, females are usually assumed to be the ones responsible for the preparations of food in the households and males are responsible for cattle herding of which they also learn a lot about the wild edible fruits. To support this, Harris and Mohammed (2003) mentioned traditional healers and herders who spend considerable periods of time away from home as specific holders of knowledge about wild foods. The elderly population outlined in this study referred to people between the age of 36 and 80 or above. Ngwane (1999) identifies the importance of including sample of participants as elderly members of the community as this serves as repositories of knowledge. The same technique is employed even in some other previous studies on indigenous knowledge. For example, the study conducted by Luoga et al. (2000) about utilization and ethnobotany of trees in the Eastern site of Tanzania mentioned older people, particularly women as impotant holders of information concerning wild foods. Youth members of ages between 15 and 35 were also involved in the present study to monitor whether knowledge is being transferred to young ones or not.

3.2.4 DATA COLLECTION

The following methods were employed in the data collection: Interviews (unstructured and focus group interviews), Field sample collection trips, Nutritional analysis….

3.2.4.1 INTERVIEWS

Background information on the wild edible plants and fruits was collected from all the four local municipalities through a series of semi-unstructured interviews (Appendix 3 pictures of the interviews).

3.2.4.2 UNSTRUCTURED INTERVIEWS

In unstructured interviews, there is actually no definite sequence of questions or rather specific wording. Schurink (1998) states that the semi-unstructured interviews with the use of a questionnaire (Appendix 1) are not completely unstructured in a sense because the interviewer already has in mind a general topic and may want to ask specific questions. Open-ended questions were used to circumvent limiting the participants' answers and to give respondents power over what they may wish to say during the interview (Irwin, 1999). These types of questions were employed during the investigation of the knowledge of wild edibles. All the interviews were conducted by the principal researcher and some of the research assistants.

3.2.4.3 FOCUS GROUP INTERVIEWS

According to Thomas et al. (1995), a focus group interview is a technique involving the use of in-depth group interviews in which participants are selected because they are a purposive, although not necessarily representative sampling of a specific population. Participants in this type of scenario are, therefore, selected on the principles that they would have something to say on the topic, have similar socio-characteristics and would be comfortable talking to the interviewer and to each other (Richardson & Rabiee, 2001). The focus group interviews were, however, applied after the pilot investigation for other sections of the study. The interviews were conducted more specifically with knowledgeable participants for further clarification on some extra questions arose during the pilot study. It should be noted that not only elderly participants formed the focus group; there were some members of youth who were amazingly knowledgeable and therefore they formed part of the focus group.

3.2.5 FIELD SAMPLES AND COLLECTION OF VOUCHER SPECIMEN

An essential activity employed and associated with ethnobotanical interviews is collection of plant voucher specimens. During collection of voucher specimens, vernacular names of the identified wild edible vegetables and fruits species are registered. Scientific names and more taxonomic information will be given at the latter stage. Significance of considering vernacular names is due to the fact that these names turn to differ from place to place and local names change over time. On the other hand, scientific names also change due to taxonomic revision. Therefore, the use of the herbarium specimens ensures verification and comparisons of results by future researchers and others (Hoffman & Gallaher, 2007). Voucher plant specimens were collected, mounted and submitted to the University of Venda Herbarium, in the Department of Botany, School of Mathematical and Natural Sciences. Field notes and wild edible plants use were recorded following Bhat et al. (1990) and Martin (1995). Photographs of the plants and edible parts were taken using digital camera.

3.2.6 SELECTION OF PLANT SPECIES FOR NUTRITIONAL ANALYSIS

Various wild edible species including vegetables and fruits were documented through semi-structured interviews. From all the inventoried wild edible plant species, eight mostly cited vegetables were selected by using the relative frequency of citation or quotation index (RFC) which is calculated by the following formula.

RFC = (FC/N)* 100,

Where FC is the number of informants who mentioned the plant species and N is the total number of informants (Madikizela et al., 2012).

3.3 NUTRITIONAL ANALYSIS

Calculations of the Relative Frequency of Citation (RFC) offered the platform of selecting wild edible vegetables for nutritional analysis. Therefore, samples of edible parts mentioned by informants during the interviews were considered with the caution of selecting those that are free of infections. All samples collected were washed thoroughly to remove any exotic particles such as soil or other impurities and then blotted dry. The prepared samples were sent in the brown envelopes to Agricultural Research Council (Pretoria) Laboratory for nutritional analysis.

Results of many studies such as Almekinders and de Boef (2000) conducted in London; Schippers (2002) conducted in the United Kingdom; Grubben and Denton (2004) conducted in Netherlands and Ahmed (2006) conducted in Tanzania indicate that traditional vegetables are rich in vitamins (especially A, B, and C). The current study focused on the analysis of Vitamin C and Vitamin A, following the results of Labadarios (1999), which indicated the highest prevalence of Vitamin A deficiency in the Limpopo Province (Figure 3.3.1). Nevertheless, the two above mentioned reasons motivated analysis of Vitamin A and Vitamin C from the eight selected wild edible vegetables of the Vhembe District Municipality.

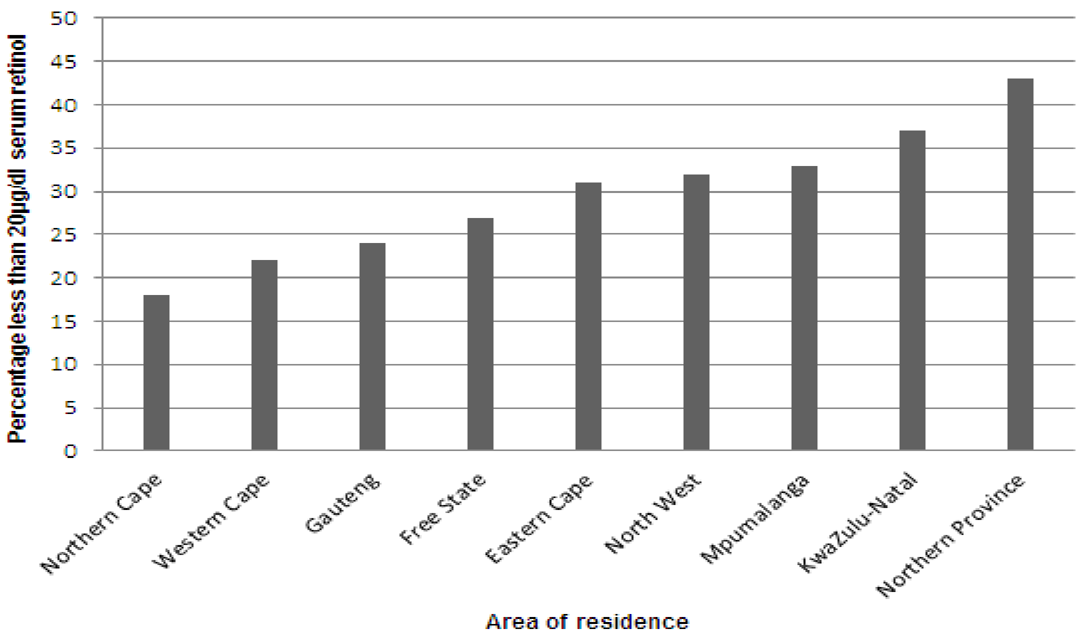

Figure 3.3.1: Vitamin A deficiency status by area of residence (Labadarios 1999).

Determination of β- Carotene

Analysis of β- Carotene from the eight selected vegetables was performed following the method applied by Moyo et al. (2018). The HPLC-PDA extraction and quantification of the β- Carotene were done following the analysis description of Biehler et al. (2010). The analytic description of Biehler et al. (2010) explains that samples are extracted (0.1g/ml) with ice-cold hexane: acetone (1:1, v/v). The mixture was then vortexed for 2 minutes before centrifuging at 2,000 rpm for 2 minutes. The organic phase was decanted into a tube containing saturated sodium chloride solution which was then placed one ice. Further extraction was performed on the remaining residue until it became colourless. The same procedure of combining the extracts with sodium chloride was repeated. The separated organic phase was filtered through a 0.4 µm syringe filter before injecting into the HPLC (Moyo et al., 2018). Chromatographic separation achieved using a C_{18} Luna ® column (150 x 4.6 mm, 5 µ) maintained at 35 ^{o} C. An isocratic mobile phase which consisted of acetonitrile: dichloromethane: methanol (7:2:1) was used with the flow rate of 1 ml/min, an injection volume of 20 µl and the detection of 450nm. Peak identification and quantification were achieved based on authentic β-carotene standard, which was used for plotting the calibration curve (Moyo et al., 2018).

Quantification of Vitamin C

Quantification of Vitamin C was achieved by following the method described by Odriozola-Serrano et al. (2007) and Parbhunath et al. (2014) with slight modifications done by Moyo et al. (2018). During the quantification, individual samples of 1g each were weighed into a tube in which 10 ml of 5 % metaphosphoric acid was added. The tube was sonicated in ice-cold water bath for 15 minutes before being centrifuged and filtered. The analysis was carried on Prominence-*i* HPLC-PDA model system equipped with cooler LC-2030C. Chromatographic separation achieved using a C_{18} Luna ® column (150 x 4.6 mm, 5 µ) maintained at 35 ^{o}C. An isocratic mobile phase made up of water: acetonitrile: formic acid (99:0.9:0.1) at a flow rate of 1ml/min was used. The injection volume of 20 µl was used at the detection set-up of 245nm. Sample quantification was attained based on the calibration curve plotted from L-ascorbic acid.

3.4 PILOT STUDY

A pilot experiment which is also called a pilot study is a small-scale preliminary study conducted to evaluate feasibility, time and cost in an attempt to predict an appropriate sample size and improve upon the study design prior to the performance of the full-scale research project (Hulley, 2007).

Prior to the main study, the pilot study was conducted. Different groups of people were consulted to get an idea of the knowledge the current study intends soliciting. Pilot study was used to test the instrument to be used in ethnobotanical data collection. Unstructured interviews were employed with three elderly participants per selected villages of the four different local municipalities. The selected samples of the pilot study did not participate in the large-scale research. Haralambos and Holborn (2000) explain a pilot study as a tool which is usually supposed to be carried out on members of the relevant population, but not those who will form part of the final sample. The main aim of pilot study is to check the effectiveness of the research tool for the large-scale research.

3.5 VALIDITY AND RELIABILITY

Joppe (2000) defines reliability as the extent to which results are consistent over time and an accurate representation of the total population under the study; and if the results of the study can be reproduced under a similar methodology, then the research instrument is reliable. Additionally, Charles (1995) states the importance of the consistency with which questionnaire items are answered or individual’s scores remain relatively the same.

Joppe (2000) further advocates for the validity of the research and he explains validity as a tool that determines whether the research truly measures that which it was intended to measure or how truthful the research results are. The present study was conducted for different seasons with the same group of selected participants to ensure consistency and accuracy of the outcomes. Same population was considered wherein the same instrument was answered by those people selected; therefore, if the answers provided appear to be similar then the research will be considered valid.

3.6 ETHICAL CONSIDERATIONS

Permission to conduct the research was requested verbally from the tribal leaders of all the selected villages. All identified participants were requested to sign the consent form to show that they are ready and willing to take part in this research.

3.7 DATA ANALYSIS

Data analysis for qualitative research should apply accurate, logical approaches and usually necessitate content analysis. Content analysis is useful for any research approach, the analysis deals with textual data such as transcripts and field notes (Bachiochi & Weiner, 2004). The results of the current study came from a range of interviews; therefore, the interview data was coded and sorted into different themes.

All values of the nutritional analysis of the selected samples of vegetables were expressed as means ± standard deviation. Data for the use of wild plants and fruits was analyzed using Student-T test. The P value < 0.05 was considered as significantly different. The software, STATISTICA was utilized for all the statistical analysis.

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Chapter 4

ELDERS VERSUS YOUTH: A COMPARATIVE STUDY OF KNOWLEDGE OF WILD EDIBLE PLANTS IN THE VHEMBE DISTRICT MUNICIPALITY

Submitted for publication in *Indilinga - African Journal of Indigenous Knowledge and Systems*

ABSTRACT

Food security has become a serious stress across provinces of South Africa. The main cause of this stressful situation is crop losses due to drought. This can be alleviated by consuming wild edible plants, thus mitigating food insecurity. Traditional edible plants provide staple and supplement foods; it also provides a financial income to local communities, thus favouring food security. The traditional edible plants form part of natural resources used by faunal community including human beings. However, traditional edible plants are largely ignored in economic development and biodiversity conservation. On the other hand, traditional edible plants related knowledge is indeed showing drastic erosion.

In this report, we present results of comparative study of knowledge of traditional edible plants amongst elders and youth members of the Vhembe District Municipality. An ethnobotanical investigation was carried out to collect information about indigenous knowledge associated with traditional edible plants. A total of 160 informants were *interviewed through semi-structured questionnaires. Data was collected over a period of twelve months (from June 2015-June 2016) in all four local municipalities. The present study demonstrated the major indigenous knowledge debility among the female youth members as they managed to mention 58% of traditional edible vegetables as compared to 71% of those mentioned by elderly female respondents. Most interestingly, elderly male respondents mentioned 63% knowledge about tradional edible vegetables which is more than what was mentioned by female youth membersof the current study. Generally, youth members showed less interest in the utilization of these plants. Fortunately, some of youth who are residing in villages that are far away from towns had better knowledge. Youth members with better education showed drastic loss of interest regarding utilization of wild edible plants. The study therefore recommends an urgent need for the documentation and promotions or awareness campaigns as a way of dealing with the loss of indigenous knowledge. Moreover, researches related to cultivation of wild edible plants must be considered.*

Keywords: *Wild edible plants, knowledge, elders, youth, respondents, Vhembe District Municipality*

4.1 INTRODUCTION

The potential contribution of natural resources to rural livelihoods, particularly as a way used to alleviate poverty, is acknowledged worldwide (Kepe, 2008). Amongst the natural resources used by rural people, there are huge numbers of edible plants. Dweba and Mearns (2011) conducted a study in a rural Xhosa village in the Eastern Cape Province of South Africa to document the use of traditional vegetables. Their findings indicated a decline in the use of traditional vegetables. The use of traditional or wild edible plants lies on the provision of 1) high nutritional values and 2) abilities to thrive under harsh circumstances (Nesamvuni, 2000 (a study done in Vhembe District Municipality); Modi et al., 2006 (a study conducted in KwaZulu-Natal)). These authors also reported on the importance of wild edible plants, although the information in most cases is provided by adult informants. In addition, results of the study conducted in Mohale's Hoek, Maseru and Leribe districts of Lesotho revealed that knowledge about plants used as leafy green vegetables was well known mainly by older people (Lephole, 2004). Another study conducted in Brazil by Bortolotto et al. (2015) found that there is a great loss of indigenous knowledge among the youth members.

Therefore, the existing fear is that nothing is being done to preserve the valuable information of traditional wild edible plants. Vorster et al. (2007) found that this information which resides amongst elderly members of the society may soon disappear if nothing is done about it. The tradition of using wild food is at risk of diminishing not only in the African continent, but throughout the world (Bhattarai et al., 2009 (a study done with people of Manang district in the Central Nepal); Abbasi et al. (2013) (the study conducted in lesser Himalays-Pakistan). Other studies such as Jansen van Rensburg et al. (2007) conducted in South Africa and Musinguzi et al. (2006) conducted in Uganda found that the great loss of indigenous knowledge of the traditional wild edible plants including vegetables.

The study conducted in the Parroha DC of Rupandehi district, Central Nepal by Acharya and Acharya (2010) revealed some of the reasons causing the drastic diminishing of the indigenous knowledge on the use of the wild edible plants. They found that 1) different indigenous communities had abandoned their traditions of using wild edible plants, and 2) that activities such as change in land use, deforestation, urbanization, cultural transformations are the major causes of change in practices and traditional knowledge on utilization of wild food plants.

The entire world is faced with challenges of food insecurity which leads to less access to sufficient protein and energy from their diets (Food and Agriculture Organization (FAO) 2009). These are consequences of negligence on the use of wild edible plants that are rich in protein and other important micronutrients. Due to lack of nutrients rich diets, more people suffer from some form of micronutrient malnourishment (FAO, 2009). Currently, the patterns in global food prices are indicators of trends in availability of food in supermarkets (Charles et al., 2010). This simply means that at least those who can afford to buy will have access to food.

The rising prices mentioned by Charles et al. (2010) are for cultivated plants; however, this problem can be addressed using traditional wild edible plants which are available in abundance in the wild. It was mentioned by Nesamvuni (2000) that traditional plants possess strategies of surviving in unfavourable conditions. Van Vuuren (2006) emphasis the option of using indigenous vegetables as it is believed that these plants require fewer amounts of water, chemical fertilizers and pesticides.

Furthermore, FAO (2013) explored the nutritional status of people of the Sub-Saharan Africa (South Africa included) and reported close to 223 million (24.8%) as undernourished. Indeed, the Sub-Saharan Africa remains the world's most food-insecure region (FAO, 2013). The way forward to avoid the unforeseen circumstances connected to food shortage can be the conservation of indigenous knowledge of the use of traditional edible plants as food.

The present study aimed at investigating the knowledge of wild edible plants amongst the inhabitants of Vhembe District Municipality of Limpopo province in South Africa. Significance of considering the project of this nature with the communities of the Vhembe is mainly to address mitigation strategies of dealing with indigenous knowledge erosion. Expectations are that elderly members of the communities i.e. members of ages 50 and above will be more knowledgeable irrespective of their gender.

4.2 MATERIALS AND METHODS

Study area

The study was conducted in the Vhembe District Municipality of the Limpopo province, South Africa. The district municipality covers about 2771 km^2 and has an average altitude of 400 m above sea level (Lombard et al. 2006). Vhembe District Municipality lies between $22^{\circ}56'$S and $30^{\circ}28'$E (LSOER 2004). It is divided into four local municipalities namely: Makhado, Mutale, Musina and Thulamela (Figure 4.2.1).

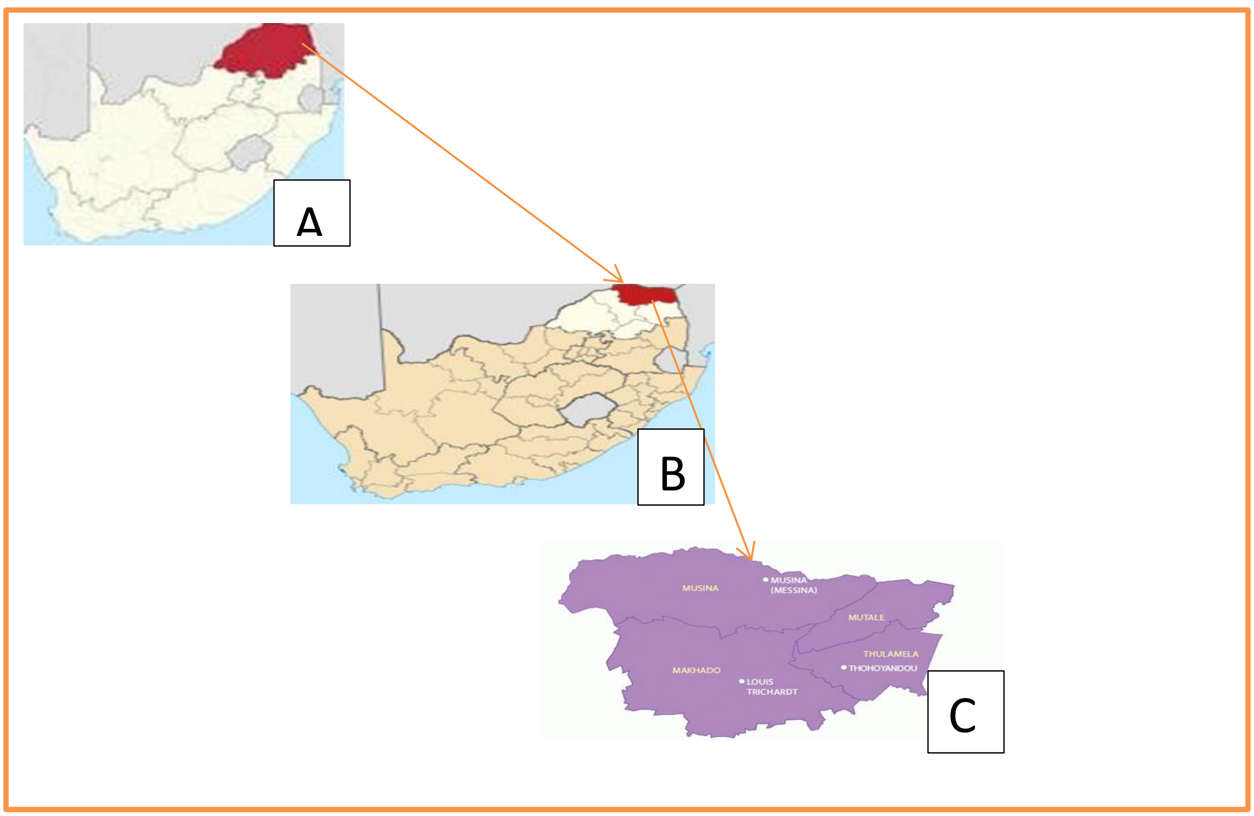

Figure 4.2.1: Maps A, B, and C showing the Limpopo Province from South Africa, Vhembe District Municipality and its local municipalities. (Limpopo State of the Environment Report [LSOER] 2004).

The mean annual rainfall of the area ranges between 378 mm and 810 mm (LSOER 2004) (Figure 4.2.2). Nature of the climatic conditions of parts of the Vhembe District Municipality supports a variety of vegetation types. Such vegetation types include the north-eastern mountain bushveld, mixed bushveld, sour mixed bushveld as well as mopane bushveld (Venter & Witkowski, 2011) (Figure 4.2.3). All these vegetation types are located within the savanna biome of the Limpopo province. In addition, there are some woodlands stretching along the Soutpansberg mountain range that have thickets and pockets resemblance of the well-developed Afromontane forests (LSOER, 2004).

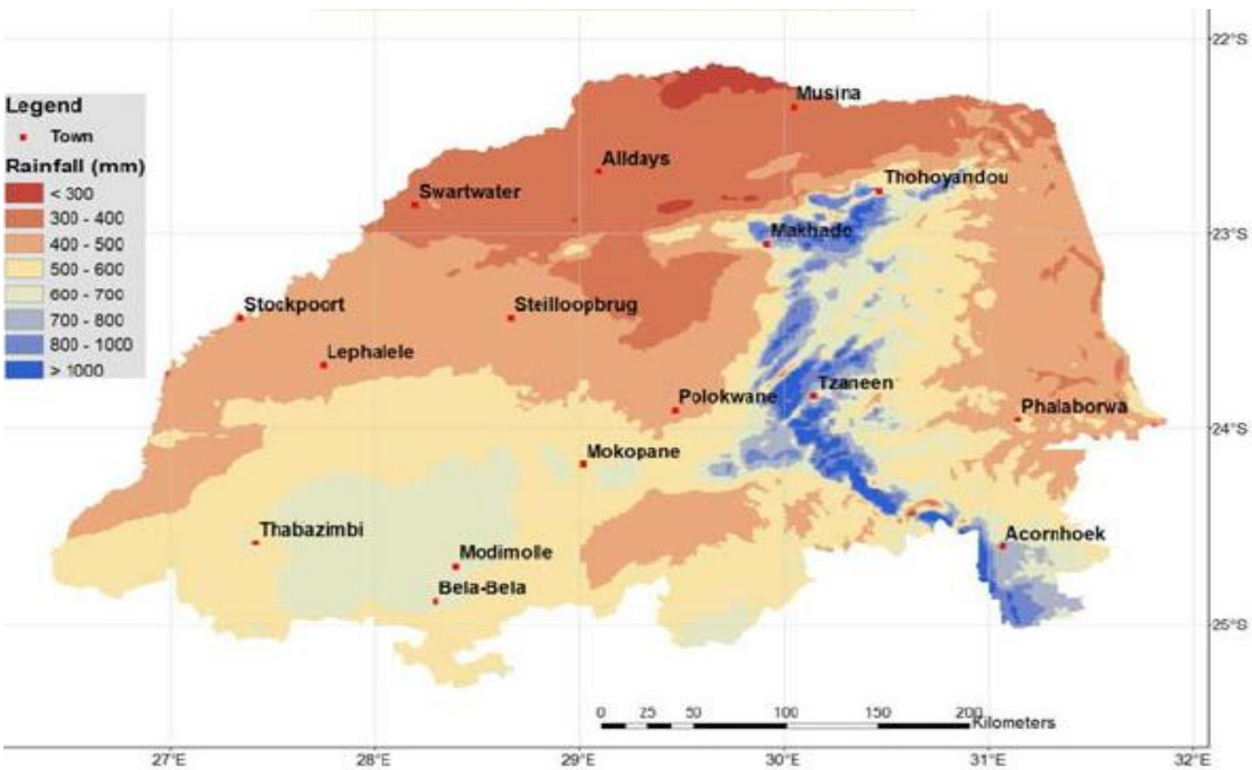

Figure 4.2.2: Mean annual rainfall of the Limpopo Province. Mean annual rainfall of the study areas is also shown (Adapted from Mpandeli et al. 2015).

Musina Local Municipality occupies the Savanna biome of the far Limpopo province. (Mucina & Rutherford, 2006). The vegetation types of the area include the Limpopo Ridge bushveld (185786,8 ha), Musina Mopane bushveld (550824ha), Southpansberg Mountain bushveld (2827,5 ha) and Subtropical alluvial vegetation (18020,4 ha) (Mucina and Rutherford 2006).

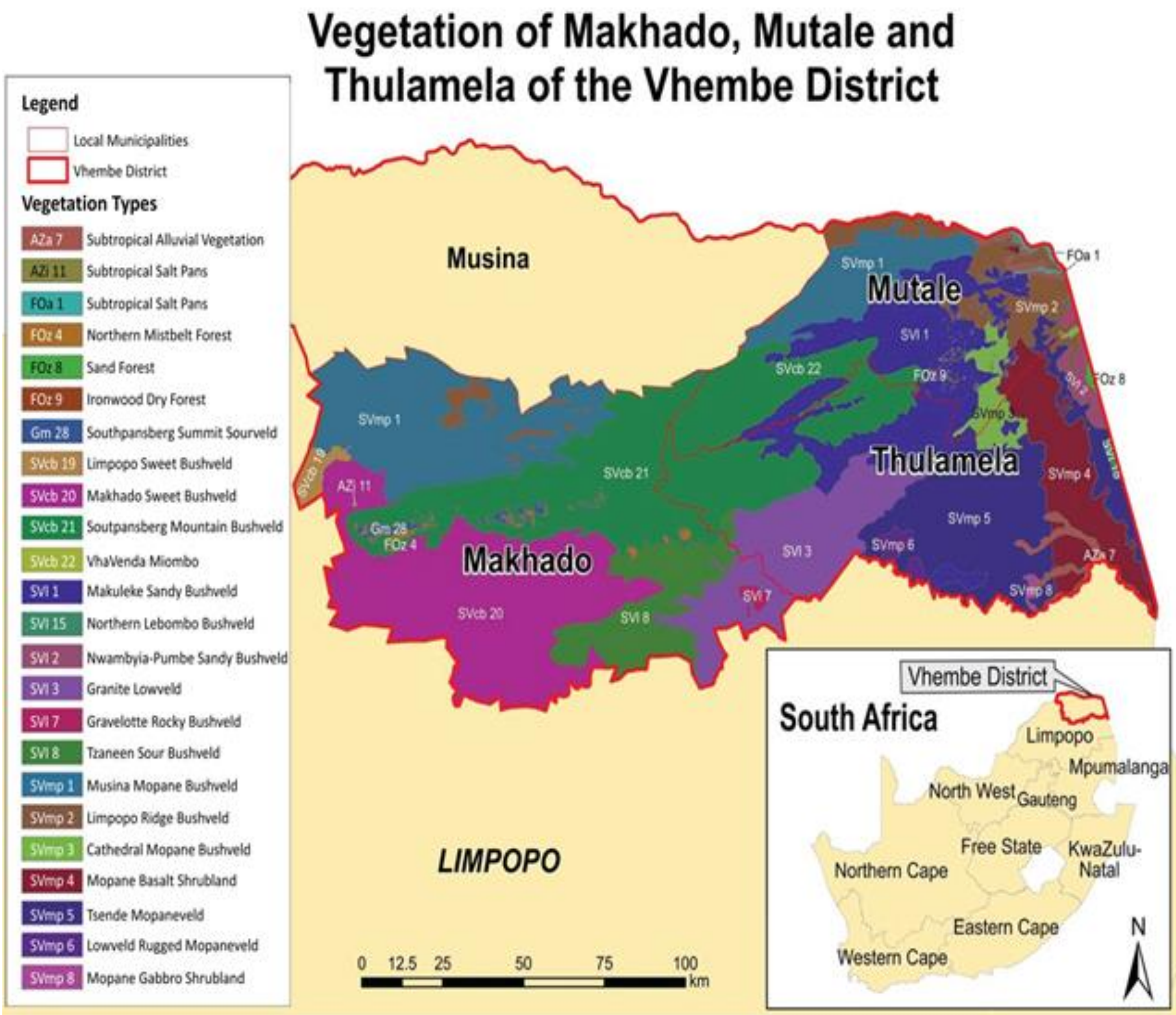

Figure 4.2.3: Vegetation types of Makhado, Mutale and Thulamela of the Vhembe District (Adapted from Ofoegbu et al. 2016).

Data collection

Field work was conducted over a period of twelve months from June 2015-June 2016 in all four local municipalities. Ethnobotanical data was collected through semi-unstructured interviews (Bartolotto et al., 2015). Questionnaires were used for all interviewees in order to obtain comparable data for analysis. Participants of different age and gender groups (Table 4.1) were interviewed on primary information such as local names; parts used method of use, season of availability, ways of conservation and taste of wild edible plants. The interviews were carried out in Venda language to cater for informants who were unable to communicate in English.

At the initial stage of plant sample collection, plants were identified by their vernacular names (Venda) and later they were botanically identified and validated at the Botany Herbarium of the University of Venda. Voucher specimen were prepared and deposited to the herbarium (Figure 4.2.4).

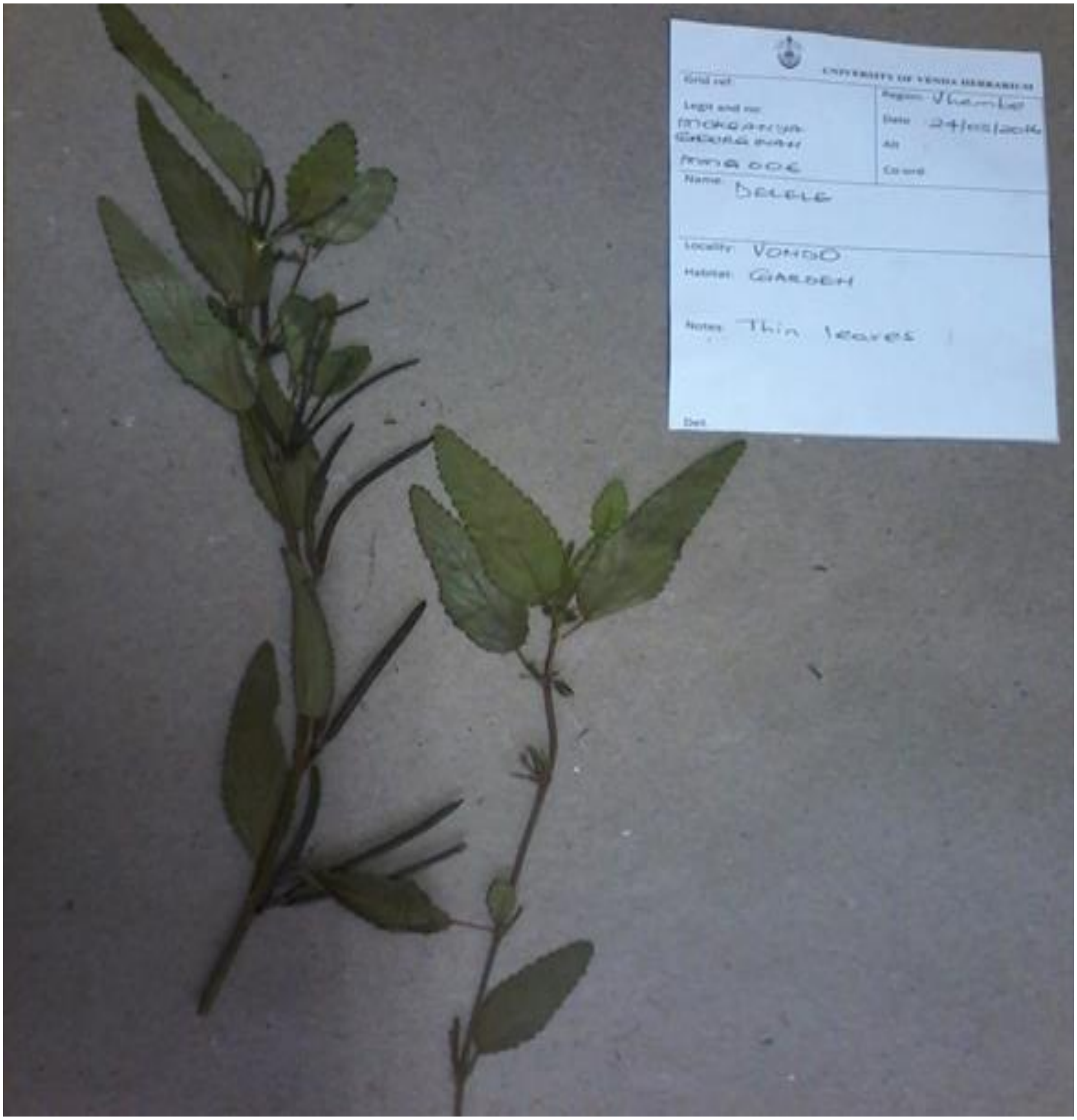

Figure 4.2.4: Pressed voucher specimen for the deposition to the University of Venda, Botany Department Herbarium.

Data analysis

All the informations provided by the respondents on the names of wild plants, food use, plant parts used were considered for qualitative analysis. As for the quantitative analysis, the number of plant species known by the respondents were analysed using the generalized linear model (GLM) (Bortolotto et al., 2015) as the data contained the counts. Pearson's correlation was used to calculate the correlation coefficients between ages of respondents and the knowledge collected.

4.3 RESULTS AND DISCUSSIONS

Most of the participants were youth aged between 18 and 35 (n= 74/160) followed by adults aged between 36 and 60 (n= 47/160) and adults aged 61 and more (n= 39/160) (Figure 4.3.1). Female informants (n= 107/160) were more than the male informants (n= 53/160) (Figure 4.3.2).

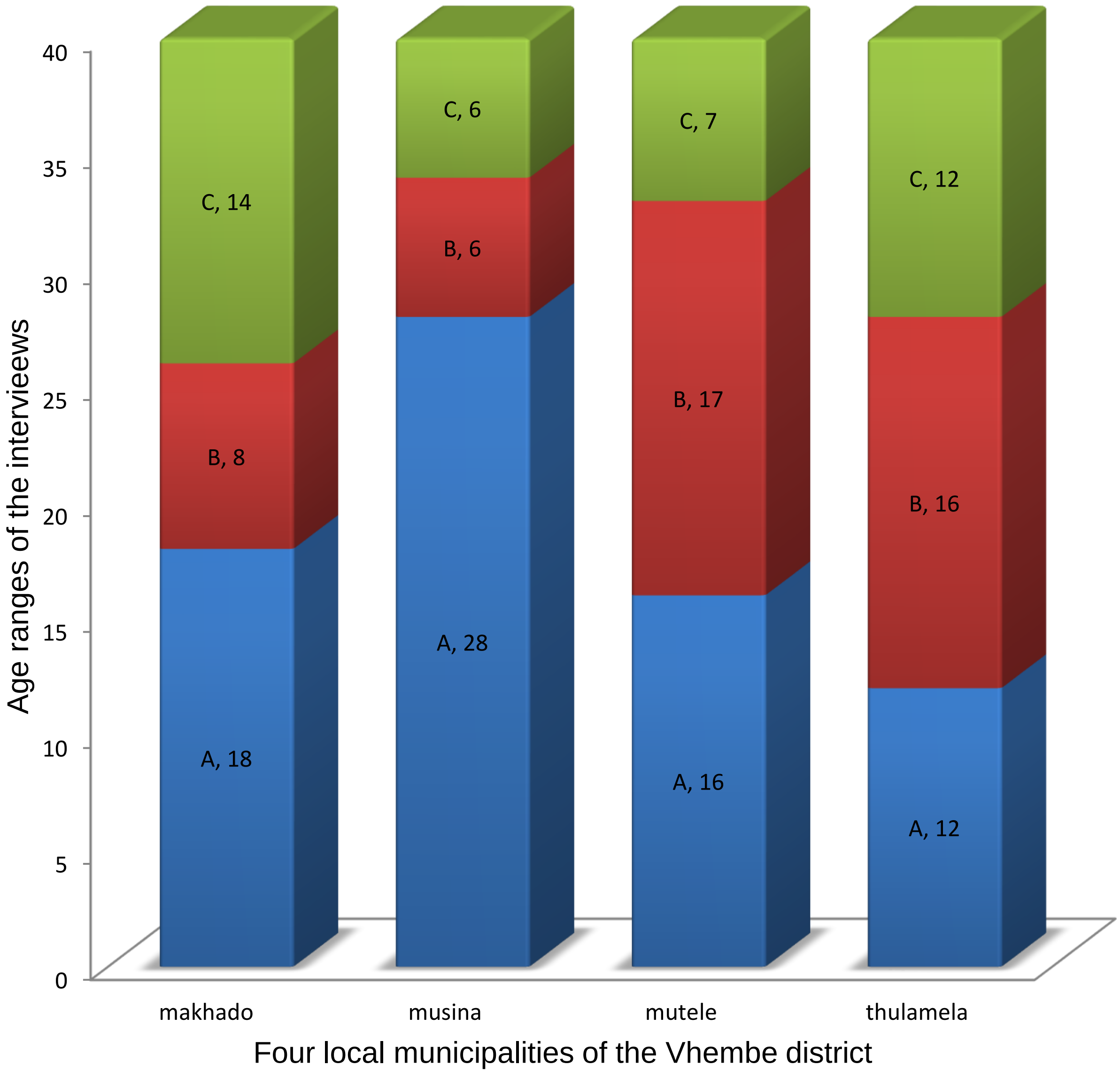

Figure 4.3.1: Age ranges of interviewees of the four local municipalities of the Vhembe district. A= (ages between 18 and 35), B = (ages between 36 and 60) and C = (ages > 61).

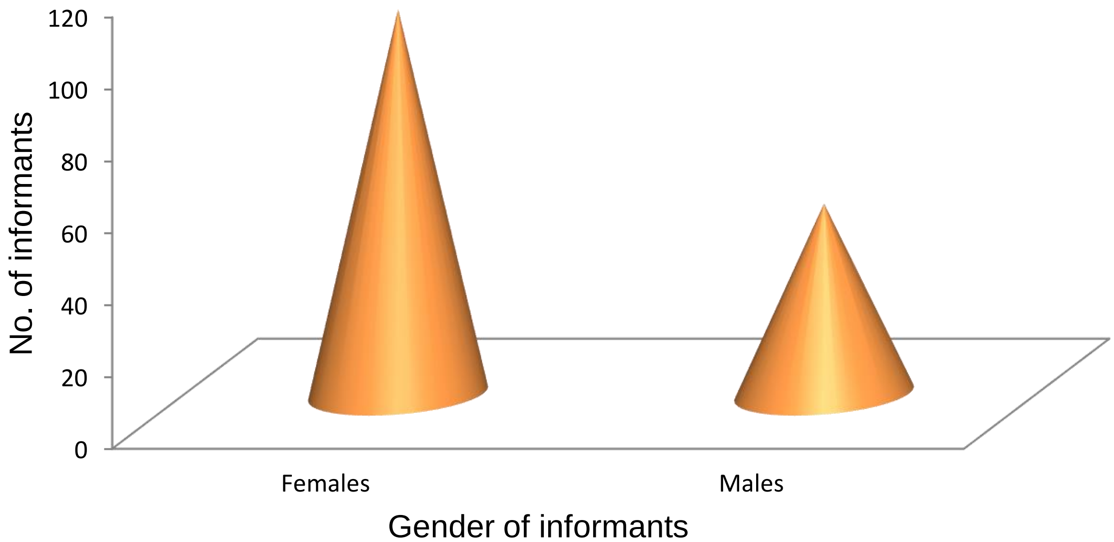

Figure 4.3.2: Gender of the informants of the survey.

The ages of the respondents were in three age ranges: A - between 18 and 35 (73), B - between 36 and 60 (47), and C - 61 and above (40). Out of 160 respondents, the oldest was a female aged 97 and a male aged 80. The expectations of the study were to find most of indigenous knowledge residing amongst elderly respondents; however, the oldest woman and man managed to mention less than five traditional edible vegetables and fruits. These numbers are less than what was mentioned by some of the youth members. The cause of encountering a smaller number of traditional vegetables and fruits listed by the oldest informants is probably because of aging where people tend to forget easily. It was experienced during the interviews that the oldest people usually give responses like "I do not know". It is indicated in Figures 4.3.3 and 4.3.4 that female and male respondents aged 36 and above were able to have better knowledge (i.e 71% and 63%)

of traditional edible vegetables. Figures 4.3.5 and 4.3.6 give a picture of percentages of knowledge of traditional edible vegetables and fruits contributed by youth members aged between 18 and 35. Even though it is indicated that there was a knowledge contribution from this group of respondents, about 80% of the information was given by specific youth members. These youth members were found residing in rural areas which are far away from towns (For example, others reside in Malale and Mutele which are 120km and 88km away from Thohoyandou respectively). Shava (2000) conducted a survey from the rural community in the Eastern Cape, and some of the youth members were found to contribute most of the indigenous knowledge.

Furthermore, they indicated during the interviews that they grew up with their grandparents who transferred traditional edible plants use knowledge. Interestingly, figures 4.3.4 and 4.3.6 illustrate that male elders and male youth members are better knowledgeable (i.e. with 37% and 57% respectively) about the traditional edible fruits as compared to female respondents. These findings are not surprising since it is well known that most of men and boys enjoy spending their times herding cattles, goats and sheeps. They also confirmed during the interviews that they acquire this knowledge from their elders and through trial and error.

On the other hand, Figure 4.3.5 show that female respondents of ages between 36 and 65 contributed 71% knowledge of traditional edible vegetables. It is not surprising to get this kind of results because in a study conducted in KwaZulu Natal women were found to play a major role in the collection and preparation of wild edible vegetables (Modi et al. 2006). Additionally, the study conducted in KwaZulu-Natal by Zobolo and Mkabela (2006) advocates that the elderly women possessed more plant use knowledge of 64.4% as compared to 7.5% knowledge from young women. Van Vuuren (2006) also argued that South African communities have supplemented their diets with an array of indigenous vegetables which are collected from the veld by women.

All in all, female respondents of ages between 36 and 65 still have knowledge about the traditional edible vegetables (Figure 4.3.7); therefore, they are regarded as important knowledge holders.

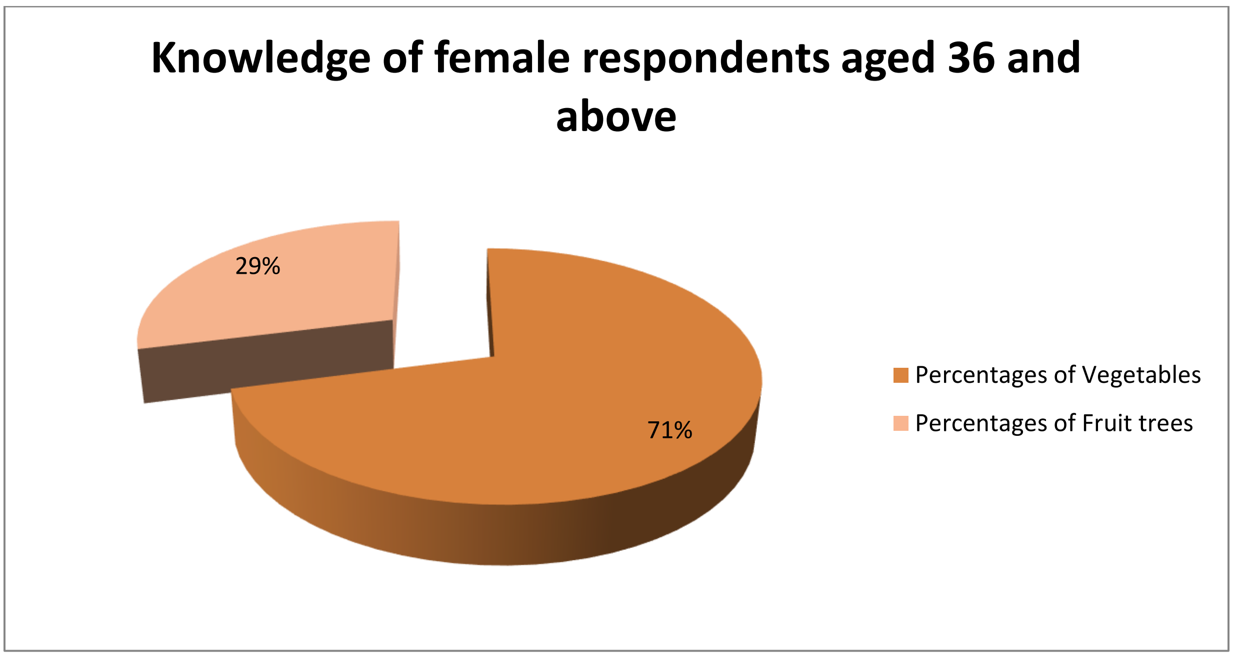

Figure 4.3.3: Number of traditional edible vegetables and fruit trees listed by female respondents aged between 36 years and above.

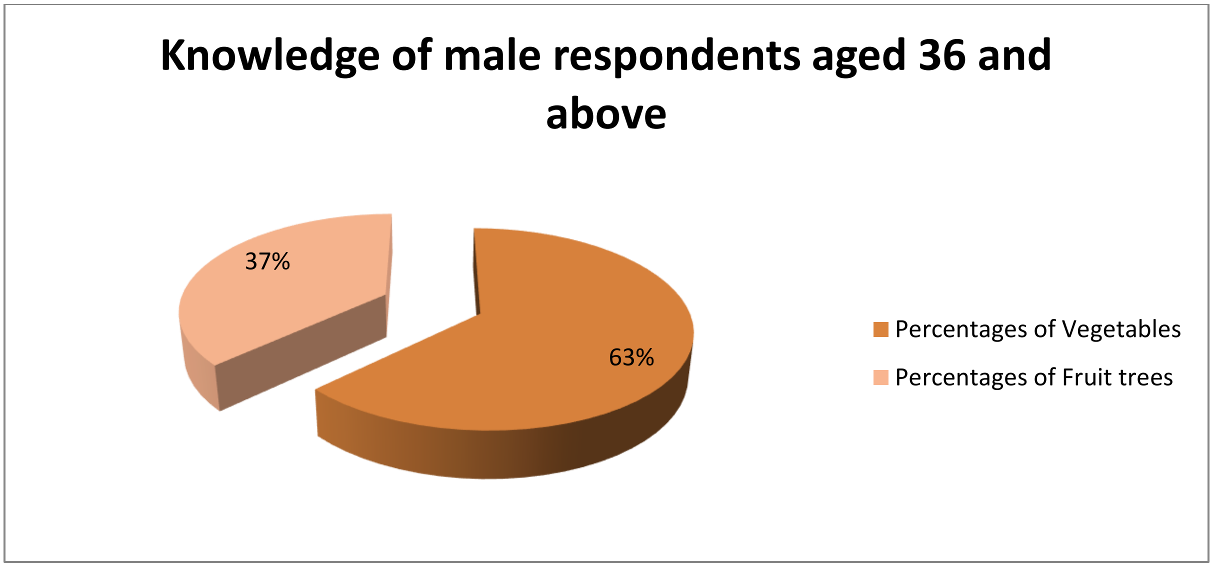

Figure 4.3.4: Number of traditional edible vegetables and fruit trees listed by male respondents aged 36 and above years.

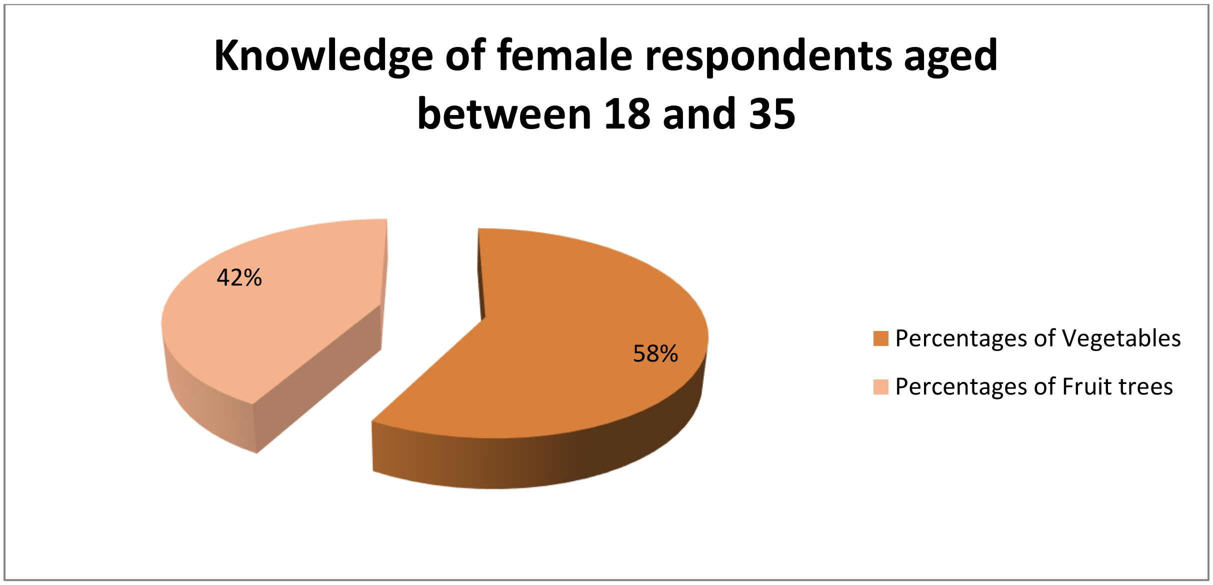

Figure 4.3.5: Number of traditional edible vegetables and fruit trees listed by female respondents aged between 18 and 35 years.

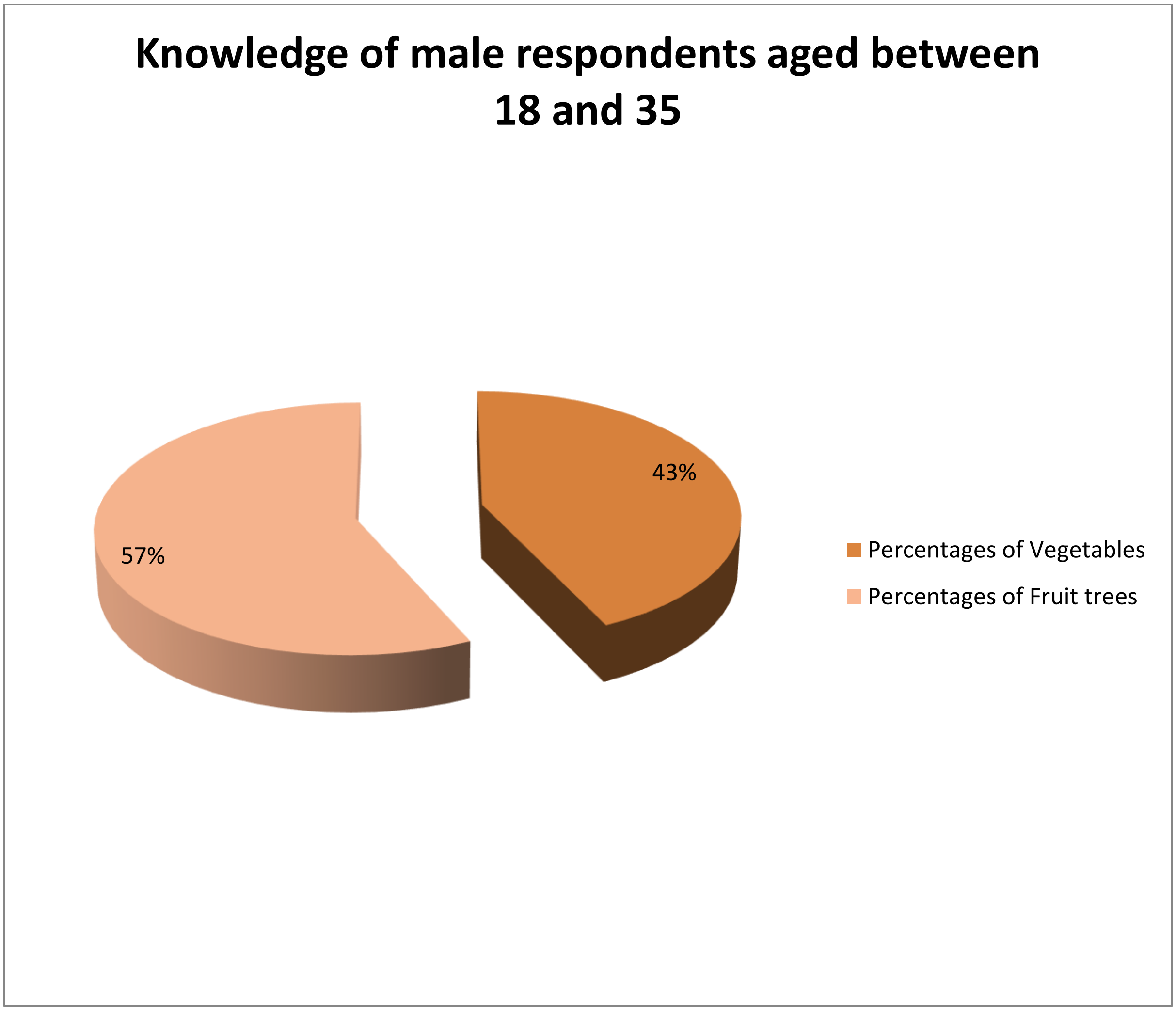

Figure 4.3.6: Number of traditional edible vegetables and fruit trees listed by male informants aged between 18 and 35 years.

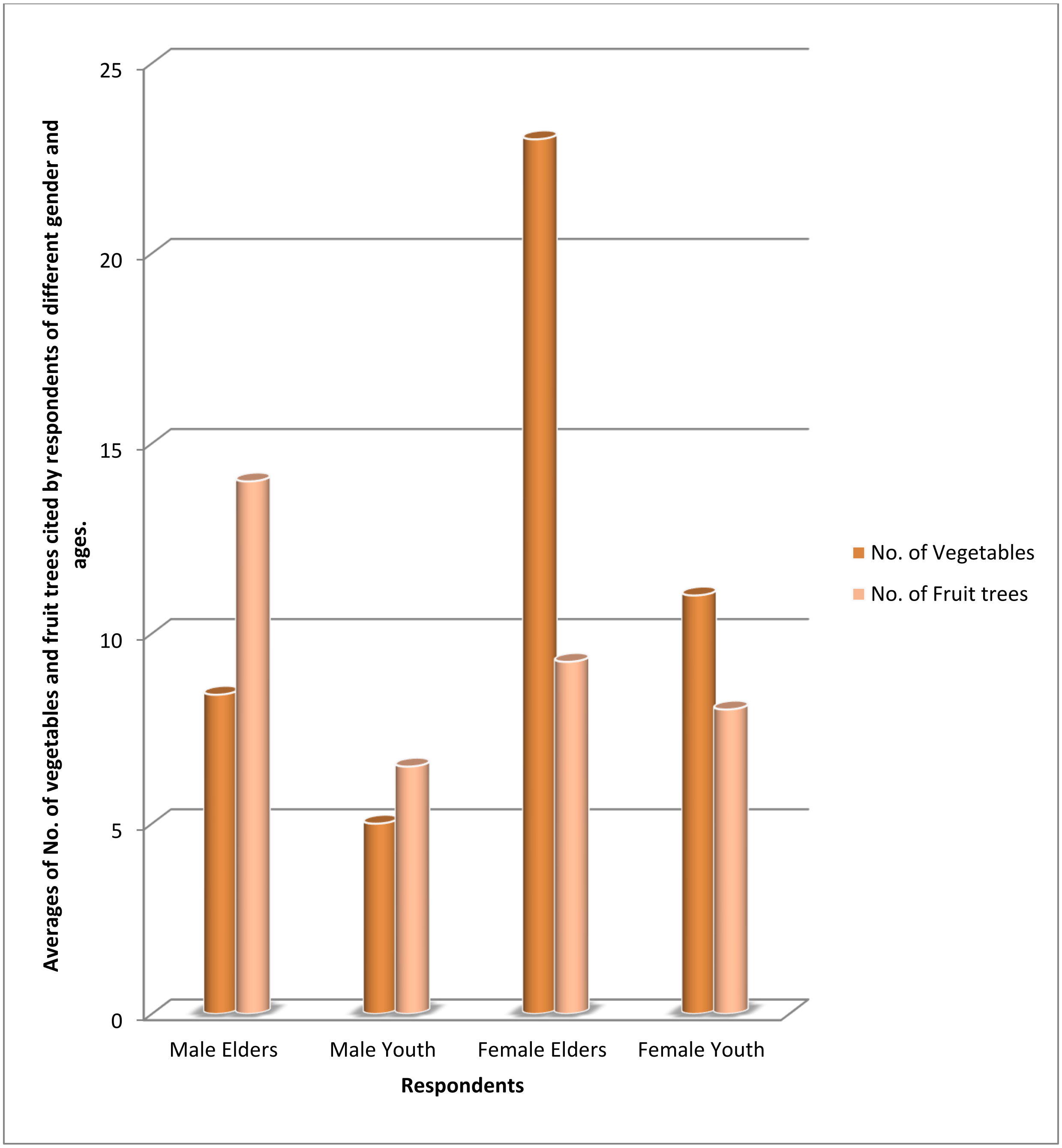

Figure 4.3.7: Averages of traditional edible vegetables and fruit trees mentioned by male and female elders and youth members of the Vhembe District Municipality.

Correlation between age and knowledge.

Table 4.3.1: Pearson's correlation coefficient (R) of ages of respondents and their traditional edible plants knowledge.

	Vegetables	**Fruit trees**
Male respondents aged between 18 and 35	0.008	-0.114
Male respondents aged between 36 and above	0.212	0.154
Female respondents aged between 18 and 35	0.255	0.149
Female respondents aged between 36 and above	0.413	0.098

Results of the current study revealed extremely weak positive correlation of wild edible vegetables knowledge portrayed by male respondents aged 18 to 35 years (Table 4.3.1). Amazingly, the correlation coefficient of traditional edible fruit plants knowledge of the same group of respondents was negative and weak. It was expected that male respondents will have more knowledge about traditional edible fruits than vegetables; however, they showed to have almost equal knowledge of traditional edible vegetables and fruits. Even though male respondents were able to mention traditional edible vegetables, almost 80% mentioned *Momordica balsamina* L. more than other vegetables in the list. Bvenura and Afolayan (2014) alluded that most men develop an interest in wild vegetables as they enjoy their bitter taste which is believed to be healthy and make contributions to their medicinal needs. Moreover, men are known to spend lot of their times in the field or wild where they play an imperative role as herdsmen. During these periods, they explore and learn through trial and error about the plants that can be edible.

Age variation in knowledge of traditional edible plants

It is clearly indicated that during the research, most of the data collected was from elderly respondents. This ultimately raises an impression that knowledge of traditional edible plants still resides amongst the elderly people of the Vhembe District Municipality. The similar scenario was experienced by Kwinana-Mandindi and Afolayan (2014) during their survey with the participants of the Amathole District Municipality. The trend of knowledge residing amongst elders was also reported in other studies conducted in the Northwestern Patagonia, North East Brazil and Brazil by (Ladio & Lozada, 2004; Cruz et al. 2013; Nascimento et al. (2013) respectively. Evidence provided by percentages (43% and 58%) of traditional edible vegetables knowledge of youth members depicted in figures 4.3.5 and 4.3.6 raises a concern regarding knowledge transmission.

Contribution of Respondents’ educational level on knowledge of the wild edible plants

Figure 4.3.8 depicts the educational status of the respondents of the survey. A total of 56% of the survey sample (n = 160) hold the secondary education. Amongst the secondary education holders, majority (90%) are aged between 18 and 40. The study revealed that respondents of the abovementioned age group had a general lack of interest to learn from older generations (Bvenura & Afolayan, 2014). Some of the responses were that “we don’t eat leaves”. They also pronounced the fact that they grew up eating wild vegetables; and therefore, it is no longer time for them to be eating wild vegetables. The fact that they have education also contributes to the loss of interest of knowing and usage of the wild pants. They mentioned that wild vegetables are food for poor people and said that their peers will look down on them if they mention that they eat wild plants.

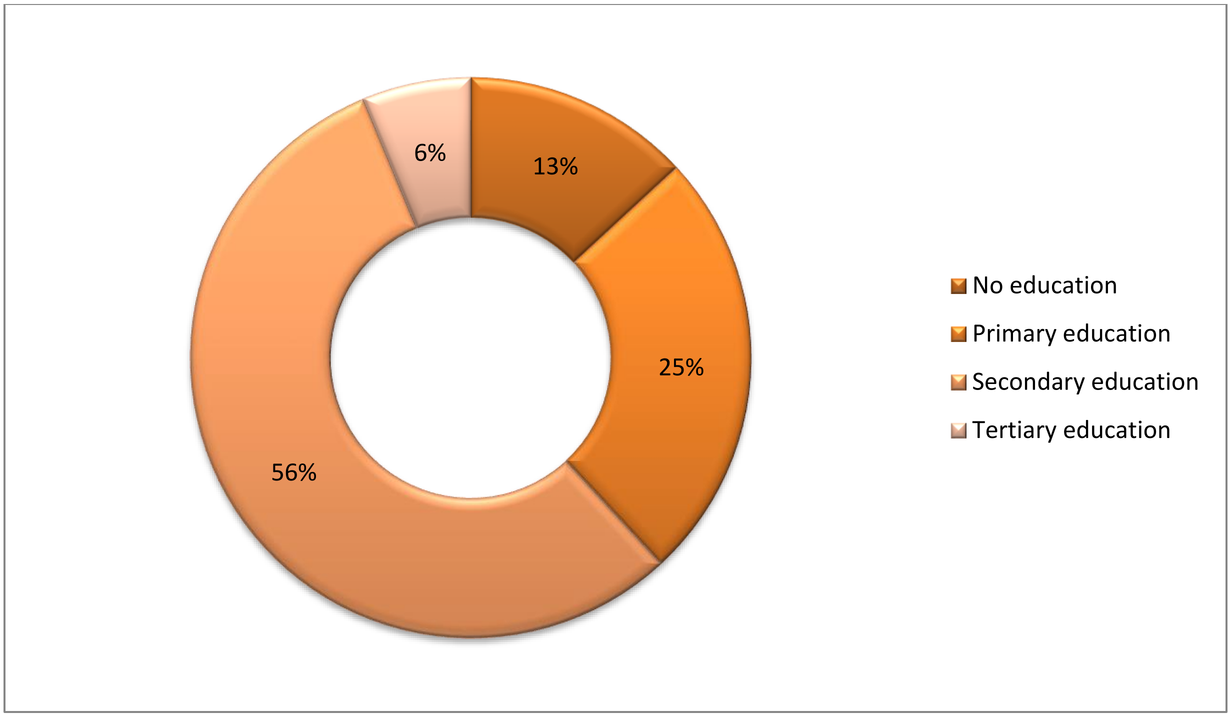

Figure 4.3.8: Educational status of the respondents

4.4 CONCLUSIONS

It is apparent from the study that inhabitants of Vhembe district of the Limpopo province still consider utilization of wild edible plants. Nevertheless, most disturbingly, these traditional edible plants are mostly utilized by elder inhabitants of the study area and most of the indigenous knowledge resides with inhabitants of ages between 36 and 65. This situation raises the eyebrows to urgently carry out the task of considering the context of disappearing of the indigenous knowledge.

Consequently, the emphasis should be given to documentation of traditional knowledge before the complete loss. Results of this study grants recommendation of educational policy programs that will foster inclusion of indigenous knowledge about traditional edible plants use in local schools' curricula.

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Chapter 5

AN EVALUATION OF ADDITIONAL USES OF SOME WILD EDIBLE FRUIT PLANTS OF THE VHEMBE DISTRICT MUNICIPALITY IN THE LIMPOPO PROVINCE, SOUTH AFRICA

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ABSTRACT

Millions of people, mostly in developing countries gathered plant resources to fulfill various daily requirements since time immemorial. The current study documented and evaluated the use of wild edible fruit plants in the Vhembe District Municipality. Data on indigenous use of wild edible fruit plants collected through a series of semi-structured interviews with 160 informants is presented. Of the 92-wild edible fruit plants species belonging to 20 different plant families, 27 plant species were reported to have other uses. Other use categories mentioned during the interviews were food, medicinal, beverages, construction, firewood, cosmetic, dye and artifacts. Out of the 27 fruit plant species cited, 21 are of least concern whereas six are not accessed. A total of 127 respondents showed a need for conserving these plants. Efforts taken by tribal authorities for the conservation are performed mainly by granting fines to people who cut and collect the edible fruit plants.

Keywords: wild edible fruit, Vhembe District Municipality, informants, use categories, multiple use

5.1 INTRODUCTION

Biodiversity is highly significant in securing different fundamental human needs (Ehrlich & Ehrlich, 1992). Millions of people, mostly in developing countries gathered plant resources to fulfill various daily requirements since time immemorial. Schippmann et al. (2002) found that most people in developing countries derived a substantial part of their subsistence and income from wild plant products. These natural products also make a significant contribution to the human and animal food web and are often a means of survival for millions of poor rural households of Malawi and Indonesia (Ficher, 2004; Scherr et al., 2004). Additionally, results of the study conducted in the southern part of India on non timber forest products revealed a significant dependence on forests products by communities living in the Nilgiri Biosphere Reserve (Narendran et al., 2001). Chadare et al. (2010) also state the indispensable use of forest food resources and local forest fruits, particurlary as sources of food and income for rural populations.

It is predominantly paramount to consider the fact that wild plants can be utilised in many different important ways. Not only do wild edible fruit plants contribute to the nutritional value of human's diet, but they can also provide many other uses. Some are medicinally important (Mabogo 1990, Tshisikhawe 2002), whilst others are used for purposes such as beverage production (Rampedi and Olivier 2013). Multiple uses attest to the importance of these plants for subsistence and as part of local cultural heritage (Shrestha and Dhillion 2006).

Many researchers documented the use of wild foods, of which wild fruits form part of local responses to increasing food insecurity and as one of the major coping mechanisms at times of food shortage and famine (Edwards, 1992 (the study conducted in Ethiopia); Abbink 1993 (a study conducted in Ethiopia); Giunand and Dechassa, 2000 (study conducted in Ethiopia); Mojeremane and Tshwenyane 2004 (a study done in Botswana); Getachew et al., 2005 (a study conducted in Ethiopia); Redzic, 2007 (a study done in Bosnia); Motlhanka et al., 2008 (a study conducted in Botswana)). Indigenous wild fruits remain one of the major options for coping with hunger and nutritional deficiency in diets and with poverty in Southern Africa. Mabogo (1990) on his ethnobotany of Vhavenda an indigenous community of Vhembe District Municipality, documented some uses of fruit plants. Additionally, Rampedi and Olivier (2013) documented 41 wild food plant species which can be used to produce traditional beverages. The aim of the study was to evaluate all the different uses of wild edible fruit plants of the Vhembe District.

5.2 MATERIALS AND METHODS

Study area

The current study was conducted in the Vhembe District Municipality of the Limpopo Province, South Africa. Vhembe District covers about 2771 km^2 and has an average altitude of 400 m above mean sea level (Lombard et al., 2006). Vhembe District Municipality lies between 22^{o}56´S and 30^{o}28´E (LSOER 2004). It is divided into four local municipalities namely: Makhado, Mutale, Musina and Thulamela. It shares boarders with

Botswana in the north-west, Zimbabwe in the north and Kruger National Park in the east (Figure. 5.2.1).

The mean annual rainfall of the area ranges between 378 mm and 810 mm (LSOER, 2004). Nature of the climatic conditions of parts of the Vhembe District Municipality supports a variety of vegetation types. Such vegetation types include the north-eastern mountain bushveld, mixed bushveld, sour mixed bushveld as well as mopane bushveld (Venter & Witkowski, 2011). All these vegetation types are located within the savanna biome of the Limpopo province. In addition, there are some woodlands stretching along the Soutpansberg mountain range that have thickets and pockets resemblance of the well-developed Afromontane forests (LSOER, 2004).

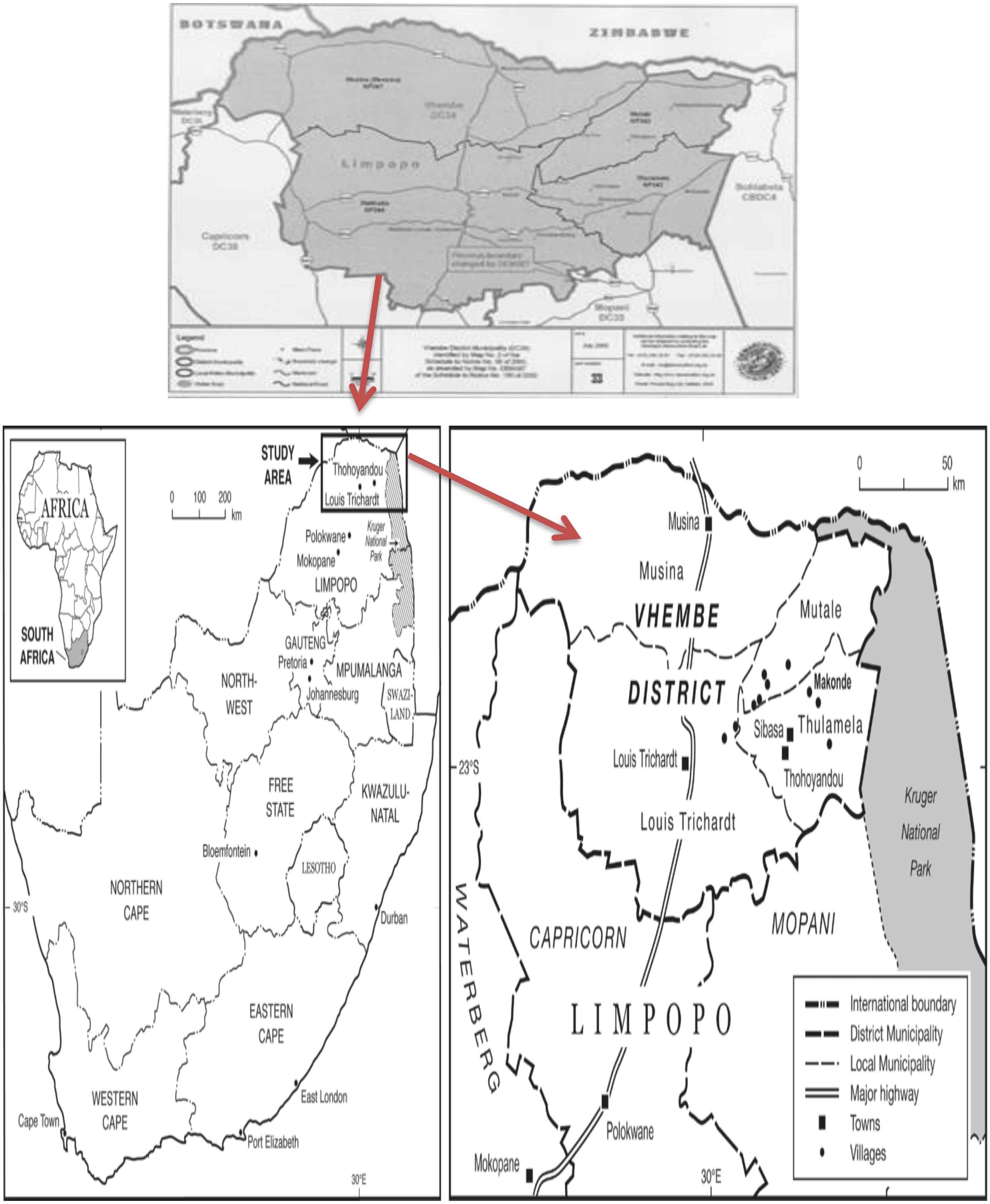

Figure 5.2.1: A map showing the location of the study area (Rampedi and Olivier 2013).

The study focused on Tshivenda speaking inhabitants of the selected rural villages within the four local municipalities of the Vhembe District (Table 5.2.1). An ethnographical approach and purposive sampling were used during data collection. Due to enormous changing of lifestyles in most rural areas that are gradually becoming urbanized, purposive sampling was used to capture indigenous information about different use of wild edible fruit plants from different informants of different age groups.

Subsequently, ten informants were sampled in each community of the selected villages and interviewed using semi unstructured interviews. An informed consent was obtained before interviews (appendix 3). The information recorded during the interviews included plants' local or vernacular names, habit, method of consuming the fruit, cultivated / uncultivated, method of storage for future use, conservation needs, season of the plant's availability, how does it taste like? (good, moderate, bitter), where did you get information about wild edible fruits and other uses. Scientific names and more taxonomic information were identified. Voucher specimens collected were identified and deposited to the University of Venda Herbarium. Photographs of the plants and edible parts were taken using digital camera.

Table 5.2.1: Outline of the Local municipalities, the studied villages and their locations within the municipalities.

Name of the local municipality	Villages	Coordinates of the study villages
Makhado	Ha-Nthabalala	-23,286352 ; 29,958219
	Ha-Madodonga	-23,086033 ; 29,683193
	Tshakhuma	-23,060434; 30,308650
	Ha-Masia	-23,216520 ; 30,330353
Mutale	Pile (Dzimauli)	-22,590940 ; 30,435505
	Tshivhongweni	-22,568836 ; 30,594393
	Ha-Makuya	-22,637461 ; 30,874103
	Mutele A	-22,478291 ; 30,870107
Musina	Madimbo	-22,448918 ; 30,562196
	Malale	-22,392859 ; 30,588908
	Tshikhudini	-22,467727 ; 30,595178
	Tanda	-22,451758 ; 30,586934
Thulamela	Vondo	-22,912577 ; 30,390894
	Ha-Begwa	-22,778123 ; 30,806271
	Gondeni (Sterkstroom)	-22,914769 ; 30,608938
	Mukula (Tshirunzini)	-22,860016 ; 30,648178

5.3 RESULTS AND DISCUSSIONS

5.3.1 Informants' profile

A total of 160 informants participated in this study. Most of them (n = 107) were females. This type of participation was expected, because women are usually responsible for ensuring that the households have access to food. Table 5.3.1.1 describes the characteristics of these informants. Most of the informants were adults of two age categories (i.e. 36 - 64 (n = 57) and 65 and older (n = 29). The number of both male and female youth informants is (n = 74). More than half of the informants (55.63%) had secondary education, even though not all of them reached the exit level. Unemployment rate among the informants is very high (i.e. 66.3%).

5.3.2 Additional uses of wild edible fruit plant species

During the research, a total number of 92 wild edible fruit plant species was documented and identified. Twenty-seven of the documented plant species were found to have more other uses. Table 5.3.2.1 summarizes the information about the 27 wild edible fruit plants that have additional uses.

Table 5.3.1: Characteristics of informants (n=160).

Personal Information	n	Percentage (%)
Age (years)		
15 – 35	74	46.3
36 – 64	57	35.6
65 and older	29	18.13
Gender		
Males	53	33.13
Females	107	67
Educational level		
No education	21	13.13
Primary education	40	25
Secondary education	89	55.63
Tertiary education	10	6.3
Work status		
Employed	10	6.3
Unemployed	106	66.3
Self employed	8	23
Retired/Pensioner	36	5

Table 5.3.2.1: Information about 27 wild edible fruity plants species with additional uses. Information gathered from WV= Welcome and Van Wyk (2019); MA= Magwede et al. (2019) and MTM= Mbambala et al. (2017).

Family	Scientific name	Vernacular(V) and Common name(E) New documented vernacular name in bold	Use categories cited during interviews Newly documented uses in bold	Literature used
Anacardiaceae	*Sclerocarya birrea* (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro, MMG45	Mufula (V), Cider tree, Marula (E)	8:beer,oil, **jam**,cooking soda,**candies**, snack, seasoning, medicine	WV and MA
Anarcadiaceae	*Lannea discolor* (Sond.) Engl., MMG43	Munie (V), Tree Grape, Wild plum (E)	2:dye, **firewood**	WV and MA
Annonaceae	*Annona senegalensis* Pers, MMG33	Muembe (V), Custard apple (E)	1: firewood	WV and MA
Annonaceae	*Artabotrys brachypetalus* Benth., MMG40	Mudzidzi (V), Red Hook-berry (E)	1: firewood	WV and MA
Annonaceae	*Hexalobus monopetalus*, MMG37	**Muhuhuma** (V), Mudzidzi (V)Purple Hook-berry (E)	1: firewood	WV and MA

Family	**Scientific name**	**Vernacular(V) and Common name(E)** **New documented vernacular name in bold**	**Use categories** **Newly documented uses in bold**	**Literature used**
Apocynaceae	*Landolphia Kirkii* T. dyer, MMG35	Muvhungo (V), Rubber Vine (E), San Apricot-vine (E)	3:**firewood**, roofing, medicine	WV and MA
Apocynaceae	*Carissa bispinosa* (L.) Desf.ex Brenan, MMG42	Murungulu (V), Fork-spined Carissa, Red Num Num (E)	1:medicine	WV and MA
Brassicaceae	*Boscia albitrunca* (Burch.) Gilg & Gilg-Ben, MMG59	Muthobi (V), Sheperd's tree (E)	1: **medicine**	MA
Cactaceae	*Opuntia Ficus- indica,* MMG50	Mudoro (V), Prickle pear, Spineless Cactus (E)	2: beer, **jam**	WV and MA
Chrysobalanaceae	*Parinari curatellifolia* Planch. ex Benth., MMG41	Muvhula (V), Mobola Plum, Cork tree (E)	3: beer, juice, **porridge cooking**	WV and MA

Family	**Scientific name**	**Vernacular(V) and Common name(E)** **New documented vernacular name in bold**	**Use categories** **Newly documented uses in bold**	**Literature used**
Ebenaceae	*Diospyros mespiliformis* Hochst.ex A.DC., MMG44	Musuma (V), Jackal-berry (E)	1: firewood	WV and MA
Fabaceae	*Pterocarpus angolensis* DC, MMG62	Mutondo (V), Blood wood (E)	2:**beer, porridge cooking**	MA
Loganiaceae	*Strychnos spinosa* Lam., MMG79	Muramba (V), Monkey orange (E)	3:juice, firewood, artifact	WV and MA
Loganiaceae	*Strychnos pungens* Soler, MMG46	Mukwakwa (V), Spiny-leaved Wild Orange (E)	5:**juice, firewood,** medicine, **artifact, beer**	WV and MA
Malvaceae	*Adansonia digitata* L. MMG47	Muvhuyu (V), Cream of tartar tree (E)	2:cooking soda, **firewood**	WV and MA

Family	Scientific name	Vernacular(V) and Common name(E) New documented vernacular name in bold	Use categories Newly documented uses in bold	Literature used
Malvaceae	*Grewia microthyrsa* K. Schum. Ex Burret MMG53	Mufuka (V), Sand Raisin (E)	1:**porridge cooking**	WV and MA
Malvaceae	*Grewia villosa* Willd MMG74	Mupunzu (V), Mallow raisins (E)	1:**porridge cooking,**	WV and MA
Meliaceae	*Trichilia emetica Vahl susp. emetica* Sond, MMG54	Mutshikili (V), White Mahogany (E)	2: seasoning, medicine	WV and MA
Moraceae	*Ficus sycomorus* L. subsp. *Sycomorus,* MMG52	Muhuyulukuse (V), False Cluster Fig (E)	1: **lotion**	WV and MA
Myrtaceae	*Psidium guajava* L. MMG57	Mugwavha (V), Apple Guava, Yellow Guava (E)	2: **beer, juice**	WV and MA
Ochnaceae	*Ochna pulchra* Hook. F. MMG51	Tshitoni (V), Granite ochna (E)	1: firewood	WV and MA

Family	Scientific name	Vernacular(V) and Common name(E) **New documented vernacular name in bold**	Use categories **Newly documented uses in bold**	Literature used
Olacaceae	*Ximenia caffra* Sond. var. *caffra* MMG56	Muthanzwa (V), Blue Sour Plum (E)	1: **firewood**	WV and MA
Passifloraceae	*Passiflora subpeltata* Ortega MMG61	Mugurunandela (V), **Mufuranta (V)**, Wild granadilla (E)	1: firewood	MTM
Rhamnaceae	*Ziziphus mucronata* Willd.subsp. *mucronata* MMG60	Mutshetshete (Mukhalu) (V), Buffalo thorn (E)	1:firewood	WV and MA
Rubiaceae	*Vangueria infausta* Burch MMG38	Muzwilo (V), Velvet Wild-medlar (E)	2:firewood, medicine	WV and MA
Sapotaceae	*Mimusops zeyheri* Sond. MMG31	Thaladzi/ Mbubulu (V), red milkwood (E)	1:medicine	WV and MA

Family	**Scientific name**	**Vernacular(V) and Common name(E)** **New documented vernacular name in bold**	**Use categories** **Newly documented uses in bold**	**Literature** **used**
Sapotaceae	*Englerophytum mogalismontanum* (Sond) Heine & J.H Hemsl. MMG36	Munombelo (V), Milkplum (E)	4:beer, firewood, **jam**	WV and MA

(V) is vernacular name as mentioned by informants during the survey and (E) isEnglish common names of the mentioned wild edible plant species.

Wild plant species documented during the study were representative of 19 different plant families (Table 5.3.2.1 and Figure 5.3.2.1). The most widely represented families were Annonaceae (n = 3), Malvaceae (n = 3), Apocynaceae (n = 2), Anarcadiaceae (n = 2), Loganiaceae (n = 2) and Sapotaceae (2). Most families quoted in the study (n = 13) are represented by only one species (Figure 5.3.2.1).

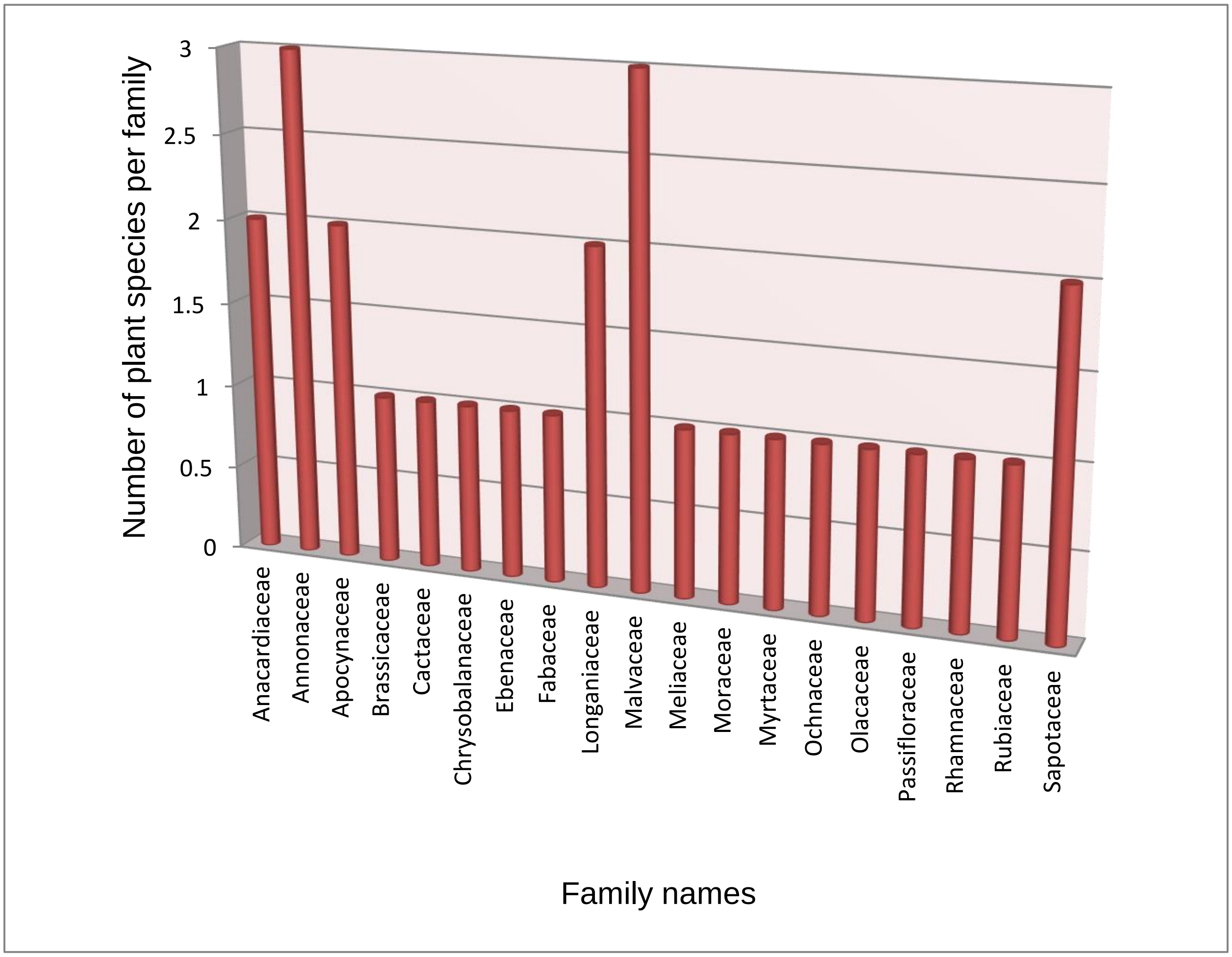

Figure 5.3.2.1: A graph showing number of plant species per identified families.

Figure 5.3.2.2 illustrates number of uses per plant species and *Sclerocarya birrea* (A. Rich.) Hochst was the one with remarkably many other uses as compared to other 27 documented wild edible fruit plants. *Sclerocarya birrea* commonly known as marula is a tropical tree that mainly grows in Southern African and it contributes a lot to local communities because of its high nutritional and commercial values (Mokgolodi et al. 2011). It is not surprising to find many additional uses from Marula tree; Hiwilepo-van Hal (2013), regards marula tree as a multipurpose tree from Southern Africa, used by local people for its fruit, and cosmetic oil from the seed and for medicinal products from the bark and leaves.

Amongst the 19 plant families identified during the study, members of the 9 families were found to have medicinal properties (Table 5.3.2.3). The 9 families include Apocynaceae (2)**,** Loganiaceae (1), Anacardiaceae (1), Annonaceae (2), Meliaceae (1), Ebenaceae (1), Rubiaceae (1), Apocynaceae (1), Sapotaceae (1) and Olacaceae (1). The main parts used for medicine from these plant species are roots (6 species), followed by fruits (4 species) and usage of the barks of only one plant species. Results shown in table 5.3.3 strengthen the uniqueness of Marula tree as three of its parts (the roots, fruits and inner bark) are utilized medicinally.

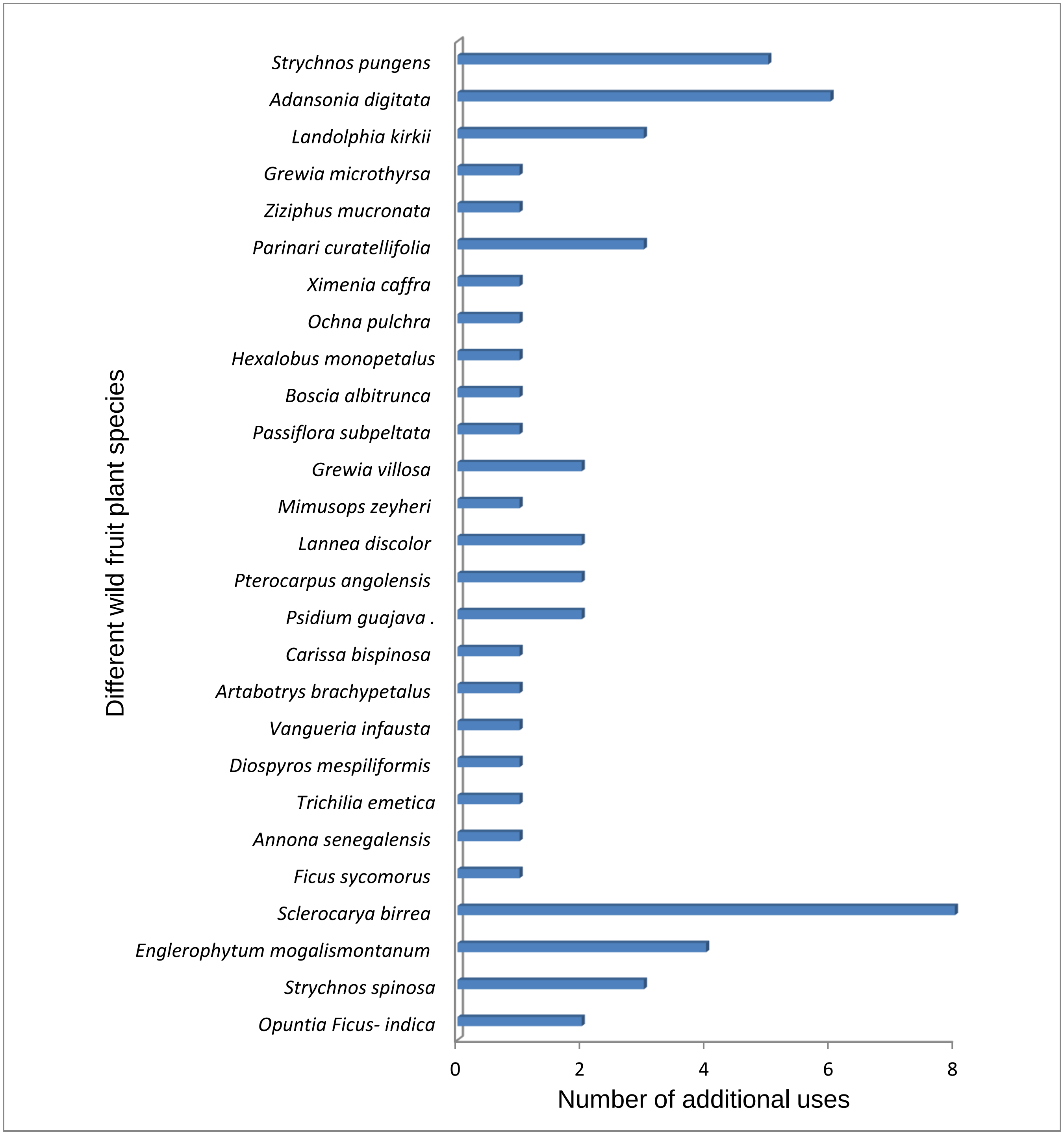

Figure 5.3.2.2: A graph showing number of other uses per plant species.

Table 5.3.2.3: List of wild edible plants species that are also used medicinally

Family	Scientific name	Vernacular name	Plant parts used and illnesses cured
Anacardiaceae	*Sclerocarya birrea* (A. Rich.) Hochst. subsp. caffra (Sond.) Kokwaro	Mufula	Roots have medicinal properties, Liquid from the fruit heals earache, Roots are used for stomachache and inner bark is used to cure colds and flu,
Annonaceae	*Anonna senegalensis Pers*	Muembe	Heal children's' stomach problems
Annonaceae	*Artabotrys brachypetalus* Benth*.*	Mudzidzi	The roots are used to treat cows with stomach problem
Apocynaceae	*Landolphia Kirkii* T. dyer	Muvhungo	Roots have medicinal purposes
Apocynaceae	*Carissa bispinosa* (L.) Desf.ex Brenan	Murungulu	Roots have medicinal properties,
Ebenaceae	*Diospyros mespiliformis* Hochst. Ex A.DC.	Musuma	Fruits are used to cure wounds,
Loganiaceae	*Strychnos pungens* Soler	Mukwakwa	Roots have medicinal purposes

Family	Scientific name	Vernacular name	Plant parts used and illnesses cured
Meliaceae	*Trichilia emetica* Vahl *subsp. emetica*	Mutshikili	Bark used as laxative and the fruits heal earache,
Olacaceae	*Ximenia caffra* Sond.var.caffra	Muthanzwa	Pain killer (boil the roots and drink the decoction)
Rubiaceae	*Vangueria infausta* Burch	Muzwilu	Fruits used to lessen the intensity of the period pains
Sapotaceae	*Mimusops zeyheri* Sond.	Mububulu	Medicine

Wild edible fruit plants do not have the medicinal properties as the only additional uses; they can also be used in other use- categories, such as food, beverages, construction, firewood, cosmetic, dye and artifacts. Thirty-four percentage of the 27 documented plant species are utilized as firewood. The second mostly quoted use category was for different food stuffs with 32% quotes (Figure 5.3.2.3). Food stuffs cited include cooking oil that is extracted from nuts of marula tree, cooking soda made from the skin of marula fruits, candies produced from the pulp of the marula fruits, jam made from prickly pear fruits and marula kernels that can be used as snack or for seasoning purposes. Besides the use of wild edible plants cited for the abovementioned food stuff, there are other uses as well. For example, other wild edible plants were found to be used for beverage- production.

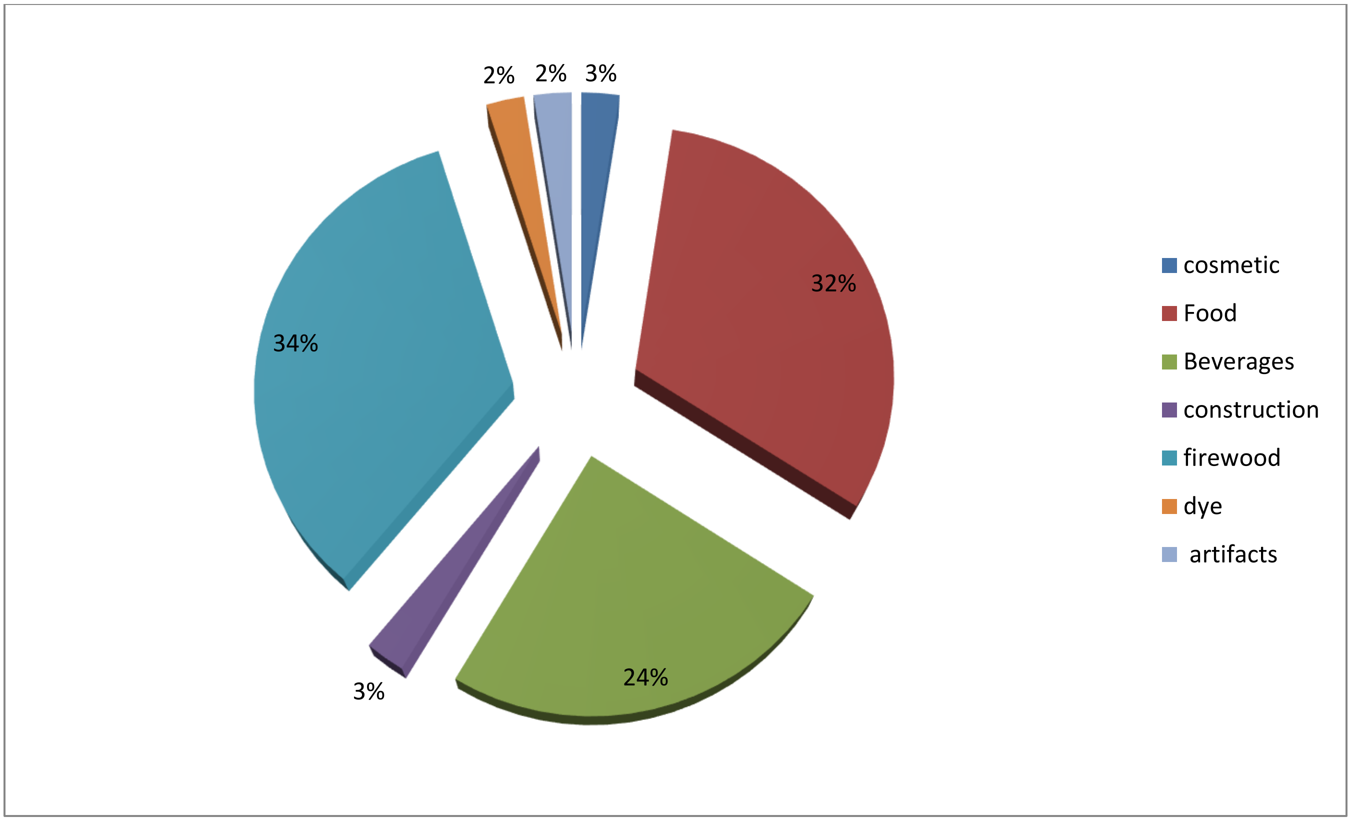

Figure 5.3.2.3: A graph showing percentages of the additional uses mentioned during the survey.

Based on information of the wild fruit plant species mentioned by informants to be utilized as beverages, there is a clear agreement with the findings of Rampedi and Olivier (2013). Most of the plant species mentioned in their work were also mentioned during the current study.

5.4 CONSERVATION NEEDS OF WILD EDIBLE FRUIT PLANTS

Figure 5.4.1 depicts results of the SANBI (South African National Biodiversity Institute) red list wherein 21 fruit plant species are found to be of least concern and six are not assessed. The six non assessed tree plant species are *Hexalobus monopetalus*, *Boscia albitrunca* (Burch.) Gilg and Gilg-Ben, *Opuntia Ficus-indica*, *Psidium guajava* L., *Passiflora subpeltata* Ortega and *Englerophytum magalismontanum* (Sond) Heine and J.H. Hemsl.

A total of 127 respondents acknowledged the need for conserving wild edible fruit plants. The respondents highlighted four different conservation reasons which are thus: to conserve fruit plant species so that future generations will have knowledge about the plants; so that people can still enjoy the fruits even in future; there is less fruit plants left and they are important to the community (Table 5.4.1) and (Figure 5.4.2). Twenty-three respondents concurred with the conversation of fruit plant species; however they did not have reasons that motivated their answers.

It is illustrated in Figure 5.4.3 that a total of 66 respondents highlighted contribution of their tribal authorities towards conservation of wild edible fruit plants through offerings of fines to residents who cut and collect the trees for other purposes. Fifty-seven respondents mentioned that people obey the tribal authority rule which says “People are not allowed to cut the trees for firewood”. The remaining total of 37 respondents mentioned that there is no law is set from the chief’s kraal. Majority of respondents of the study conducted in Kpashimi Forest Reserve, Niger State, Nigeria by Abdullahi et al. (2013) showed Royal traditions, taboos and myths playing significant role in the conservation of forest diversity. This simply explicates that sustainable use and hence conservation of wild edible plant species can be enhanced if local rules and regulations are enforced and obeyed.

It is illustrated in table 5.3.2.1 that six fruit plant species which were never mentioned to be used for firewood are now reported for this use. Possible reasons for this scenario might be that tribal practices on conservation of important plants are no more enforced. Additional reason is that our society is full of modernized youth members who practically use any tree for any purpose due to lack of knowledge of tribal rules or due to their careless attitude. Elderly people participated in the study done in Niger State, Nigeria lamented that trees that were not utilized as firewood in three decades back are now been used due to carefree attitude of some members of the society (Abdullahi et al., 2013).

It was mentioned during the research that plants like *Sclerocarya birrea* is regarded as the Chief's plant simply because of the reason that every community member is compelled to deliver Marula beer to the Chief's kraal. Nevertheless, this practice promotes conservation of *Sclerocarya birrea*. This information clearly explains that plant species can be protected from extinction when are used for cultural and traditional purposes rather than being utilized for its effectiveness purposes (Shackleton et al., 2007). On the other hand, 37 respondents indicated that there are no set laws coming from the tribal authorities. This really motivates an urgent need for the enforcement of the royal rules and regulations that will result in promoting wild edible fruit plant species conservation. However, full cooperation from members of the society is required for the successful implementation of the tribal conservation rules. The work done by Albuquerque et al. (2011) in North Eastern region of Brazil recommend the direct involvement of community members in the design and implementation of a management plan for conservation and monitoring of culturally valuable and vulnerable plant species.

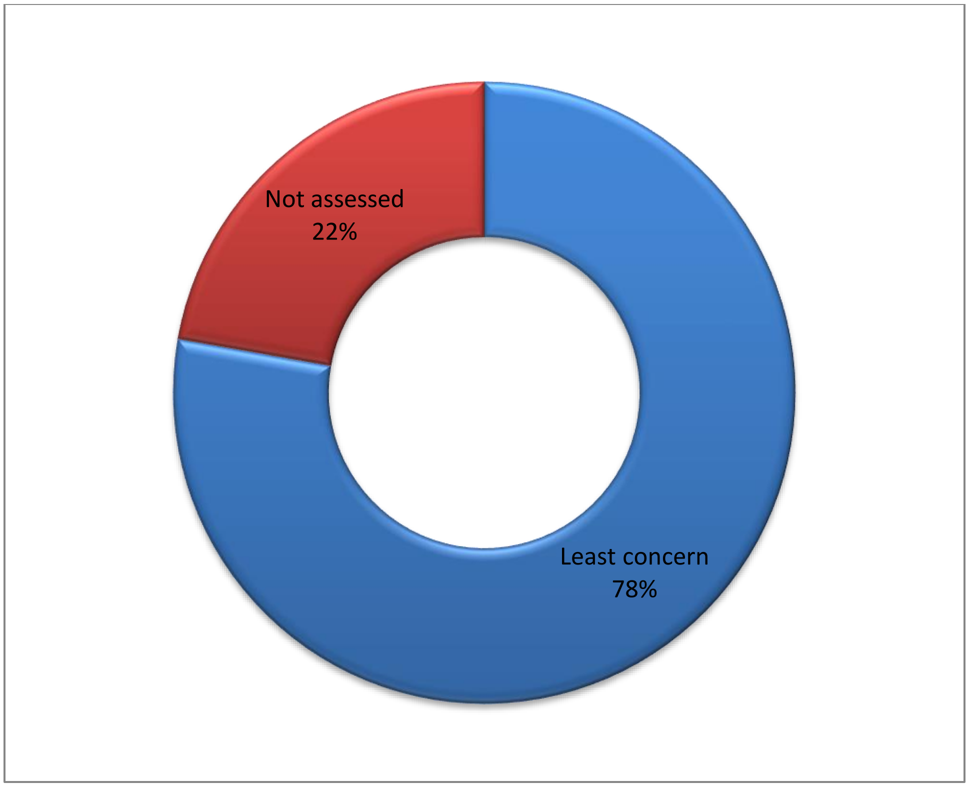

Figure 5.4.1: SANBI Red List Statuses of wild edible fruit plant species.

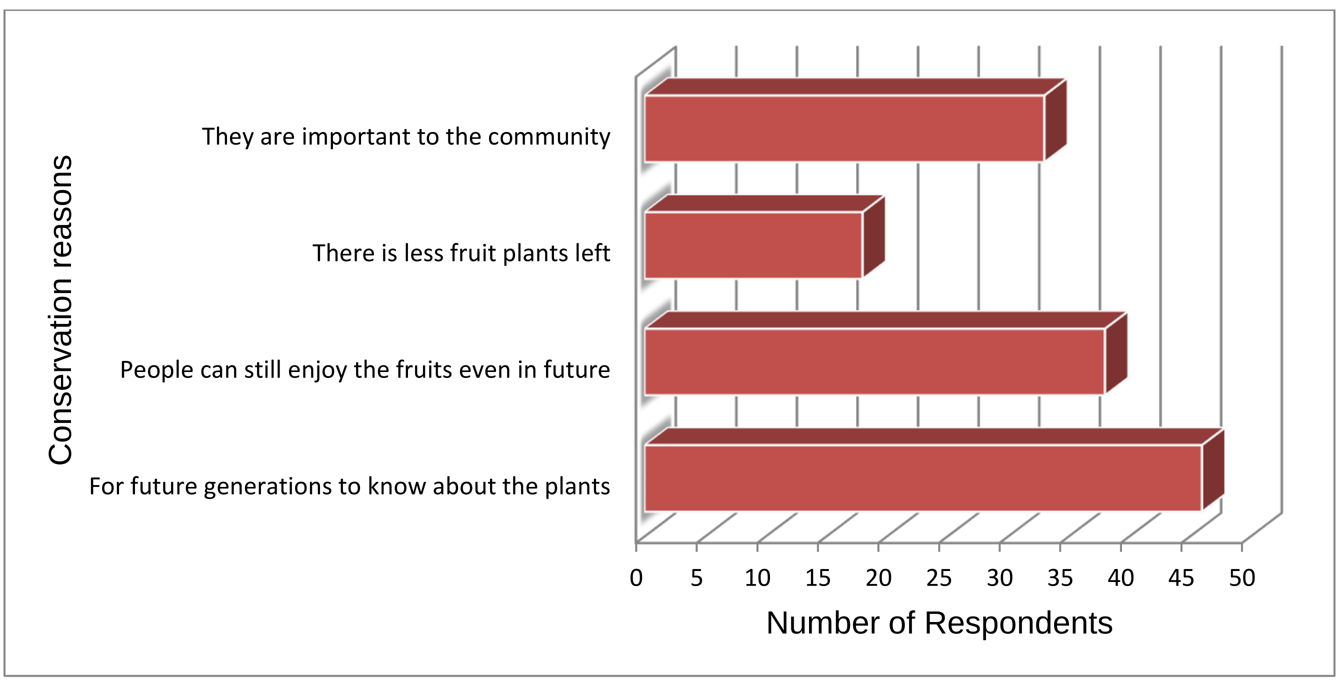

Figure 5.4.2: Conservation reasons of wild edible fruit plant species.

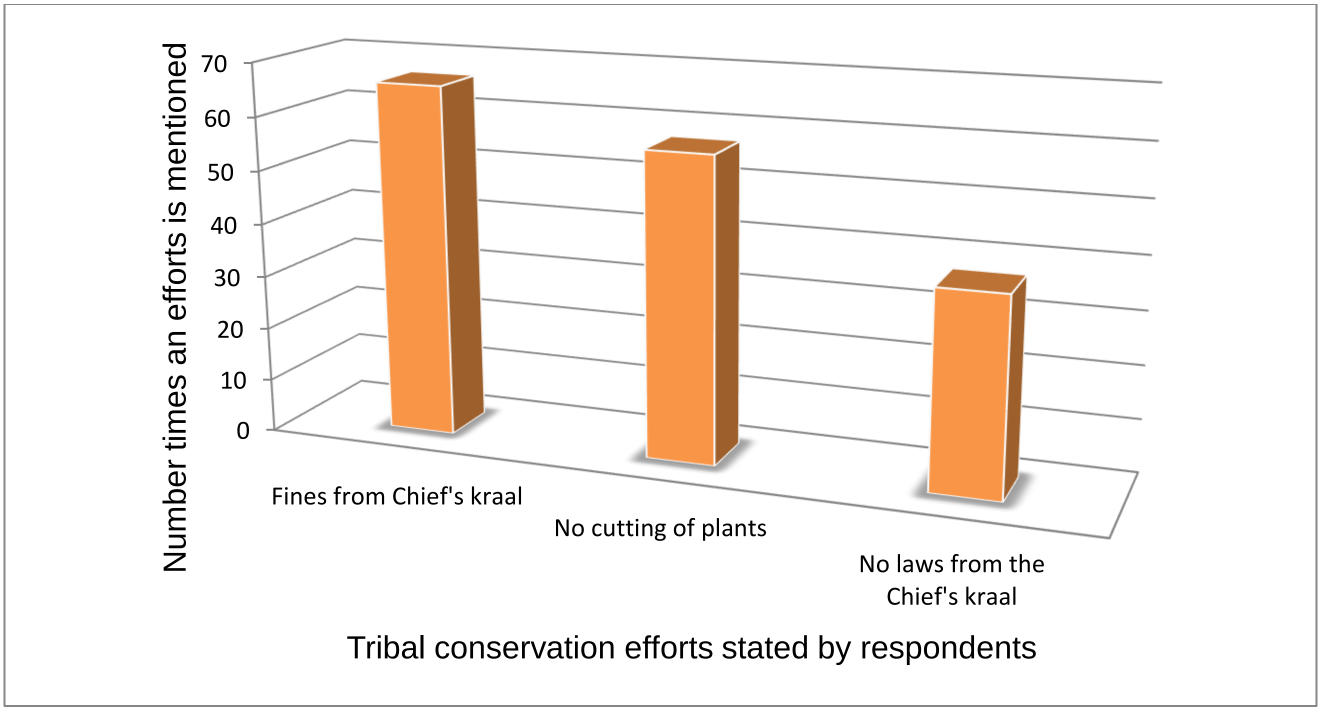

Figure 5.4.3: Tribal conservation efforts of wild edible fruit plant species.

Table 5.4.1: Different reasons motivating conservation of fruit plant species.

Reasons motivating conservation of fruit plant species	**Number of respondents mentioned the reason**
For future generations to know about the plants	46
So that people can still enjoy the fruits even in future	38
There is less fruit plants left	18
They are important to the community	33

5.5 CONCLUSIONS

The current research outlined the indispensability of wild edible fruity plants as they can be utilized in many beneficial pivotal ways. Conducting this type of research helped to prevent the loss of indigenous knowledge on the apparent other uses of wild fruit plants. Since these plants play a paramount role in the lives of rural communities, the development of appropriate cultivation and harvesting strategies is suggested. Utilization of tribal rules and regulations must be enforced with the help of ideas emanating from scientific researches. Vanderbroek et al. (2011) argue that Local Knowledge Systems should not be seen as panacea to every problem , rather be considered complementary to scientific research.The participation of local community, conservers, educators and other stakeholders in the field of conservation, documentation and application of local indigenous knowledge on the use of medicinal and edible wild fruit plants should be reinforced. Some respondents of this study attested that conservation laws from the tribal authorities are actually not existing. The other way to provide protection of wild edible fruit plants is to legalize communal resource-use rights (Gadgil et al., 1993); this may include incooperation of national laws with local rules by appointing responsible local leaders who are enforcing traditional rules, as rangers.

Nevertheless, despite the rich indigenous knowledge on the medicinal use of wild plants which has been well documented (Mabogo, 1990) and inventory of useful plants of VhaVenda by Magwede et al. (2019), more research; particularly to serve the concern on conservation of wild edible fruit plants still require adequate attention.

5.6 ACKNOWLEDGEMENTS

Special thanks are due to the Almighty God who provided wisdom, courage and good health throughout the study. Many thanks to the local people for their participation and for sharing their wisdom to enrich our understanding of wild edible fruity plants. Financial support from the University of Venda Capacity Development towards a Higher Degree Grant is gratefully acknowledged.

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Chapter 6

AN ETHNOBOTANICAL SURVEY OF TRADITIONAL EDIBLE VEGETABLES WITH ADDITIONAL USES: A STUDY OF THE VHEMBE REGION IN THE LIMPOPO PROVINCE, SOUTH AFRICA

An extract paper of this chapter “Medicinal uses of selected wild edible vegetables consumed by Vhavenda of the Vhembe District Municipality, South Africa” is In Press in the South African Journal of Botany.

ABSTRACT

Studies conducted globally evident that rural communities are faced with food insecurity and are chronically malnourished. The use of the traditional edible vegetables can be of pivotal use to mitigate the stress of food insecurity. On the other hand, traditional edible vegetables can serve multiple purposes such as 1) medicinally 2) and as condiments in special traditional cuisines. A total of 160 participants were interviewed in 16 different villages of the four local municipalities found in the Vhembe district municipality. The interviews aimed at gathering data on ethnobotanical aspects such as local names of traditional edibles vegetables, parts used, life forms, mode of consumption, taste, other uses and mode of storage. The taxonomic diversity of wild edible vegetables with additional uses is 24 species belonging to 20 genera and 15 families. Thirty six percent (36 %) of the wild edible vegetables listed during the survey were herbs. Some of these vegetables were reported to play paramount roles in the traditional therapeutic practices. As for the taste of the vegetables, it was explained by many participants that the ones with bitter taste can lower the blood pressure. The study indicated that wild edible vegetables

can not only serve as vegetables that supplement the maize-based diets but can also serve as food-medicine and spices to be used in preparations of special Venda traditional cuisines like the one called bovhola. The dried fruits of some vegetables can be used as kitchen utensils.

6.1 INTRODUCTION

Studies conducted globally evident that rural communities face food insecurity and are chronically malnourished (Tiisekwa et al., 2004). The cause of malnourishment of the rural communities is due to drought stress (Ludlow & Muchow, 1990; Harris & Mohammed, 2003). The use of wild edible plants can be used as one of pivotal mitigation strategies to the food insecurity. According to Johns and Kokwaro (1991) and Leaky and Newton (1994), wild edible plants are described as wild food plants that grow naturally in the wild. Successively, their consumption plays a pivotal role in the livelihoods of rural communities as an integral part of the subsistence strategy of people in many developing countries. Wild edible vegetables serve several native reasons to staple food during periods of food scarcity (Somnasang & Moreno-Black, 2000). Those native reasons are 1) supplement for a nutritionally balanced diet and 2) regarded as one of the primary alternative sources of income for many local communities.

Other studies conducted in South Africa describe indigenous vegetables as wild edible vegetables which are usually leafy greens, almost all deep green in colour and often have bitter taste (Uusiku et al., 2010). Shackleton (2003) reported the contribution of the food livelihood security enhancement offered through consumption of wild edible herbs. Additionally, Nesamvuni (2000) reported on the use of wild edible herbs in the Venda region of which recommendations emphasized the dietary values gained by rural communities.

Results of the research conducted by Nesamvuni et al. (2001) indicate that ten plants studied were *delelemandande* (*Abelmoschus esculentus* (L) Moench), *thebe* (Amaranthus hybridus L.), *vowa* (*Amarunthus dubius* C. Mart ex Thell.), *mushidzhi* (*Bidens pilosa* L.), *murudi* (*Cloeme gynandra* L.), *mutohotoho* (*Cloeme monophylla* L.), *delelelupfumo* (*Corchorus olitorius var. oilitorius*), *phuri* (*Cucurbita pepo* L.), *nngu* (*Momordica foetida* Schumach) and *muxe* (*Solanum retroflexum* Dunal . *Murudi* was found to have the highest content of micronutrients, being exceptionally high in folate, vitamin C and beta-carotene. All the plants examined were good sources of dietary fibre. *Vowa, phuri* and *nngu* were also rich sources of vitamin c. *Delelemandande* was the only poor source of beta-carotene and iron". Realizing the beneficial dietary impact of many studied vegetables, it was then recommended that health educators should spread the gospel of the nutritional benefits of wild vegetables in rural communities to increase micronutrient in the diets of local people.

Wild edible vegetables have gained more desirable traits thus: 1) many of them are richer in protein, vitamins, iron and other nutrients in comparison with commercialized crops (Gockowski et al*.,* 2003); 2) they also better able to resist extreme droughts and pests. Resistance abilities of the wild edible plants towards drought make them potent weapon against food scarcity for local communities.

Aim of the Study

Researchers such as Maanda and Bhat (2010), Nesamvuni et al. (2001) and Mbhenyane et al. (2005) focused on the documentation and nutritional analysis of the wild edible vegetables consumed by Vhavenda and determine the habitual diet and the consumption of indigenous foods among college students in Limpopo province respectively. The current study assessed extra uses of wild edible vegetables in addition to their edibility.

6.2 MATERIALS AND METHODS

Study area and research methodologies

A survey on inventories of different wild edible vegetables was conducted in the Vhembe District Municipality of the Limpopo Province (Figure 6.2.1). The four local municipalities of the Vhembe District Municipality (i.e. Makhado, Musina, Mutale and Thulamela) were all considered in the current study.

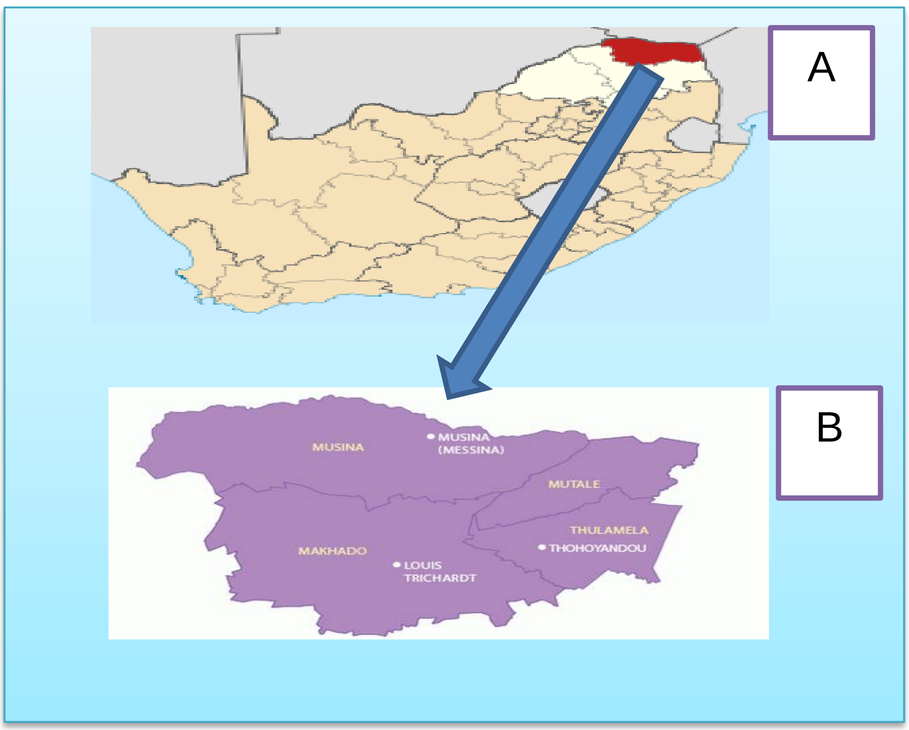

Figure 6.2.1: A: Map of the Limpopo Province showing its five district municipalities, Vhembe District is coloured in red and B: Illustration of the four local municipalities of the Vhembe District Municipality (LSOER, 2004).

Four villages of each local municipality were randomly sampled. This was achieved by placing names of ten villages purposively selected from each of the four local municipalities in a container wherein only four were sampled (Mushaphi, 2011). Ten members from 10 different homesteads were visited. The selection of the homesteads was done by skipping ten homesteads away from each other and considering all directions of the compass. Most of the participants were youth members aged between 18 and 35 (n = 74/160) followed by elderly aged between 36 and 64 (n = 57/160 and lastly elderly participants (n = 29/160 aged 65 and over) (Table 6.2.1 and Figure 6.2.2). Regarding gender, female participants (n = 107/160) were more than male participants (n = 53/160) (Table 6.2.1 and Figure 6.2.3).

According to Pitso and Lebese (2014), women are given a high representation in the community samples because according to the community leaders, they are the main knowledge-holders and custodians of the major activities of community life. Data was collected by means of interviews which took place in the homesteads of the participants. Most of the participants were found in their respective homes as they were unemployed (Figure 6.2.4). All the interviews were carried out in Venda language because most of the informants were unable to communicate in English. Prior Informed Consent (PIC) was obtained verbally from the participants before the commencement of each interview.

Table 6.2.1: Characteristics of informants (n=160).

Personal Information	N	Percentage (%)
Age (years)		
15 – 35	74	46.3
36 – 64	57	35.6
65 and older	29	18.13
Gender		
Males	53	33.13
Females	107	67
Educational level		
No education	21	13.13
Primary education	40	25
Secondary education	89	55.63
Tertiary education	10	6.3
Work status		
Employed	10	6.3
Unemployed	106	66.3
Self employed	8	23
Retired/Pensioner	36	5

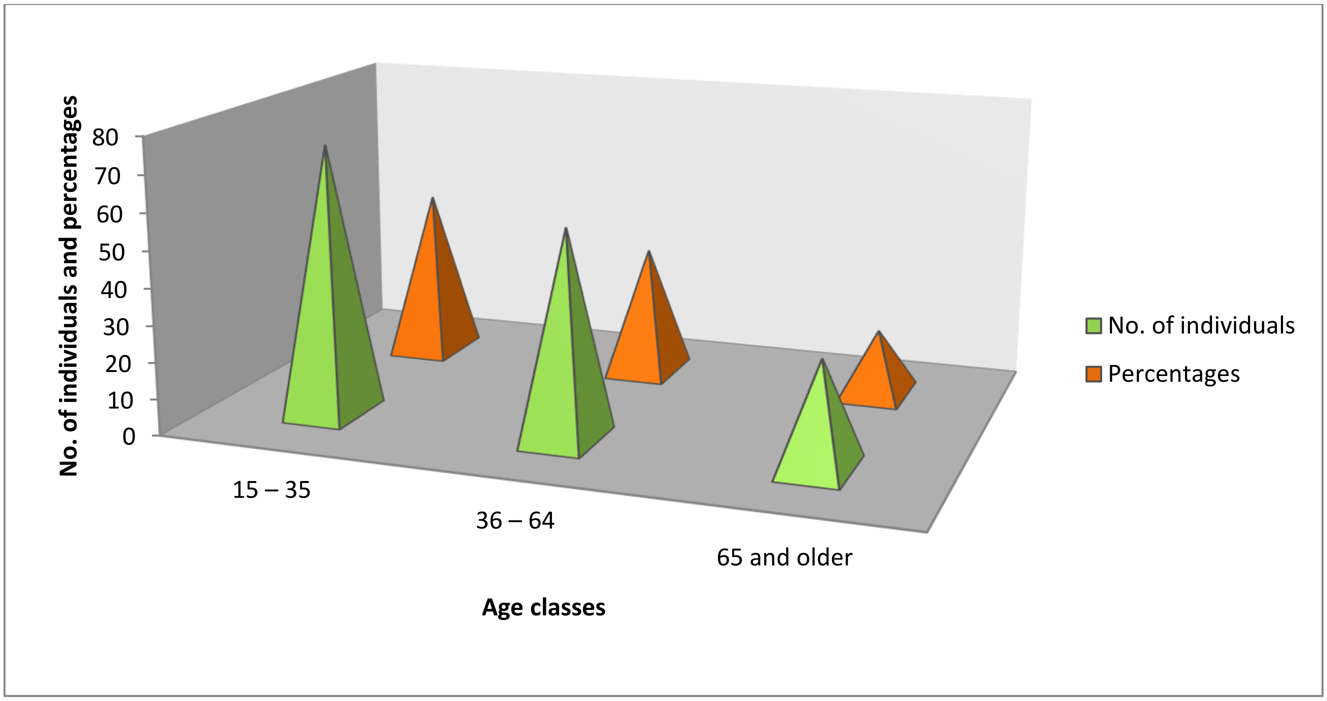

Figure 6.2.2: Different age classes of participants.

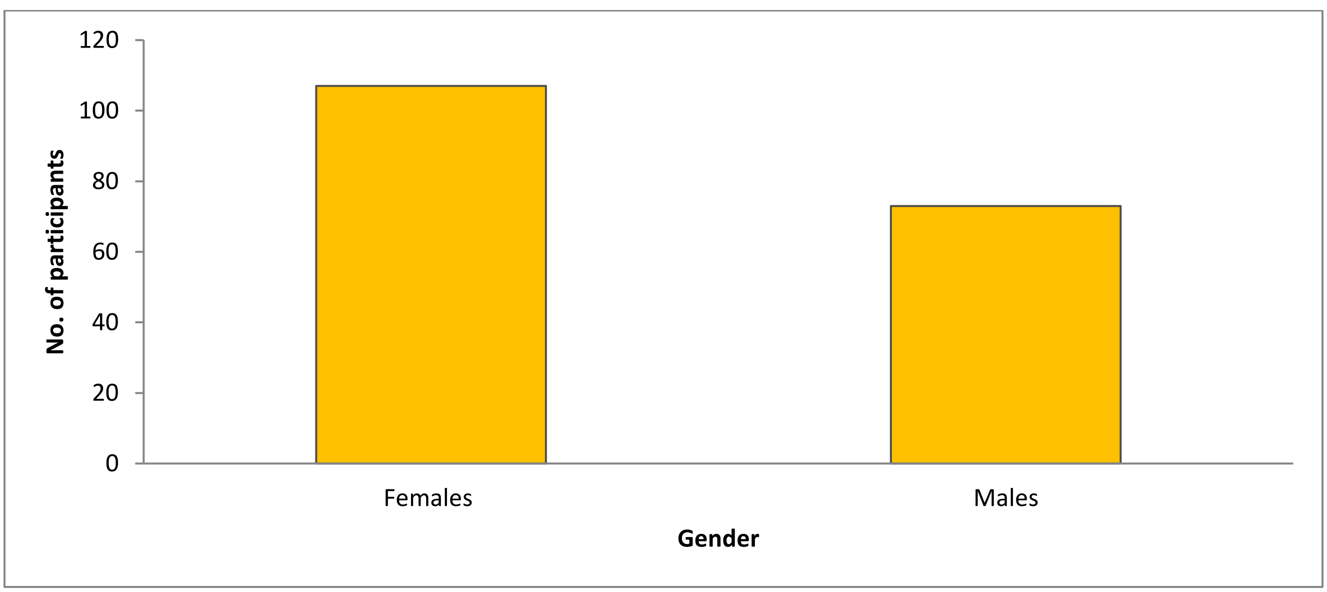

Figure 6.2.3: Number of female participants versus male participants.

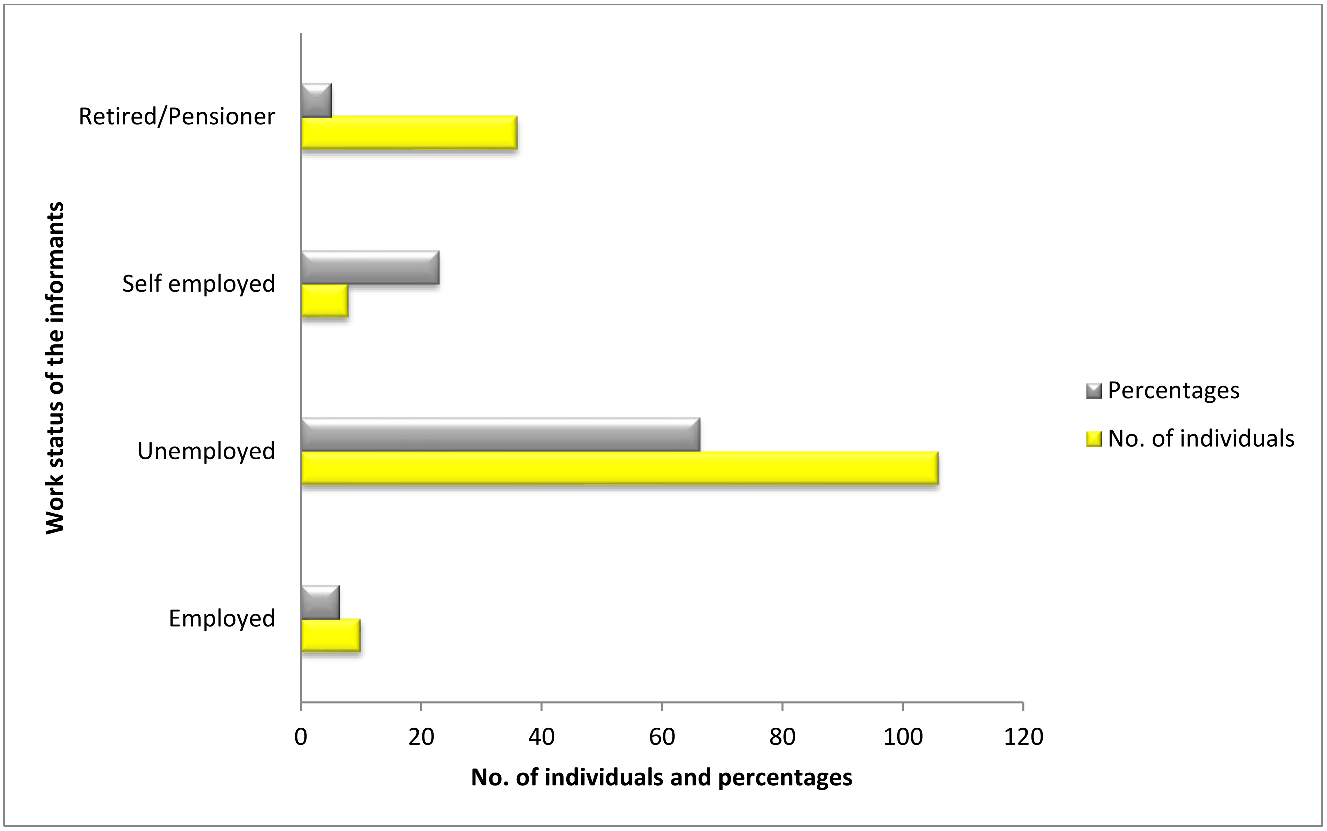

Figure 6.2.4: Employment status of the participants.

Data analysis

Data analysis for qualitative research should apply accurate, logical approaches and usually necessitate content analysis. Content analysis is useful for any research approach, the analysis deals with textual data such as transcripts and field notes (Bachiochi & Weiner, 2004). The results of the current study were obtained from a range of interviews; therefore, the interview data was transformed to produce counts of individuals in different categories such as family, plant parts, habits, taste and mode of consumption. The produced counts were used to calculate percentages and then expressed in the form of graphs.

6.3 RESULTS AND DISCUSSIONS

Taxonomic diversity

The ethnobotanical survey conducted in the Vhembe District revealed a great diversity of the wild edible vegetables with additional uses. A total of 24 species of 20 genera and 15 families have been recorded as wild edible vegetables with additional uses. Out of 15 families inventoried during the research, Cucurbitaceae was shown to be at the top with seven species. Majority of the remaining 14 families had only one species (Amaranthaceae, Urticaceae, Polygonaceae, Solanaceae, Convulvaceae, Pedaliaceae, Araceae, Asclepiadaceae and Asteraceae). Tiliaceae and Malvaceae had two species whereas Fabaceae had 3 species (Figure 6.3.1).

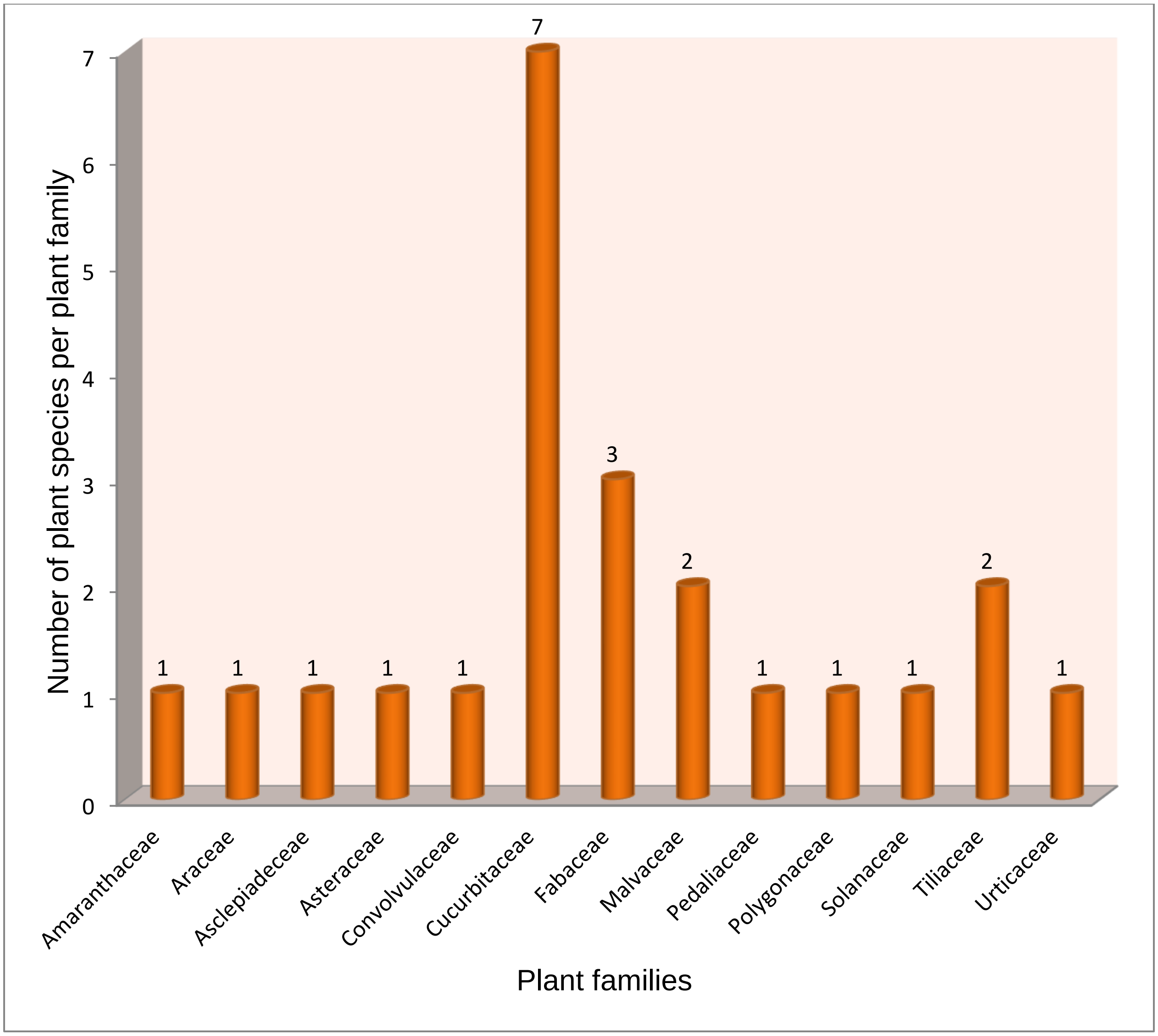

Figure 6.3.1: Number of species per family.

The fact that Cucurbitaceae was found to be at the top in terms of number of species is not astounding. Dansi et al. (2008) documented the use of traditional leafy vegetables in Benin. They indeed found Cucurbitaceae to be amongst the five most important families with 13 species and their results reinforced the significance of the Cucurbits which also prevailed in the Vhembe region of the Limpopo province.

Life forms and parts used

Amongst all recorded wild edibles vegetables, 8 (36%) were herbaceous plants followed by 6 (27%) creepers, 5 (23%) climbers, 2(9%) trees and 1(5%) shrub (Figure 6.3.2). The plant parts were categorized into leaves, seeds, flowers, fruits, corms and root tubers. Of all the recorded plants, leaves of 21 plant species were edible as vegetables followed by fruits (eight plant species), flowers (one plant species), seeds (one plant species), root tubers (two plant species) and finally corms (one plant species) (Figure 6.3.3). One of the aspects considered during the survey was the taste of the vegetables and the study revealed that 63% of vegetables were good tasting, followed by 29% of vegetables with bitter taste and 8% with moderate taste (Figure 6.3.4).

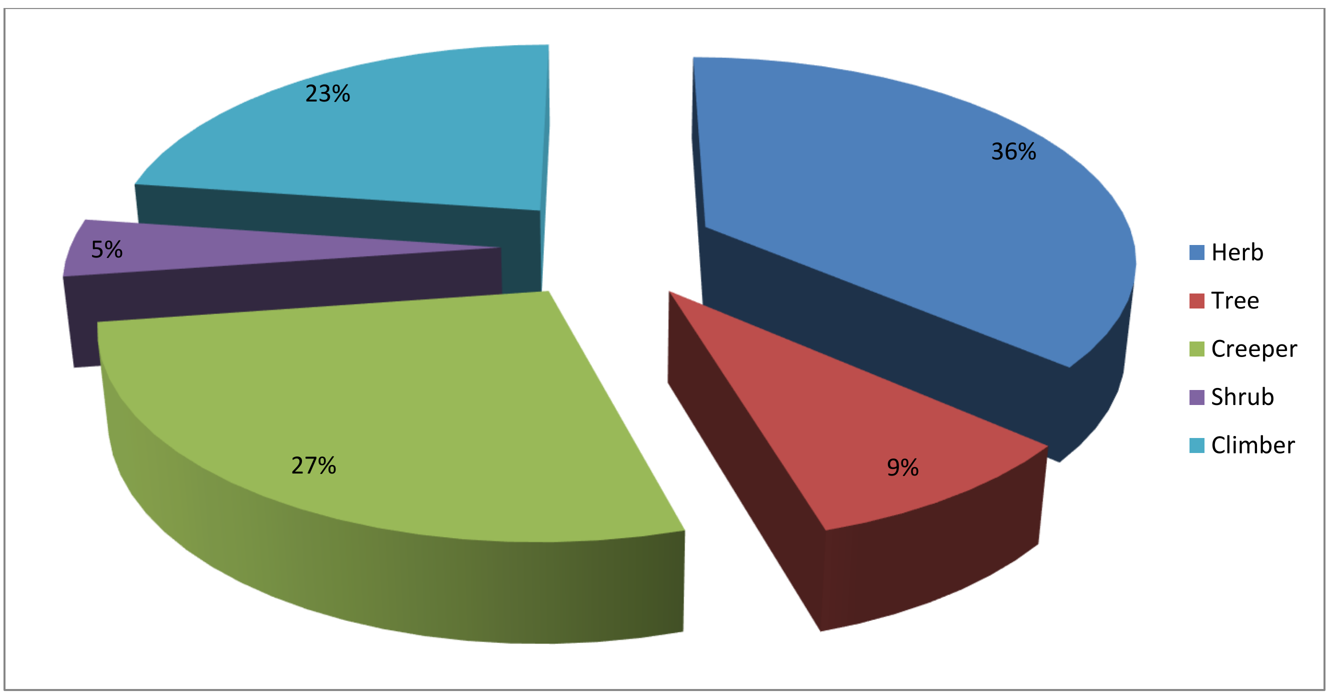

Figure 6.3.2: Percentages of different life forms.

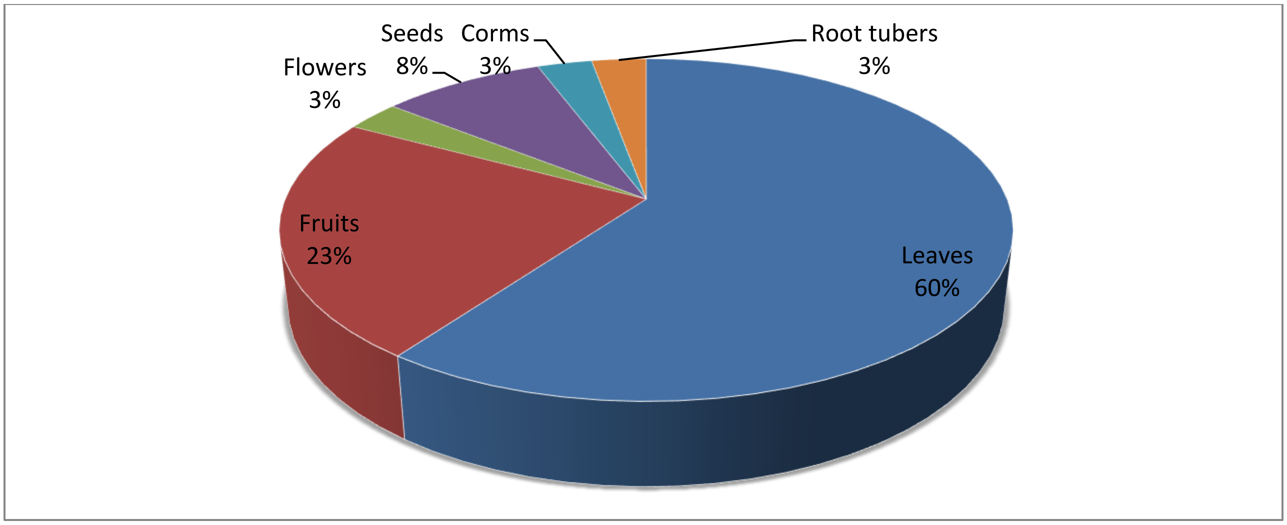

Figure 6.3.3: Percentages of the different edible parts of the wild vegetables

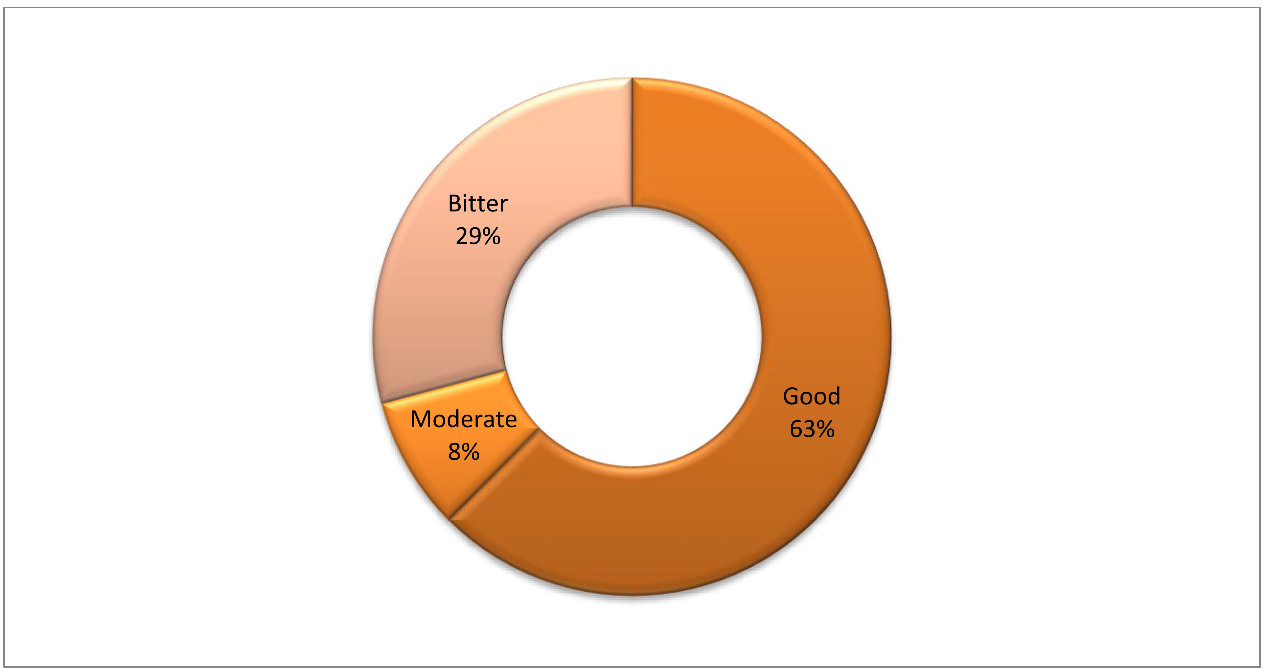

Figure 6.3.4: Percentages of tastes of different wild vegetables.

About 70% of the vegetables with bitter taste belonged to the Cucurbitaceae (that is, 5 species from the overall total of 7 species found in the family).

Table 6.3.1: List of traditional edible vegetables with additional uses.

Family	**Botanical name**	**Local Venda name**	**Life form**	**Parts used**	**Taste**	**Mode of consumption**
Amaranthaceae	*Amaranthus dubius* C. Mart ex Thell	Vowa	Herb	Leaves	Good	Young shoots and leaves can be cooked alone or mixed with other vegetables such as *Cloeme gynandra* to make potherb.
Aracea	*Colocasia esculenta* (L.) Scott	Mufhongwe	Herb	Leaves and corm	Good	The corm and the leaves are both harvested and used as a delicious vegetable.

Family	**Botanical name**	**Local Venda name**	**Life form**	**Parts used**	**Taste**	**Mode of consumption**
Asclepiadaceae	*Pentarrhinum inspidum* E. Mey	Phulule	Climber	Leaves	Good	The leaves are collected and cooked by boiling to make potherb that supplement the maize porridge.
Asteraceae	*Bidens pilosa* L.	Mushidzhi	Herb	Leaves	Moderate	Leaves are harvested and consumed as vegetable.

Family	Botanical name	Local Venda name	Life form	Parts used	Taste	Mode of consumption
Convolvulaceae	*Ipomoea batatas* (L.) Lam	Murambo	Creeper	Leaves and Root tuber	Good	Tender leaves ae comsumed as vegetable and tubers are also cooked and consumed as side dish.
Cucurbitaceae	*Citrullus colocynthis* L.	Mutshatsha	Creeper	Leaves	Bitter	Leaves are cooked and consumed as vegetable.
Cucurbitaceae	*Momordica charantia*	Tshibavhe	Climber	Leaves	Bitter	Leaves are cooked with other vegetables to serve as spice. Others mix it with meat.

Family	Botanical name	Local Venda name	Life form	Parts used	Taste	Mode of consumption
Cucurbitaceae	*Lagenaria siceraria*	Muphapha	Creeper	Leaves, seeds and fruits	Good	Leaves are mixed with herbs like Delele to make a delicious potherb while fruits are cooked separately to serve as side dish. Seeds of matured fruits are fried and consumed as snack.
Cucurbitaceae	*Momordica balsamina*	Lugu	Climber	Leaves	Bitter	Leaves are cooked with other herbs like Delele and phuri to serve as spice with its bitter taste.

Family	Botanical name	Local Venda name	Life form	Parts used	Taste	Mode of consumption
Cucurbitaceae	*Cucurbita pepo* L.	Phuri	Creeper	Leaves, Flowers, Seeds and Fruits	Good	Tender leaves are collected and cooked with Delele and Nngu to make a delicious potherb. Sometimes the leaves, flowers and young fruits are mixed with ground peanuts to make a vegetable dish called *bovhola.* Seeds of ripe fruits are dried and fried to be eaten as snack. Mature fruits are mixed with maize meal to make *thophi.*

Family	Botanical name	Local Venda name	Life form	Parts used	Taste	Mode of consumption
Cucurbitaceae	*Citrullus lanatus*	Muvani	Creeper	Leaves, Seeds and Fruits	Bitter	Tender leaves are consumed as vegetables. Ripe fruits are edible.
Cucurbitaceae	*Momordica foetida* Schumach	Nngu	Climber	Leaves	Bitter	Leaves are cooked with other herbs like delele and phuri to serve as spice with its bitter taste.
Cleomeceae	*Cleome gynandra*	Murudi	Herb	Leaves	Bitter	Tender stems and leaves are cooked and consumed as potherb.
Fabaceae	*Vigna subterranea*	Phonda	Herb	Fruits	Good	Ripe underground fruits are cooked and consumed as snack.

Family	Botanical name	Local Venda name	Life form	Parts used	Taste	Mode of consumption
Fabaceae	*Arachis hypogaea*	Muduhu	Herb	Fruits	Good	Ripe underground fruits are cooked and consumed as snack. Dried fruits are ground to serve as condiment. Dried fruits are mixed with samp and fruits of *Vigna unguiculata* as well as fruits of *Vigna subterranea* to make *Tshidzimba.*
Fabaceae	*Vigna unguiculata* (L.) Walp	Munawa	Creeper	Leaves and Fruits	Good	Young fresh leaves are harvested, cooked and consumed as potherb.

Family	Botanical name	Local Venda name	Life form	Parts used	Taste	Mode of consumption
Malvaceae	*Adansonia digitata* L.	Muvhuyu	Tree	Leaves and Fruits	Good	Young tender leaves serve as vegetable and the powdered ripe fruits are used to thicken milk.
Malvaceae	*Abelmoschus esculentus* (L.) Moench	Delele Mandande	Herb	Leaves and Fruits	Good	Leaves are cooked with other vegetables to enhance the tender texture and then consumed as potherb. Fruits are also consumed as potherb.
Pedaliaceae	*Dicerocaryum zanguebaricum*	Museto	Herb	Leaves	Good	Fresh leaves are consumed as potherb.

Family	**Botanical name**	**Local Venda name**	**Life form**	**Parts used**	**Taste**	**Mode of consumption**
Polygonaceae	*Oxygonum dregeanum* Meisn	Tanyi	Herb	Leaves	Moderate	Leaves are combined with vowa to be consumed as potherb.
Solanaceae	*Solanum retroflexum* Dunal	Muxe	Herb	Leaves	Bitter	Leaves are mixed with vowa and consumed as vegetable dish.
Tiliaceae	Grewia occidentalis L.	Mulembu	Shrub	Leaves	Good	Leaves are cooked and consumed as potherb.
Tiliaceae	*Corchorus tridens* L.	Delele	Herb	Leaves	Good	Leaves and young shoots are harvested and consumed as vegetable.
Urticaceae	Obetia tenax (N.E. Br.) Friis	Muvhazwi	Tree	Leaves	Good	Young and old leaves are consumed as vegetable.

Various uses of the traditional edible vegetables are listed below. New uses mentioned during the research are written in bold.

Figure 6.3.5: A picture showing *Amaranthus dubius* Mart. Ex. Thell.

Family name : Amaranthaceae
Species name : *Amaranthus dubius* Mart. Ex. Thell
Vernacular name : Vowa

Uses obtained during the survey	Uses reported by other researchers
***Vowa* is known by VhaVenda to make *khongodoli* (first food of a new born). Main stem is processed mostly by women to make the cooking soda.**	According the findings of the study conducted by Grubben (2004), *Amaranthus dubius* Mart. Ex. Thell is regarded as a subsistence vegetable and also a collected pot herb used in most parts of Africa. Additionally, ethnomedicinal study of plants used in Ethiopia by Sheko ethnic group revealed that *A. dubius* Mart. Ex. Thell can also be used medicinally to treat chest bone fracture in children as well as treating the back bone pain (Giday et al., 2010). Another study conducted in Vhembe region by Mabogo (1990) attest that leaves and shoots of *A. dubius* Mart. Ex. Thell can be collected, dried and burnt to be placed in snuff. When added to snuff it acts as stimulant which enhances flavor.

Figure 6.3.6: Picture showing *Colocasia esculenta* (L.) Schott.

Family name : Araceae
Species name : *Colocasia esculenta* (L.) Schott
Vernacular name : Mufongwe

Uses obtained during the survey	**Uses reported by other researchers**
Respondents of this study were able to mention only the consumption of leaves and corms of *Colocasia esculenta* (L.) Schott.	Even though the medicinal properties of this plant are unknown amongst the respondents of the current study, findings of other researchers such as Prajapati et al. (2011) made *Colocasia esculenta* (L.) Schott to be one of the plants that played pivotal roles in the traditional medicines. As a reinforcement of their arguments, this plant was found to have numerous traditional medicinal uses such as: 1. The use of juice pressed from petioles to arrest arterial hemorrhage. 2. Juice pressed from leaves acts as stimulant or appetizer. 3. Decoction of the peel is given as a folk medicine to cure diarrhea. 4. It is also regarded as purgative because it acts as laxative.

Figure 6.3.7: Picture showing *Pentarrhinum insipidum* E. Mey.

Family name : Apocynaceae
Species name : *Pentarrhinum insipidum* E. Mey
Vernacular name : Phulule

Uses obtained during the survey	Uses reported by other researchers
To strengthen the baby if the mother sleeps with the father before 7 months elapsed. The whole body of the child except the neck and the head is bathed.	Leaves are used as vegetable (Magwede, 2019). Review conducted by Welcome and Van Wyk (2019) revealed that stem, leaves and fruits of this plant are used as snack and vegetable; snack, vegetable and flavourant; snack and vegetable respectively.

Figure 6.3.8: A Picture of *Bidens Pilosa* L.

Family name : Asteraceae
Species name *: Bidens pilosa* L.
Vernacular name : Mushidzhi

Uses obtained during the survey	Uses reported by other researchers
Leaves are crushed and the liquid is used to cure the earache in children. The crushed leaves of *Bidens pilosa* are also used to cure pimples of cuts.	The fresh or dried shoots and young leaves are eaten in some cultures. The whole plant is used as the host and vector of harmful parasites such as root knot nematodes (*Meloidogyne* species) and tomato spotted wilt virus (GISD, 2010)

Figure 6.3.9: A Picture of *Ipomoea batatas.*

Family name : Convolvaceae
Species name : *Ipomoea batatas*
Vernacular name : Murambo

Uses obtained during the survey	Uses reported by other researchers
The consumption of root tubers is very common than that of leaves. The root tubers are sometimes used to replace the butternut during the special events when rice is cooked as the source of starch.	*Ipomoea batatas* was mentioned to have capabilities of curing boils and wounds and can also be antimicrobial (Ogulensi et al., 2010)

Figure 6.3.10: A Picture of *Mormodica charantia* L.

Family name : Cucurbitaceae
Species name : *Mormodica charantia* L.
Vernacular name : Lugu

Uses obtained during the survey	Uses reported by other researchers
Leaves are used medicinally to treat and prevent the abnormal levels of the blood pressure.	Ananya and Raychaudhun (2010) attested that *Mormodica charantia* L. can be considered as an alternative therapy for lowering blood glucose levels in patients with diabetes.

Figure 6.3.11: A Picture of *Momordica balsamina* Wall.

Family name : Cucurbitaceae
Species name : *Momordica balsamina* Wall*.*
Vernacular name : Tshibavhe

Uses obtained during the survey	Uses reported by other researchers
Most of the citations which outlined this plant to have medicinal potentialities, emphasized that it can be used as a perfect blood pressure controller. Furthermore, other participants mentioned that it is also **a good treatment for hangover** and diabetes.	*Mormodica balsamina* L. is highly ranked as the most important medicinal and nutritional plant of the family Cucurbitaceae (Thakur et al. 2009). They found the reason to be that *Mormodica balsamina* possess active compounds that are anti-bacterial, antidiabetic, anti-diarrheal, anti-HIV, anti-viral, anti-inflammatory and hepatoprotective (Thakur et al., 2009).

Figure 6.3.12: A Picture of *Momordica foetida* Schumach*.*

Family name : Cucurbitaceae
Species name : *Momordica foetida* Schumach
Vernacular name : Nngu

Uses obtained during the survey	Uses reported by other researchers
The edible leaves are used to control the blood pressure. Boiled leaves are used to cure sore throat.	Leaves are cooked with leaves of pumpkin and serve as a side-dish and is eaten by women (Burkil, 2004). Furthermore, Burkil (2004) reported the fruit pulp to be poisonous to ants, moths and weevils, therefore people use this as insect repellent. Leaves of *Mormodica foetida* can also be used medicinally to prevent inflammation that results from cobra's spitting (Burkil, 2004). On the other hand, Ruffo et al. (2002) use the liquid from the crushed leaves to treat earache.

Figure 6.3.13: A Picture of *Langenaria siceraria* (Mol.) Standl.

Family name : Curcubitaceae
Species name : *Langenaria siceraria* (Mol.) Standl.
Vernacular name : Muphapha

Uses obtained during the survey	Uses reported by other researchers
Consumption of leaves lessens the period pains. Fruits are dried and processed to make different kitchen utensils.	The fact that *Lagenaria siceraria* (Mol.) Standl. was mentioned by some of the participants to have potentialities of easing period pains is in concurrence with findings from other researches. For example, Shah et al. (2010) reported this plant to have medicinal properties to treat ailments such as severe pains, ulcers and fever. It was mentioned that syrup prepared from the tender fruits can be used for pectoral cough, asthma and other bronchial disorders (Shah et al., 2010). *Lagenaria siceraria* (Mol.) Standl. is not a stand-alone plant in terms of medicinal capabilities; other many vegetables inventoried during the survey showed some potentials of medicinal vitality for healing many various ailments. As a valuable support of these findings, Rahman (2003) argues that when we consume vegetables, we get proper nutrition to live healthy lifes. Shackleton et al. (2009) found that seeds of this plant are used to cook meatballs in soup or are used to thicken tomato soup or can be used as condiment during the preparations of leafy vegetables.

Figure 6.3.14: A Picture of *Citrullus lanatus*

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Family name : Curcubitaceae
Species name : *Citrullus lanatus*
Vernacular name : Muvani

Uses obtained during the survey	Uses reported by other researchers
Fruits are processed to make juice and jam. **The leaves are bitter and help to lower the blood pressure levels.**	Edible oil that is commonly used for cooking can be obtained from the seeds of *Citrullus lanatus* (Facciola, 1990). According to Moerman (1998), these seeds have been used in America to treat bed wetting.

Figure 6.3.15: A Picture of *Citrullus cycocilis.*

Family name : Curcubitaceae
Species name : *Citrullus cycocilis*
Vernacular name : Mutshatsha

Uses obtained during the survey	Uses reported by other researchers
Fruits are used by local people of the Venda region to prepare the sweet porridge called *thophi*. Additionally, the fruits can be cooked and garnished with other fruits to make jam. Fruits are mixed with leaves of *Vigna unguiculata* (L.) Walp to serve as condiment.	*Citrullus colocynthis* is recorded with most commonly used species for the treatment of diabetes mellitus in traditional medicine (Allali et al., 2008).

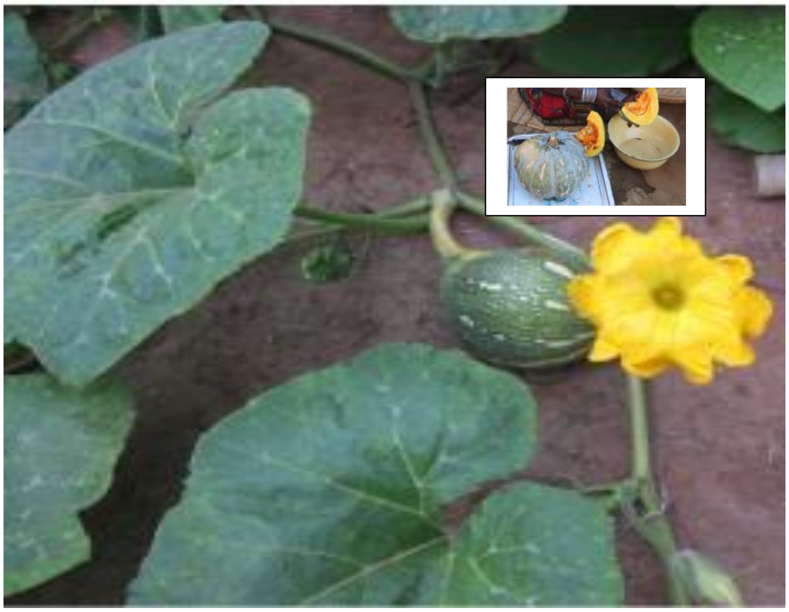

Figure 6.3.16: A Picture of *Cucurbita pepo* L.

Family name : Cucurbitaceae
Species name *: Cucurbita pepo* L.
Vernacular name : Thanga

Uses obtained during the survey	Uses reported by other researchers
Leaves, fruits and flowers are mixed with groundnuts to prepare a delicious potherb called *bovhola*. Ripe fruits are cut, cooked and eaten as snack like shown in the picture below. Some of the cut ripe fruits are slightly dried, boiled in water and finally mixed with maize meal and sugar to form *thopi*.	*Cucurbita pepo* L. has been used much as a medicine in Central and North America. It is regarded as a gentle remedy for a number of complaints, especially as an effective tapeworm remover for children and pregnant women (Chevallier, 1996).

Figure 6.3.17: A Picture of *Cloeme gynandra.*

Family name : Cloemeceae
Species name : *Cloeme gynandra*
Vernacular name : Murudi

Uses obtained during the survey	Uses reported by other researchers
Leaves are eaten as vegetable and at the same help to control the blood pressure.	*Cloeme gynandra* is eaten by breastfeeding mothers to stimulate milk production and regain lost blood during deliverance (Dansi et al., 2008).

Figure 6.3.18: A Picture of *Arachis hypogaea.*

Family name : Fabaceae
Species name : *Arachis hypogaea*
Vernacular name : Muduhu

Uses obtained during the survey	Uses reported by other researchers
Seeds are pulverized and used to garnish other vegetable dishes. The seeds are also mixed with samp and groundnuts to make the Venda traditional food called Tshidzimba.	According to Odugbeni (2008), *Arachis hypogaea* is a well-known antimicrobial plant in Nigeria.

Figure 6.3.19: A Picture of *Vigna subterranean (*L.) Verdc.

Family name	: Fabaceae
Species name	: *Vigna subterranea (*L.) Verdc.
Vernacular name	: Phonda

Uses obtained during the survey	Uses reported by other researchers
People of the Venda region mentioned that they grow *Vigna subterranea (*L.) Verdc. for the consumption of fresh underground fruits. When fresh ones are prepared for consumption, they are normally cooked while still in their coats. They can also be removed from their coats dried and when cooked they will be mixed with samp to prepare a delicious Venda cuisine called *tshidzimba.*	According to Omoikhoje (2008), Bambara groundnut (*Vigna subterranean* (L.) Verdc) is a healthy crop as it is a good source of fiber, calcium, iron, potassium. Additionally, it is also usually found to be high in methionine which is an essential sulfur-containing amino acid. Other researches like the one conducted by Murevanhema and Jideani (2012), it was revealed that Bambara groundnut can be fermented with lactic acid to produce milk which is a probiotic beverage.

Figure 6.3.20: A Picture of *Vigna unguiculata* (L.) Walp*.*

Family name : Fabaceae
Species name : *Vigna unguiculata* (L.) Walp
Vernacular name : Munawa

Uses obtained during the survey	Uses reported by other researchers
Tender leaves and immature pods are consumed as vegetable. Seeds are cooked with samp, groundnuts and peanuts to prepare Venda traditional food called Tshidzimba.	According to Burnham (n.d.) *Vigna unguiculata* (L.) Walp is ranked with very important crop species worldwide. The seeds have deworming as well as diuretic properties and hence promote stomach health. Powdered and burnt seeds are used to alleviate insect bites. Roots are on the other side have medicinal properties and are used to cure snakebites and can also work as medicine for epilepsy, chest pain and dysmenorrhea (Madamba et al. 2006; Bryson & Defelice, 2009).

Figure 6.3.21: A Picture of *Adansonia digitata* L.

Family name : Malvaceae
Species name : *Adansonia digitata* L.
Vernacular name : Muvhuyu

Uses obtained during the survey	**Uses reported by other researchers**
The powdery substance found in fruits is used to thicken milk. Some participants said that they mix the powder with milk and some sweeteners to make yoghurt. The consumption of the leaves alleviates period pains.	*Adansonia digitata* L. regulates women' menstrual cycle and heartbeat (Dansi et al. 2008). According to Jitin et al. (2015) the fruit pulp of *Adansonia digitata* L. can be soaked in water or milk to prepare a refreshing drink. The same liquid can also be used as source for food. Furthermore, fruit pulp is used to cure diseases caused by microbial infestations (Kamatou et al., 2011). On the other side of the world Brendler et al. (2003) found leaves of *Adansonia digitata* L. to be effective against diarrhea, fever, kidney and bladder disorders, blood clearing and asthma.

Figure 6.3.22: A Picture of *Abelmoschus esculentus* (L) Moench.

Family name : Malvaceae
Species name : *Abelmoschus esculentus* (L) Moench.
Vernacular name : Delele mandande

Uses obtained during the survey	Uses reported by other researchers
Respondents of the current study indicated their desire of using both the leaves and young fruits of this plant to prepare relish. Furthermore, they mentioned that it can also be considered as one of the purgative plants because of its mucilaginous properties. Fruits are eaten as vegetable to aid to lessen constipation.	Siemonsma and Kouame (2004) studied the uses of *Abelmoschus esculentus* L) Moench. and revealed a number of important uses which include: 1. Young immature fruits are an important vegetable that can be consumed either cooked or fried. 2. Leaves are sometimes used as cattle feed. 3. Okra mucilage is suitable for medicinal and industrial applications. 4. Finally, the bark fibre has been locally used for fishlines and game traps.

Figure 6.3.23: A Picture of *Grewia occidentalis* L.

Family name : Malvaceae
Species name : *Grewia occidentalis* L.
Vernacular name : Mulembu

Uses obtained during the survey	Uses reported by other researchers
The fruits are sticky and therefore used by men to trap birds**.**	Ripe fruits of *Grewia occidentalis* L. are used to prepare beer in certain areas. Other uses of this species include the use of its wood to make bows and spear shafts (Turner, 2008). In addition, Turner (2008) indicated that the bruised bark can be soaked in water and become useful in treatment of wounds. The powdered bark of *Grewia occidentalis* L. is used as shampoo and it is believed to prevent hair from turning grey. The roots extract is used to help during childbirth (Turner, 2008). Turner (2008) regards *Grewia occidentalis* L. as a “must –have” species in the garden due to its ornamental properties.

Figure 6.3.24: A Picture of *Dicerocaryum senocioides* (Klotzsch) Abels

Family name : Pedaliaceae
Species name : *Dicerocaryum senocioides* (Klotzsch) Abels
Vernacular name : Museto

Uses obtained during the survey	Uses reported by other researchers
Leaves produce a soapy substance that is used as traditional bathing shampoo. The leaves are slippery therefore this characteristic qualifies it to be purgative.	Soaked leaves are frequently used as soap substitute (Mabogo, 1990). He further attested that infusion obtained from the soaked leaf and stem is used fasten the expulsion of the hanging placenta in cattle and humans. Similarly, results achieved from the review of traditional use of medicinal plants in south-central Zimbabwe revealed the use of the whole *Dicerocaryum senocioides* (Klotzsch) Abels to dilate the birth canal as well as the expulsion of the placenta. The prepared plant foam is inserted into vagina to dilate birth canal (Maroyi, 2013).

Figure 6.3.25: A Picture of *Oxygonum dregeanum* Meisn*.*

Family name : Polygonaceae
Species name : *Oxygonum dregeanum* Meisn
Vernacular name : Muthanya

Uses obtained during the survey	**Uses reported by other researchers**
Oxygonum dregeanum Meisn is a plant that was mentioned to have potential of controlling the blood pressure level.	Leaves of this plant are used as vegetable and flavourant (Maanda & Bhat, 2010).

Figure 6.3.26: A Picture of *Solanum retroflexum* Dunal.

Family name : Solanaceae
Species name : *Solanum retroflexum* Dunal
Vernacular name : Muxe

Uses obtained during the survey	Uses reported by other researchers
It is believed to have medicinal properties. Fresh leaves are grinded and squeezed to remove the liquid to be used as earache remedy in children. The same liquid is used to cure pimples or cuts.	*Solanum retroflexum* Dunal is an annual plant. Its leaves are consumed as vegetable (Maanda & Bhat, 2010). Results of the research conducted by Magwede et al. (2019) revealed that the leaves of this plant possess medicinal properties and whereas fruits are edible.

Figure 6.3.27: A Picture of *Corchorus tridens.*

Family name : Malvaceae
Species name : *Corchorus tridens*
Vernacular name : Delele

Uses obtained during the survey	Uses reported by other researchers
It is a purgative plant that is trusted to loosen the bowels very quickly.	The leaves are used as vegetable in stews eaten with starchy staple foods, and in soups and sauces (Ruffo et al., 2002). Isaiah et al*.* 2016 attest the decoction of the root and leaves are used for ailments such as fever, genital ulcers and to prevent Anemia. The study also alluded to the significant antimicrobial activity of the leaf ethanol extracts of *Corchorus tridens* L.

Figure 6.3.28: A Picture of *Obetia tenax* (N. E. Br.) Friis.

Family name : Urticaceae
Species name : *Obetia tenax* (N. E. Br.) Friis
Vernacular name : Muvhazwi

Uses obtained during the survey	**Uses reported by other researchers**
It is used as a purgative plant.	The bark of this plant has a very strong fibre which is used to make tough cords, ropes, nets and mats (Brink, 2009). The bark can also be used for thatching. Other parts of *Obetia tenax* (N. E. Br.). Friis are also indispensable, for example, the root pulp is applied on snakebites (Neuwinger, 2000; Shackleton et al., 1998).

6.4 CONCLUSIONS

Majority of additional uses mentioned in the survey were of health boosting by enhancing immunity against various diseases and infections. Results of the research conducted in the northern part of the KwaZulu- Natal province had shown 42% of the traditional leafy vegetables surveyed to have medicinal value (Ntuli et al., 2012). Our findings support this and propose the awareness of medicinal properties of wild vegetables may enhance their re-acceptance as crucial part of human diets.

In addition to mostly cited medicinal use of wild edible vegetables, some vegetables had ornamental and cultural uses. The results of this study appear to bring forward recommendations of further researches which will be worthwhile. For example, further studies can focus on the production of pharmaceutical drugs from these precious plants. It is also anticipated that this initiative will foster smaller industries based on indigenous products which in future can grow to compete locally and internationally.

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Chapter 7

INDIGENOUS PREPARATION AND PRESERVATION METHODS OF SELECTED TRADITIONAL EDIBLE VEGETABLES OF THE VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA.

This chapter is published in Indilinga.

ABSTRACT

Wild edible plants especially vegetables have been utilized by indigenous communities since time immemorial. Vhavenda people situated in the Vhembe District Municipality in the northern part of South Africa are no exception in the utilization of indigenous wild edible vegetables. This report is based on the study which was conducted to determine the indigenous or traditional preparation and preservation methods of selected wild edible vegetables. A total of 160 respondents of different ages were consulted and interviewed through semi-unstructured interviews. A total of 46 traditional edible vegetables was listed during the current survey. Ten mostly cited vegetables were then considered for the purpose of this report. Results on the preparation methods of the selected vegetables revealed that locals prefer dishes of combined vegetables (for example, Cloeme gynandra and Amaranthus dubius). Leaves were mentioned to be the mostly used parts as compared to other plant parts like fruits, flowers, corms and tubers. In some preparation methods, all edible parts can be mixed together to make a delicious relish to accomplished maize-based diets *of the respondents. An example of the Vhavenda cuisine prepared from most edible parts is bovhola which is prepared from leaves, flowers, fruits of Curcubita pepo and leaves of Momordica foetida or Momordica charantia. Further study to determine the nutritional values of the prepared Venda cuisines is recommended.*

***Keywords**: Wild edible vegetables, Vhavenda, Vhavenda cuisines, Respondents, Semi-unstructured interviews.*

7.1 INTRODUCTION

Wild edible vegetables have been utilized as food since time immemorial by native people all over the world. Vhavenda people situated in Vhembe District Municipality in the northern part of South Africa are no exception in the utilization of wild edible vegetables. Apart from being consumed as food, most wild plants including vegetables are believed to also have medicinal properties. For example, *Momordica balsamina* L. was mentioned by many researchers to have potential of curing high blood pressure and diabetes (Shackleton, 2003; Modi et al., 2006; Jansen van Rensburg et al., 2007; Vorster et al., 2007; Vorster et al., 2008).

The wild edible plants are very beneficial to the inhabitants of the poor rural villages for many other reasons. Three reasons worth of noting are 1) wild edible plants can grow near villages no matter what part of the world the village is; 2) many wild edible plants were tested to be highly nutritious; 3) they also allow native communities to be food secured (Nesamvuni et al. 2001). Food security is defined as the state where all people have access to enough safe and nutritious food to meet their dietary needs. In actual fact, food must allow consumers an active healthy life (FAO, 2009).

In many sections of the rural areas, people traditionally harvest wide range of leafy vegetables, root tubers, fruits, flowers and rhizomes from the wild because of their taste, cultural practices, as food supplements or as an aid to ease situations over food shortage

(Mahapatra et al., 2012). Additionally, Guinand and Dechassa (2000) argued that wild plants were recognized to have the potential to satisfy the needs on household food security. Foods processed from these plant parts are distinctive in taste, appearance and ingredients (Tangkanakul & Trakoontivakorn, 2014). Native communities have a unique indigenous knowledge system for different food preparation methods of traditional or local cuisines. Cautiously, local communities have long had a significant interdependence relationship with their immediate environment. They are utilizing natural resources in a thoughtful manner considering the crisis of food insecurity. This paper specifically reports on preparation methods of indigenous/traditional wild edible vegetables of the Vhembe District Municipality.

7.2 MATERIAL AND METHODS

Field work of the current study was conducted over a period of twelve months from June 2015 – June 2016.

Study area

The current study was conducted in the Vhembe District Municipality of the Limpopo province, South Africa. Vhembe District covers about 2771 km^2 and has an average altitude of 400 m above mean sea level (Lombard et al., 2006). Vhembe District Municipality lies between 22°56´S and 30°28´E (LSOER, 2004). It is divided into four local municipalities namely: Makhado, Mutale, Musina and Thulamela (Figure 7.2.1 a and b).

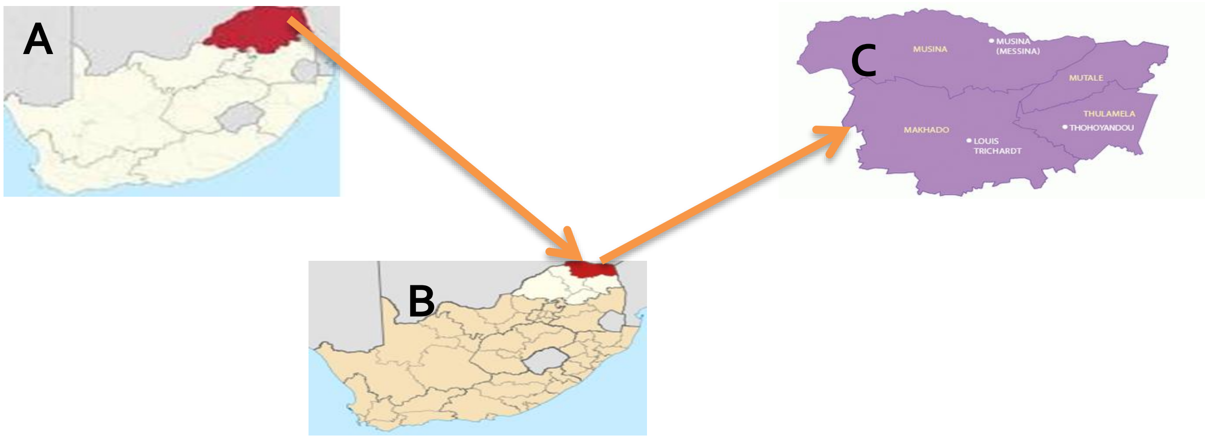

Figure 7.2.1 a: Maps A, B and C showing the Limpopo Province from South Africa, Vhembe District Municipality and its local municipalities. (Limpopo State of the Environment Report [LSOER] 2004)

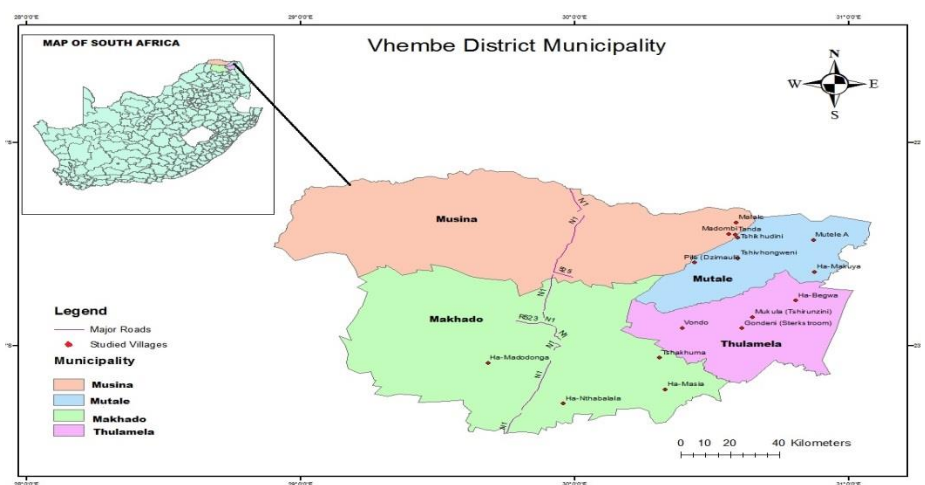

Figure 7.2.1 b: Geographical locations of the villages per local municipalities.

Data collection

This survey consisted of two phases of which collection of the ethnobotanical data was done during the first phase. This data was gathered through semi-structured interviews where 160 participants were interviewed. The questionnaire forms with a list of questions were given to participants. The main reason for using questionnaires with similar questions was to obtain comparable data for analysis (Bartolotto et al., 2015). Some of the questions asked during the interviews were indigenous knowledge about the wild edible vegetables and their various uses. This research involved participants of different ages as well as different genders (Figure 7.2.2 and Figure7.2.3). Most of the participants were youth aged between 18 and 35 (Figure 7.2.2) followed by adults aged between 36 and 60 (Figure 7.2.2) and adults of ages 61 and above (Figure 7.2.2). Regarding gender of the participants, females were found to be more than males (Figure 7.2.3). The aspect of employment was explored from all participants and it was found that most of the youth members were unemployed.

The second phase of the survey looked at the aspect of preparation and preservation methods of wild edible vegetables wherein two female participants who managed to mention 90% of the wild edible vegetables were considered. Special visits to their households were done where the wild vegetables preparation and preservation procedures were viewed. Interviews for both phases were carried out in Tshivenda language to cater for informants since they were unable to communicate in English.

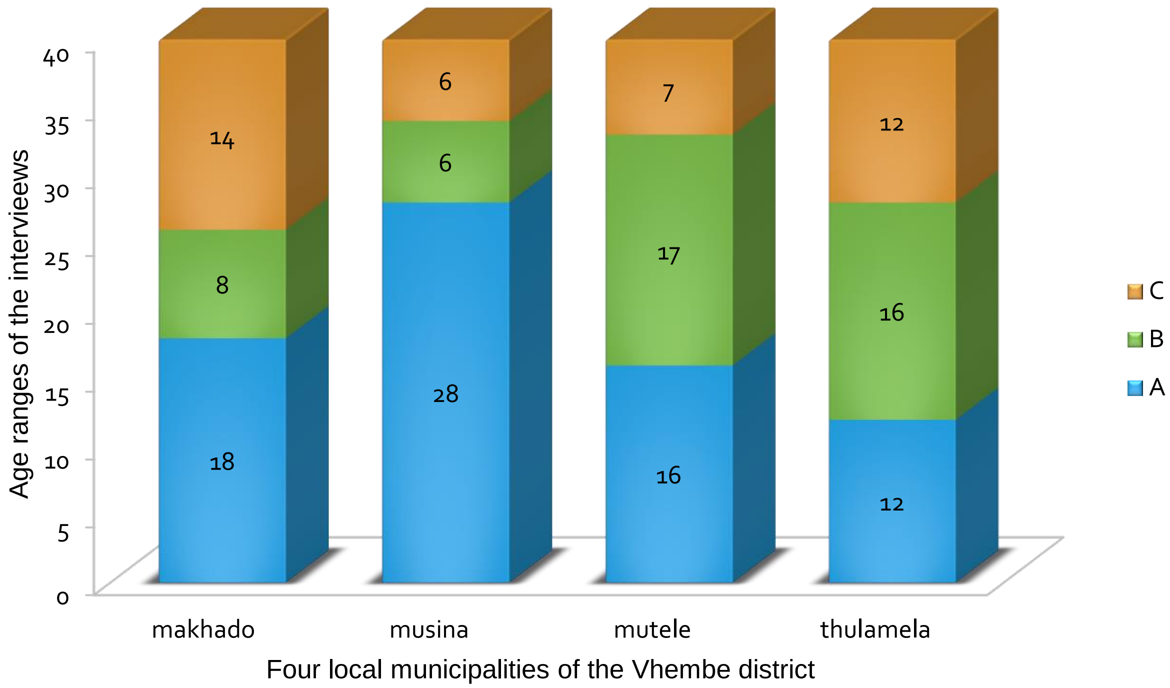

Figure 7.2.2: Age ranges of interviewees of the four local municipalities of the Vhembe District. A= (ages between 18 and 35), B = (ages between 36 and 60) and C = (ages > 61).

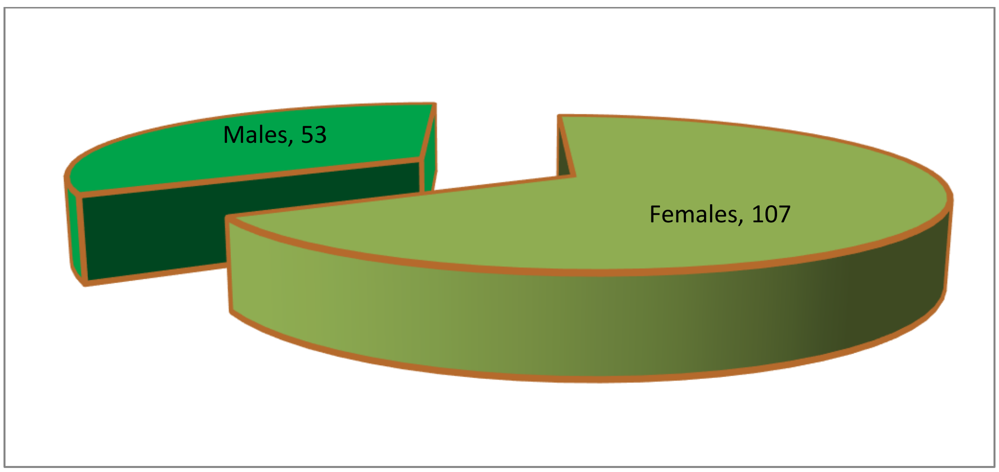

Figure 7.2.3: Gender of the informants of the survey.

7.3 RESULTS AND DISCUSSIONS

Taxonomic diversity

A total of 46 tradional edible vegetables was recorded and identified. However, for this report, top ten species with high frequency of citation calculated following Madikizela et al. (2010) were considered. The top ten plants belonged to six different families where Amaranthaceae had three species followed by Cloemeceae and Cucurbitacea with two species each and Asteraceae, Fabaceae and Convolvuceae with one species each. A comprehensive list of ten mostly mentioned wild edible vegetables for this study is shown in table1.

Edible plant parts

The edible plant parts of the listed wild vegetables belonged to five broad categories, namely: leaves, fruits, tubers, flowers and seeds. Amongst the five mentioned categories, leaves were found to be predominantly consumed, followed by fruits and flowers, tubers and seeds (Figure 7.3.1).

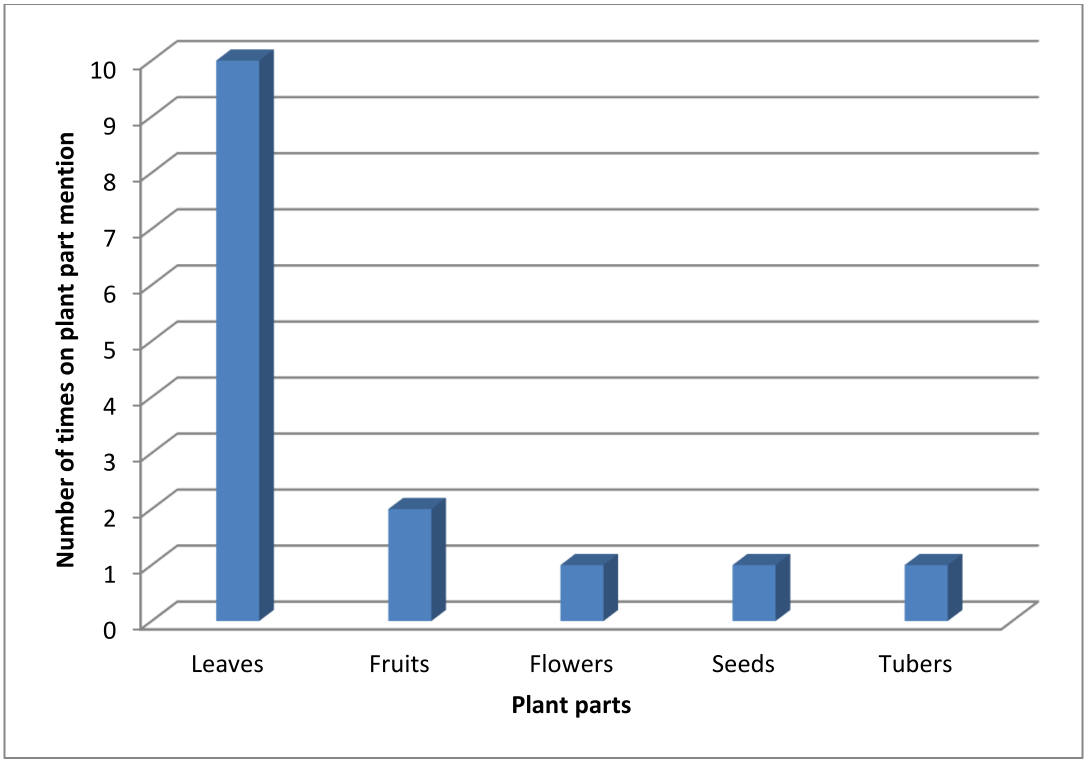

Figure 7.3.1: Frequency of use of five different parts of wild edible vegetables.

In support of the findings of the current survey, Musinguzi et al. (2006) demonstrated utilization of leafy vegetables by over 80% of his survey's respondents. It was apparent from the respondents of the current study that some plant parts such as flowers, tubers and seeds are utilized mostly as accompaniments or as food snacks. The fact that such parts are mostly used by people of the Vhembe District Municipality is not a coincidence because Musinguzi et al. (2006) also found that indigenous fruits of the Rukungiri District of Uganda are mainly used as food in the form of snack.

Informants' employment status versus wild vegetables usage.

Unemployment rate of the informants was found to be very high as compared to the employment rates. This situation then compelled the use of traditional or wild edible vegetables. Vorster et al. (2007) argued that in winter food prices are inflated in a way that unemployed citizens are faced with serious hunger. They then highlighted the importance of the use of dried wild vegetables which will be of great help to the unemployed residents.

Table 7.3.1: List of selected traditional edible vegetables of the Vhembe District Municipality.

Family/ species name	Local name(s)	Life form	Part used	Frequency of citation	Mode of storage
Amaranthaceae *Amaranthus dubius* C. Mart ex Thell.	Vowa	Herb	Leaves	56.9	Leaves are sun dried
Amaranthaceae *Amaranthus hydridus* L.	Thebe	Herb	Leaves	47.2	Leaves are collected and sun dried
Amaranthaceae *Amaranthus Spinosus* L.	Mukhuluvhali	Herb	Leaves	30.1	Leaves are sun dried
Asteraceae *Bidens pilosa* L	Mushidzhi	herb	Leaves	50.6	Leaves are cooked and sun dried
Curcubitaceae *Mormodica foetida* Schumach	Nngu	Climber	Leaves	34.4	Leaves are collected cleaned to removed soil and sun dried

Family/ species name	**Local name(s)**	**Life form**	**Part used**	**Frequency of citation**	**Mode of storage**
Curcubitaceae *Curcurbita pepo* L.	Phuri	Creeper	Leaves, Flowers, Seeds and Fruits	38.1	Leaves, flowers and fruits are cooked and sun dried
Cloemeceae *Cloeme monophylla* L.	Mutohotoho	Herb	Leaves	32.4	Leaves are cooked and sun dried
Cloemeceae *Cloeme gynandra* L.	Murudi	Herb	Leaves	34.7	Cooked and sun dried
Convolvulaceae *Ipomoea batatas* (L.) Lam	Murambo	Creeper	Leaves and tubers	19.6	Leaves are collected and sun dried
Fabaceae *Vigna unguiculata* (L.) Walp.	Munawa	Creeper	Leaves and fruits	44.1	Leaves are cooked with Curcubita pepo fruits and sun dried

Preservation methods

Fifty percent of the studied wild vegetables were found to be preserved by sun drying while the preservation of the remaining half was through cooking and sun drying (Figure 7.3.2). The fact that Vhavenda use the sun drying methods as their way of preserving wild edible was supported by Legwaila et al. (2011) where they reported principal method of extending the shelf life of the wild edible vegetables as sun drying fresh leaves or boiling in water before sun drying. Vorster et al. (2007) also mentioned the sun drying of leaves as a way of preserving wild edible vegetables for future use.

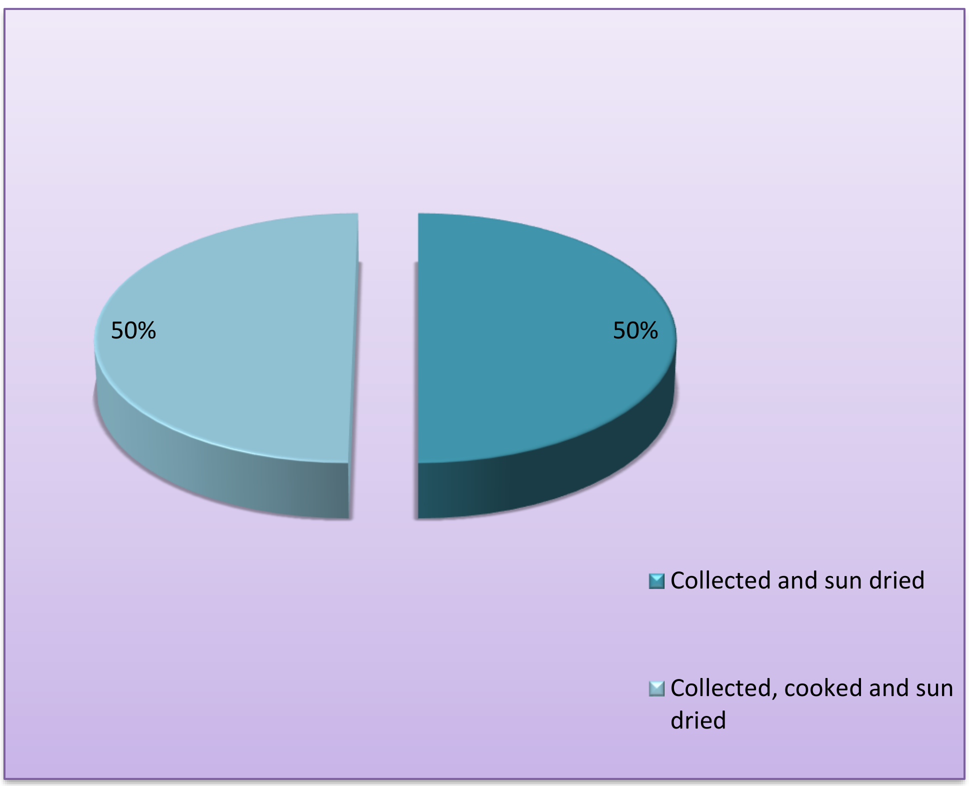

Figure 7.3.2: Preservation methods of the ten selected wild edible vegetables.

Wild edible vegetables that are cooked before sun dried are normally placed on the corrugated iron like the one shown in figure 7.3.3. During the cooking period, fruits of Cucurbita pepo can be added to the leafy vegetables to serve as condiments. Other researchers reported the use of reed mats or sacks to serve as drying surfaces (Nguni, 2007). During the interviews, it was indeed observed that some informants utilize sacks of maize meal as their drying surface. This therefore simply indicates that corrugated iron is not the only drying surface preferred by Vhavenda. Furthermore, some informants even mentioned the use of reed basket or tray which is called "*Luselo*" in Tshivenda.

Figure 7.3.3: A Picture showing VhoEmma arranging her cooked wild vegetable on the corrugated iron for sun drying.

According to results of the current study, informants rely only on sun drying methods; however drying methods are approximately grouped into sun drying, solar drying and mechanized drying (Ochieng et al., 2018) which means three of them can be utilized.

Some preparation methods of the selected wild vegetables consumed by VhaVenda.

For the preparation of selected vegetables, informants acknowledged the use of only one cooking method. This cooking method is boiling of the vegetables of which the period differs from one vegetable to the other. For example, boiling of vegetables like *Amaranthus hydridus* and *Ipomoea batatas* consumes less than 30 minutes whereas the boiling period of vegetables such as *Cloeme monophylla* and *Cloeme gynandra* can even go beyond 60 minutes. Results of the researches conducted by Flyman and Afolayan (2006) and Nguni (2007) in Botswana and Zambia respectively are in full consensus with the results of the current study as they also found *Cloeme gynandra* and *Cloeme monophylla* to take long to cook.

Another unique preparation method attested during the survey is that of the cow pea leaves which are sun dried before being cooked. Alternatively, cow pea leaves can also be blended with the leaves of *Amaranthus hybridus* to improve the texture of the dish. According to Owuor and Olaimer-Anyara (2007), *Vigna unguiculata* can be blended with *Corchorus sp* to enhance the tenderness of the dish. Despite the vegetables blending method to address the issue of texture and taste, informants also recommended collection of young tender leaves of all vegetables for the purpose of minimized cooking periods.

It was also indicated during the survey that wild edible vegetables sometimes prepared individually or as a mixture. The blending of these vegetables depends on people' different choices. Informants were able to give a clear vegetable blending picture by also indicating the reasons for their blending choices (Table 7.3.2). In view of this aspect, it was alluded that their combinations mostly rely on three reasons which include improvement of texture for the rough vegetables, improvement of flavor and the reduction of bitter taste. Informants of this research indicated much of their interest in the consumption of the Vhavenda's favourite cuisine called '*bovhola*". This dish is prepared by mixing the leaves, flowers and fruits of *Cucurbita pepo* as well as the leaves of *Mormodica foetida*. Leaves of *Momordica foetida* are added to enhance the flavour and it is believed that the bitter taste is of medicinal important.

Additionally, to enhance the taste and texture of *bovhola*, ingredients like tomatoes, pounded peanuts, bicarbonate of soda and salt are used (Figure 7.3.5). In this case, peanuts are manually pounded as indicated in figure 7.3.4. On the other hand, the aforementioned parts of *Cucurbita pepo* can be mixed with tender leaves of *Cochorus tridens* to prepare another delicious relish to go with the maize stiff porridge.

Figure 7.3.4: Preparation of powdered nuts.

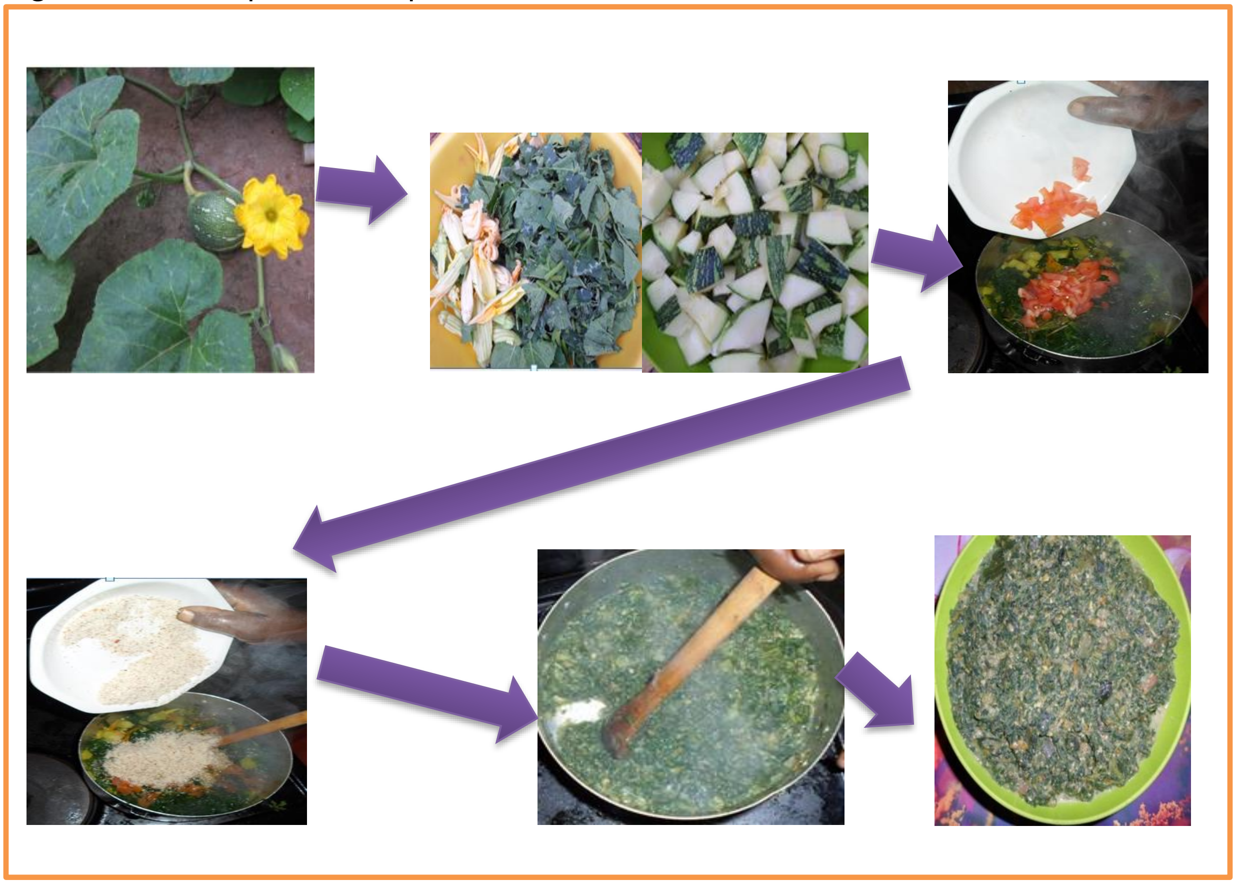

Figure 7.3.5: Preparation of Vhavenda's favourite cuisine *bovhola.*

Table 7.3.2: Different wild vegetables combinations and the motivations of their blendings.

Blending	Reason
***Cucurbita pepo* leaves, fruits, flowers and *Momordica charantia* leaves.**	Improvement of the flavour
Ipomoea batatas* leaves and leaves of *Amaranthus hybridus	Enhancement of the flavour
Leaves of *Bidens pilosa* and leaves of *Amaranthus hybridus*	Reduction of the bitter taste
Leaves of *Cloeme gynandra* and leaves of *Amaranthus hybridus*	Reduction of the bitter taste

Another mostly consumed vegetable dish was found to be that of *Ipomoea batatas* and *Amaranthus hybridus* leaves. Leaves and tubers are the only edible parts of *Ipomoea batatas*. Leaves are mixed with tender leaves of *Amaranthus sp*. to prepare delicious relish as indicated in figure 7.3.6. The tubers can be boiled and be eaten as side dish.

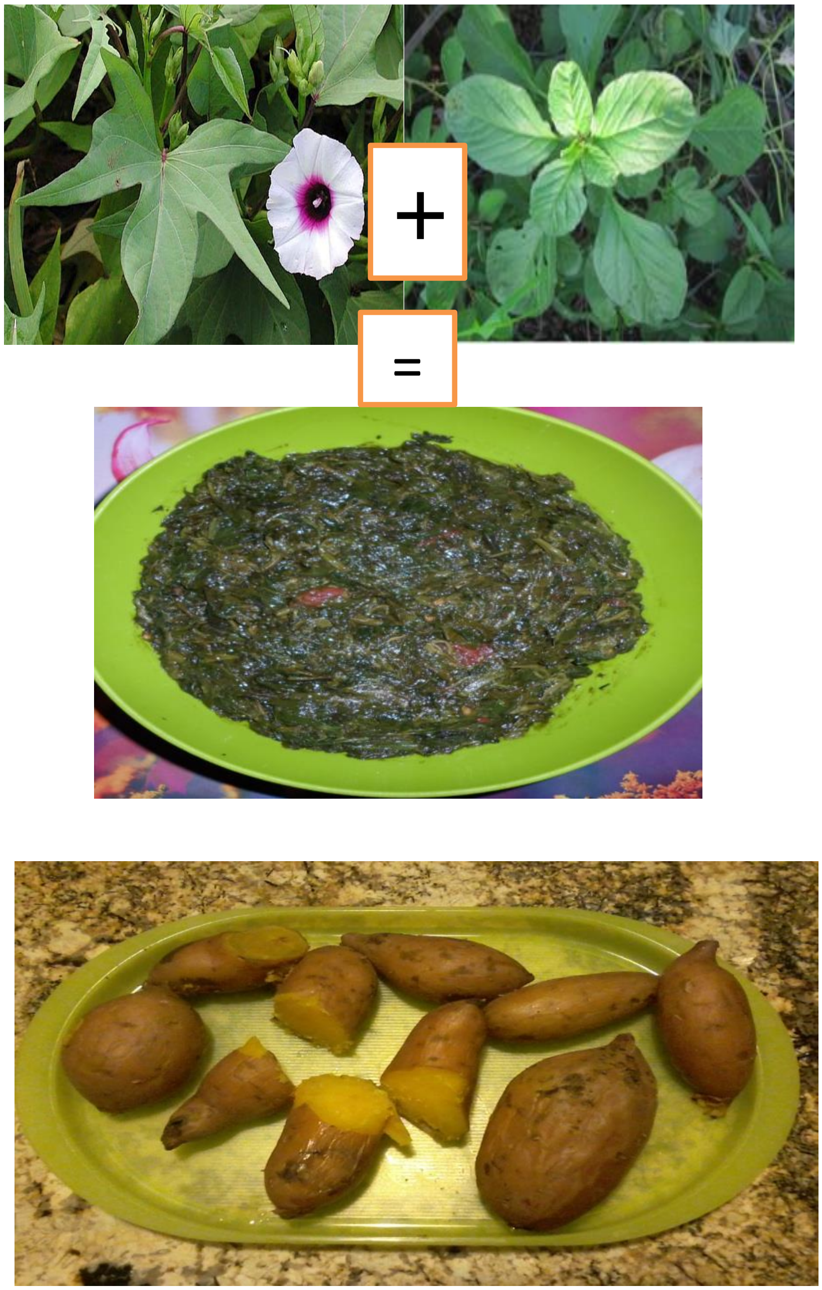

Figure 7.3.6: Relish prepared from leaves of *Ipomoea batatas* and *Amaranthus sp.* and cooked tubers for the side dish.

Almost all mentioned bitter vegetables were blended with *Amaranthus hybridus.* For the purpose of lessening the bitter taste. During our visits in the informants’ households, *Amaranthus hybridus* was also mixed with other wild vegetables like *Cloeme gynandra* and *Bidens pilosa* to prepare favourable Venda cuisines (Figures 7.3.7 and 7.3.8).

Figure 7.3.7: Relish prepared from *Cloeme gynandra* and *Amaranthus sp*.

Figure 7.3.8: Relish prepared from *Bidens pilosa* and *Amaranthus sp*.

7.4 CONCLUSIONS AND RECOMMENDATIONS

The current study revealed that the selected wild edible vegetables are utilized in different levels. The study has emphasized the importance of preservation of wild edible vegetables as most of them are seasonal. Another important issue raised as a reason for the preservation of these vegetables is that they serve as available food for the unemployed people of the district during times of food scarcity. The study also showed VhaVenda people using sun drying as the only preservation method. There is therefore a need for the improvement of the drying process as the hygienic cautions are supposed to be considered (Nguni, 2007). In view of this, the use of solar dryers (tray dryers) can be tried (Nguni, 2007). Furthermore, James and Matemu (2016) encourage the use of solar dryers as they enhance retention of micronutrients in the dried products which are obviously lost if the sun drying method is used. Another advantage of solar drying method is the shelflife longevity of the dried products. Ochieng et al. (2018) emphasise the advantages of solar drying methods by indicating that foods are dried in shade with the availability of high temperatures and low humidity to fasten the drying rate, thus retaining more nutrients and reducing moisture content.

The study further highlighted the priority wild edible vegetables that can be made available to the users throughout all seasons. Another way of guaranteeing their availability can be through cultivation. Cultivation of these vegetables can add an advantage to the creation of employment to the unemployed youth members of our society. If the production is good, the vegetables can be sold in various open markets in big towns.

As it was indicated that the preparation procedures were compiled through consultations with only two most knowledgeable informants, it is therefore highly recommended that this could be preserved through documentations and training of cooks in local restaurants. This will result in good promotion of wild vegetables use which can spread from generation to another.

7.5 ACKNOWLEDGEMENTS

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Chapter 8

NUTRITIONAL ANALYSIS OF SELECTED TRADITIONAL EDIBLE VEGETABLES OF THE VHEMBE REGION

Many research findinings reported that the important roles played by wild edible plants is to serve as emergency foods which improve the nutritional status and combat food insecurity. Nevertheless, the current study focused on nutritional analysis of some wild edible vegetables. A total of eight traditional edible vegetables were selected based on their frequency of citations by the informants. A micronutrient (i.e. vitamin A) which is of health concern in South Africa, Limpopo Province and Vhembe district Municipality was considered during this survey. Vitamin C is the water soluble antioxidant which was also considered in this survey. With regard to the Vitamin C contents of the eight selected plants, Amaranthus hybridus L subsp. *cruentus* (L) Thell*. (Mugango) was found to be at the top with 69.106 mg/100gDW. On the other hand, Solanum retroflexum L. (Muxe) was found to have high amount of Vitamin A of 10.905. There is a chance of blending wild edible vegetables for consumption. The blending of Solanum retroflexum L. and Amaranthus thunbergii L. is therefore recommended as it promotes Vitamin A and Vitamin C contents in the consumer' diet.*

Keywords: *Nutritional analysis, Nutritional status, Vitamin C, Vitamin A, Health, South Africa, Vhembe District Municipality, Wild Edible Vegetables*

8.1 INTRODUCTION

Over a billion people are estimated to be continuing to rely on wild vegetables to combat food insecurity and improve their nutritional status (Aberoumond, 2011). In Europe, wild edible plants are regarded as imperative dietary supplements providing trace elements, vitamins and minerals (Pieroni et al., 2002; Lentini & Venza, 2007). To this note, many researchers reported the satisfying renewed or increasing interest in consuming wild edible plants by local people (Heinrich et al., 2006 (study conducted in Local Meditterranean); Delang, 2006; Vitalini et al., 2006 (study done in Northern Italy); Redzic 2006 (study conducted in Bosnia-Herzegovina). Results of the study conducted by Johns and Eyzaguirre (2006) in Kenya showed an increased interest in consumption of traditional plants by the locals. Kim and Oh (1996) reported about 280 wild plant species consumed in Korea. In other parts of the globe, for example India, Malaysia and Thailand, about 150 wild plant species were identified to play important roles as emergency foods (Burlingame 2000).

According to Cameroon Demographic and Health Survey (CDHS), many sub-Saharan countries are experiencing unacceptably high prevalence of under nutrition (CDHS 2011). Results of the study conducted by Modise (2010) indicated that large proportions (> 50%) of the rural people in the North-West Province are undernourished where children as well as women of childbearing age are especially being affected.

The study conducted by Vorster et al. (1997) advocates the high occurrence of poverty in the Northern Province (the now Limpopo Province) which result in the increase of under-nutritional status in the province (Figure 8.1.1). Their results are therefore serving as one of the driving forces towards this study.

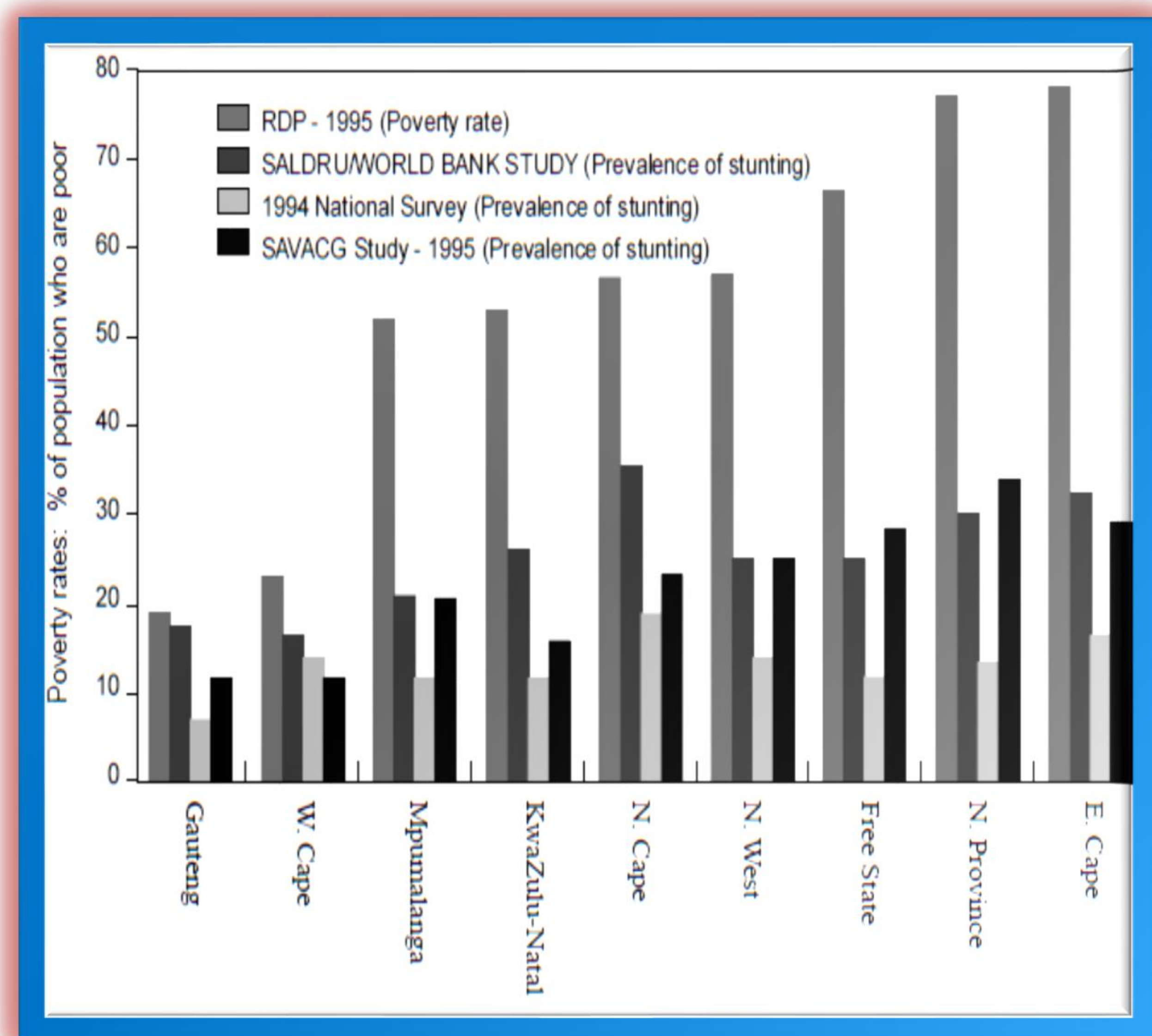

Figure 8.1.1: Comparison of poverty rates with prevalence of stunting (Vorster et al. 1997).

Micronutrients deficiency within the global, developed and developing countries and South African perspectives.

Micronutrients are essential for the normal growth of children (Labadarios 1999), however, there are disturbing reports of low intake of micronutrients rich foods wherein the influence come from the country's recommendations of increasing the energy density of foods eaten by children compromising of consumption of foods with essential micronutrients. Nevertheless, these recommendations can lead to micronutrients deficiencies (Labadarios 1999).

The South African National Nutritional Status Study Group (SANNSS 1995) found that 55 studies reported the remarkable low intake of Vitamin C primarily in Blacks, Indians and Coloured adolescent population groups. The report also showed the low intake of Vitamin A in black children younger than 10 years of ages. Vitamin A deficiency continues to be a major public health problem not only to South Africans; however, it is a worldwide problem which is estimated to drastically affect about 127 million preschool children and more than 7.2 million pregnant women (West, 2002).

Results of the study conducted by Nojilana et al. (2007) revealed the negative impact of Vitamin A deficiencies towards the mortality rates caused by related diseases such as malaria, measles, diarrheal diseases and other infectious diseases (Figure 8.1.2).

They indicated strong relationship between Vitamin A deficiencies and diarrheal diseases as these diseases contributed 96.9% mortality rate of children aged 0-4 years.

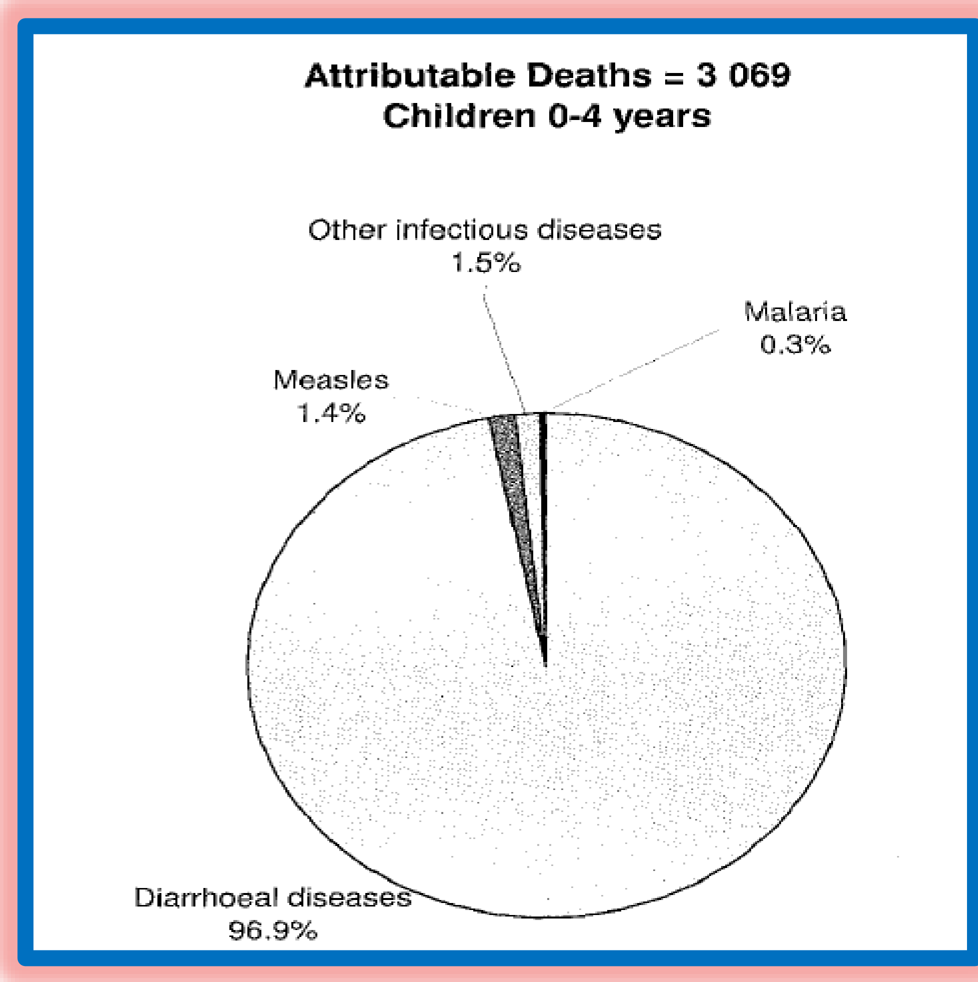

Figure 8.1.2: Deaths attributable to Vitamin A deficiency in Children 0-4 years in South Africa in 2000 (Nojilana et al. 2007).

In order to mitigate this matter, recommendations will be that if one needs all the micronutrients, there must be consideration of a balanced diet which can only be realistic if one has financial means. Therefore, this motivates options of utilization of traditional leafy vegetables or wild edible leafy vegetables that are available and affordable to the poor populations of the study area. Reinforcing this motivation, Steyn et al. (2001) analysed 14 wild leafy vegetables and found 9 to be good sources of Vitamin C and 6 to be good sources of Vitamin A. The paper by Vanderbroek et al. (2011) on Local knowledge: Who cares argues that Local Knowledge System has a potential value to identify plants for diversification of human dietary habits. Results of many other studies conducted in London, United Kingdom, Netherlands and Ahmed by (Almekinders and de Boef 2000; Schippers 2002; Grubben and Denton 2004; Ahmed 2006) respectively indicate that traditional vegetables are rich in vitamins (especially A, B, and C), minerals, fibres, carbohydrates and proteins. Therefore, utilization of these plants can eradicate the prevalence of under nutrition in the sub-Saharan region. It was further indicated that vitamins found from leafy wild vegetables and fruits have protective effects against damage from free radicals (Gupta and Bains 2006). The study conducted by Padayatty et al. (2003) also mentions that one of the important vitamins (vitamin C) is mainly found in fruits and vegetables. These plants are of great benefit to local communities since they represent cheap but quality nutrition and offer opportunities of improving the nutritional status of many families in both urban and rural areas of the sub-Saharan Africa (Chweya and Eyzaguirre 1999).

Another important nutrient in human's diet is vitamin A. In plants, vitamin A occurs in the form of provitamin A carotenoids such as lutein, β- carotene, violaxanthin and neoxanthin (Rodriquez-Amaya 2001). Vitamin A is very important as it plays many functions in the human's body. According to the Food and Nutrition board (2001), the important functions that are played by Vitamin A in human's body include maintenance of normal vision, gene expression, reproduction, embryonic development and growth as well as proper immune functioning.

The remarkable significance of vitamin A is clearly outlined in the study conducted by Grune et al. (2010) as its presence in people' nutrition was illustrated to be essential for normal growth and development; paramount for proper immune system functioning and proper vision. It is worth noting that β-carotene intake helps to balance inadequate retinol supply in significant parts of the world and the highest intake is achieved in vegans and vegetarians (Elmadfa and Freisling 2004).

Results of a study conducted by Faber et al. (2015) revealed the highest prevalence of Vitamin A deficiency in the Limpopo Province among children from households in which homemade bread was highly consumed. They also revealed the lowest intake of vegetables and fruits in general. None of vitamin A- rich fruits or vegetables were reported for any of the children for the recall period (Faber et al. 2015). They purposefully selected rural Limpopo Province as one of their study areas persuaded by the national data recorded by Labadarios et al. (2000) which indicated the frequent consumption of green leafy vegetables in the province. Contrastingly, their findings showed that only 10% of children consumed leafy vegetables and hence the total vitamin A intake was small. These findings therefore drew our attention to investigate the nutritional status of selected wild edible vegetables focus mainly on vitamin C and Beta carotene which their importance in nutrition were mentioned by other authors (Faber et al. 2015).

Interestingly, some of these plants even possess medicinal properties. Dansi et al. (2008) emphasize the fact that leafy vegetables are two headed since they can contribute to both household nutrition and health. Beecher (1999) found that diets rich in vegetables and fruits have been associated with lower rates of cancer and coronary heart disease. Maroyi (2013) attests that some of the traditional/ indigenous vegetables may be used both as food and medicine. Furthermore, the results of Maroyi (2013). revealed that *Bidens pilosa* can be consumed to normalize high blood pressure, ease stomach pains and cure oral thrush.

8.2 MATERIALS AND METHODS

Selection of plant species for nutritional analysis

Various wild edible species including vegetables and fruits were documented through semi-structured interviews. From all the inventoried wild edible plant species, traditional edible vegetables were selected by using the relative frequency of citation or quotation index (RFC) which is calculated by the following formula.

RFC = (FC/N) * 100,

Where FC is the number of informants who mentioned the plant species and N is the total number of informants (Madikizela et al. 2012). Cautiously, for this study the cut-off percentage of citation for the selected vegetables was 10. Jansen Van Rensburg et al. (2004) attest that preference of leafy vegetable species differs depending on the gender and age of consumers, as well as cultural background and geographical location. Calculations of the Relative Frequency of citation (RFC) offered the platform of selecting eight wild edible vegetables for nutritional analysis (Table 8.2.1). Although some of the selected traditional edible vegetables were previously analysed in the Vhembe District Municipality, the uniqueness of this study is that nutritional analysis was performed on raw materials. According to Bwembya et al. (2018), the cooking of vegetables with additives amplify the loss in mineral content. The floristic data on different species have been sourced from Maanda and Bhat (2010) and Mabogo (1990).

Table 8.2.1: Description of eight selected wild vegetables for nutritional analysis.

Family	Vernacular Name	Scientific Name
Amaranthaceae	Vowa	*Amaranthus hybridus* L.
Amaranthaceae	Mugango	*Amaranthus hybridus* L subsp. *cruentus* (L) Thell.
Asteraceae	Mushidzhi	*Bidens pilosa* L.
Asteraceae	Shashe	*Sonchus asper* (L) Hill
Cucurbitaceae	Tshibavhe	*Momordica balsamina* Wall
Cucurbitaceae	Nngu	*Momordica foetida* Schumach
Cucurbitaceae	Thanga	*Cucurbita pepo* L.
Solanaceae	Muxe	*Solanum retroflexum* L.

Processing of plant samples

All plant samples were purchased from the street hawkers located between Levubu and Makhado. Plant materials were immediately transported in different brown envelopes to the Botany laboratory at the University of Venda. In the laboratory, the edible parts were carefully washed with tap water and then rinsed with distilled water. Furthermore, samples of edible parts mentioned by informants during the interviews were considered with the caution of selecting those that are free of infections. After rinsing plant, materials were blotted dry and the remaining moisture on the leaves was evaporated at room temperature. Plant samples were then left at room temperature to a complete drying and they were thereafter ground to fine powder and stored in brown envelopes for the nutritional analysis.

Nutritional analysis

Results of many studies (Almekinders and de Boef 2000; Schippers 2002; Grubben and Denton 2004; Ahmed 2006) indicate that traditional vegetables are rich in vitamins (especially A, B, and C). The current study focused on analysis of Vitamin A following the results of Labadarios (1999) which indicated the highest prevalence of Vitamin A deficiency in the Limpopo Province (Figure 8.2.1). Vitamin C on the other hand is a water insoluble antioxidant provided by fresh fruits and vegetables which is known to protect against chronic diseases such as cancer. These two reasons motivated analysis of

Vitamin A and Vitamin C from the eight selected wild edible vegetables of the Vhembe District Municipality.

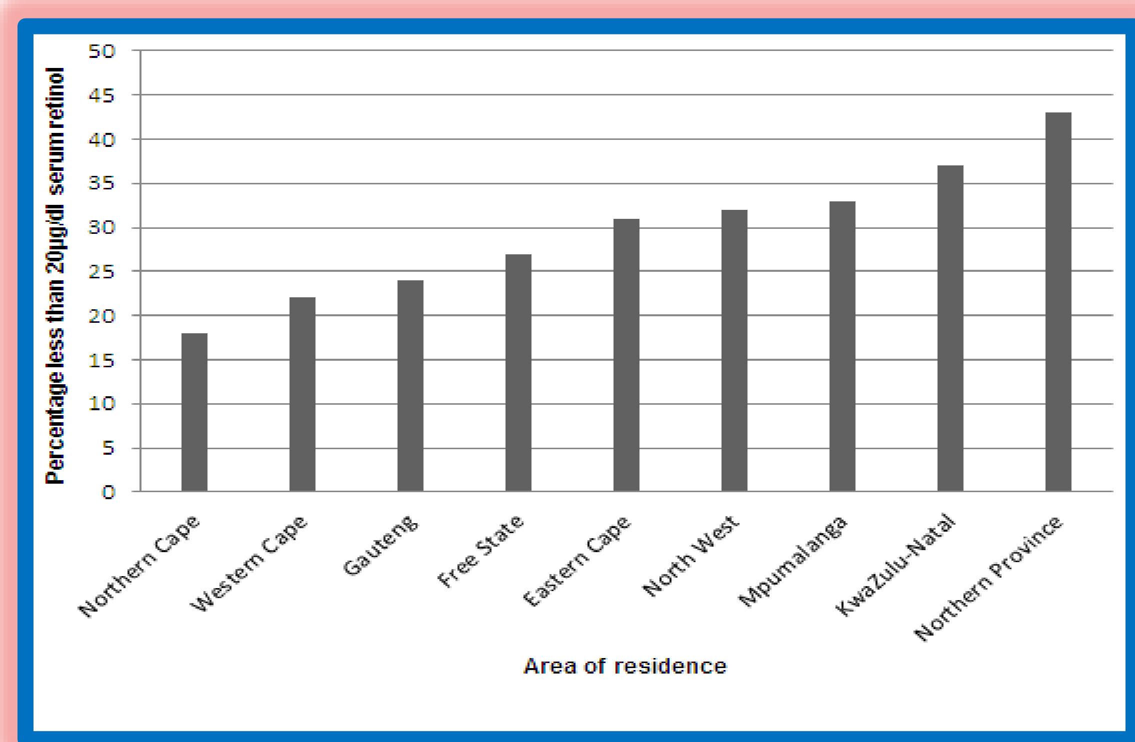

Figure 8.2.1: Vitamin A deficiency status by area of residence (Labadarios 1999).

Determination of β- Carotene

Analysis of β- Carotene from the eight elected vegetables was performed following the method applied by Moyo et al. (2018). The HPLC-PDA extraction and quantification of the β- Carotene were done following the analysis description of Biehler et al. (2010). The analytic description of Biehler et al. (2010) explains that samples are extracted (0.1g/ml) with ice-cold hexane: acetone (1:1, v/v). The mixture was then vortexed for 2 minutes before centrifuging at 2,000 rpm for 2 minutes. The organic phase was decanted into a tube containing saturated sodium chloride solution which was then placed one ice. Further extraction was performed on the remaining residue until it became colourless. The same procedure of combining the extracts with sodium chloride was repeated. The separated organic phase was filtered through a 0.4 µm syringe filter before injecting into the HPLC (Moyo et al. 2018). Chromatographic separation achieved using a C_{18} Luna ® column (150 x 4.6 mm, 5 µ) maintained at 35 °C. An isocratic mobile phase which consisted of acetonitrile: dichloromethane: methanol (7:2:1) was used with the flow rate of 1 ml/min, an injection volume of 20 µl and the detection of 450nm. Peak identification and quantification were achieved based on authentic β-carotene standard, which was used for plotting the calibration curve (Moyo et al. 2018).

Quantification of Vitamin C

Quantification of Vitamin C was achieved by following the method described by Odriozola-Serrano et al. (2007) and Parbhunath et al. (2014) with slight modifications done by Moyo et al. (2018). During the quantification, individual samples of 1g each were weighed into a tube in which 10 ml of 5 % metaphosphoric acid was added. The tube was sonicated in ice-cold water bath for 15 minutes before being centrifuged and filtered. The analysis was carried on Prominence-*i* HPLC-PDA model system equipped with cooler LC-2030C. Chromatographic separation achieved using a C_{18} Luna ® column (150 x 4.6 mm, 5 µ) maintained at 35 °C. An isocratic mobile phase made up of water: acetonitrile: formic acid (99:0.9:0.1) at a flow rate of 1ml/min was used. The injection volume of 20 µl was used at the detection set-up of 245nm. Sample quantification was attained based on the calibration curve plotted from L-ascorbic acid.

8.3 RESULTS AND DISCUSSIONS

Results of three replicates and averages of Vitamin C and Beta carotene are presented in table 8.3.1. The plant species analyzed in this study contained Vitamin C amounts ranging from 10.105 mg/100g to 69.106 mg/100g. Noteworthy is the outstanding Vitamin C concentration found in the leaves of *Amaranthus thunbergii* and *Amaranthus hybridus* with 69.106 mg/100g and 43.299 mg/100g respectively (Figure 8.3.1).

Table 8.3.1: Results of three replicates and averages of Vitamin C and Beta carotene contents of eight selected traditional edible vegetables.

Sample names	Beta carotene (mg/100g DW)	Beta carotene averages	Vitamin C (mg/100g DW)	Vitamin C averages
Momordica foetida	7. 468	7.495	10.037	10.105
Schumach	7.540		10.066	
	7.477		10.213	
Momordica balsamina	3.442	3.444	19.903	20.080
Wall	3.468		20.120	
	3.424		20.218	

Sample names	Beta carotene (mg/100g DW)	Beta carotene averages	Vitamin C (mg/100g DW)	Vitamin C averages
Bidens pilosa L.	3.167	2.994	34.976	34.942
	2.902		34.975	
	2.913		34.877	
Solanum retroflexum L.	11.208	10.905	30.445	30.629
	10.845		30.993	
	10.664		30.450	
Amaranthus hybridus L subsp. *cruentus* (L) Thell.	7.030	7.259	69.447	69.106
	7.438		68.757	
	7.310		69.113	
Sonchus asper (L) Hill	10.341	10.367	10.819	10.886
	10.368		10.748	
	10.392		11.093	
Cucurbita pepo L.	6.908	6.963	21.529	21.903
	7.0011		22.172	
	6.980		22.008	
Amaranthus hybridus L.	10.638	10.618	43.484	43.299
	10.648		43.571	
	10.568		42.842	

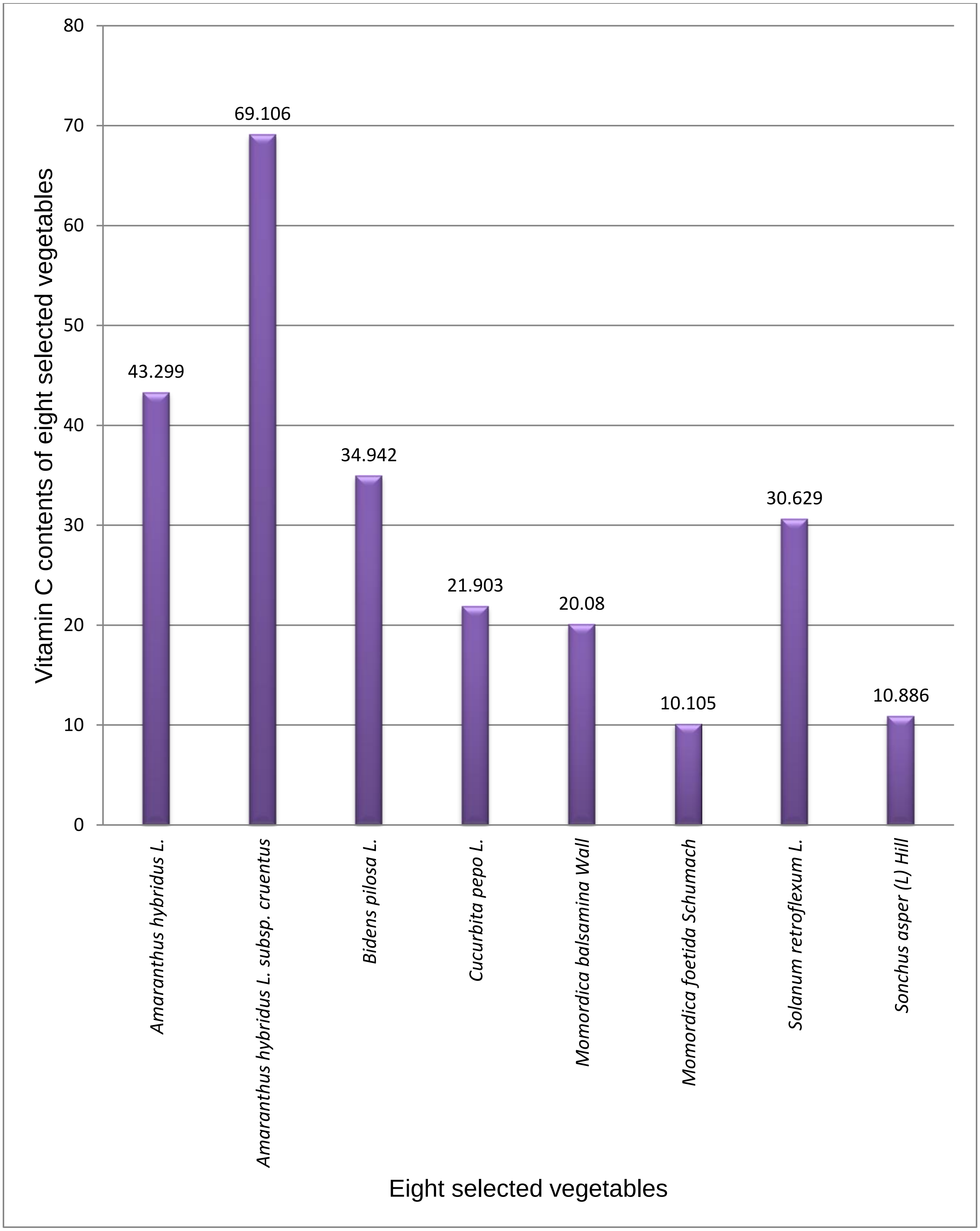

Figure 8.3.1: Vitamin C contents of eight selected traditional edible vegetables.

The results of the study conducted by Nesamvuni et al. (2001) are in concurrence with the results of the current study in terms of high levels of Vitamin C found in species of the family Amaranthaceae. Their results showed *Amaranthus sp* (vowa) with Vitamin C content of 22.3 mg which was high as compared with vitamin C contents of other plant species. Of eight evaluated vegetables, leaves of *Momordica foetida* were found to have the lowest amount of Vitamin C (Figure 8.3.1). Availability of different vitamins in wild edible plants is in fact species dependent (Uusiku et al. 2010). This was also evidenced during the current study as some plant species were found to have high levels of vitamin C whereas some had low levels of vitamin C.

Another cause of low Vitamin C concentration in plants is due to postharvest drying methodology and temperature of storage which can result into a great loss (FAO 2001). Low concentrations of Vitamin C contents of six of eight evaluated samples is probably because these samples were dried at room temperature after which they were ground to fine powder and stored in brown envelopes at room temperature. According to Negi and Roy (2001), the storage of dehydrated leafy vegetables should be at low temperature simply because it effectively reduces degradation of Vitamin C and browning. Vitamin C is very crucial to human's diets as it promotes absorption of soluble non-haem iron (FAO, 2001). Moreover, its presence in the diet is significant because it also inhibits the iron absorption by phytates (Halliwell and Gutteridge, 1999).

The beta carotene contents of leaves of plant species analyzed during this study ranged from 2.994 mg/100g to 10.905 mg/100g (Figure 8.3.2). Majority of the wild edible vegetables (i.e. six out of eight) evaluated contain substantial quantities of β-carotene.

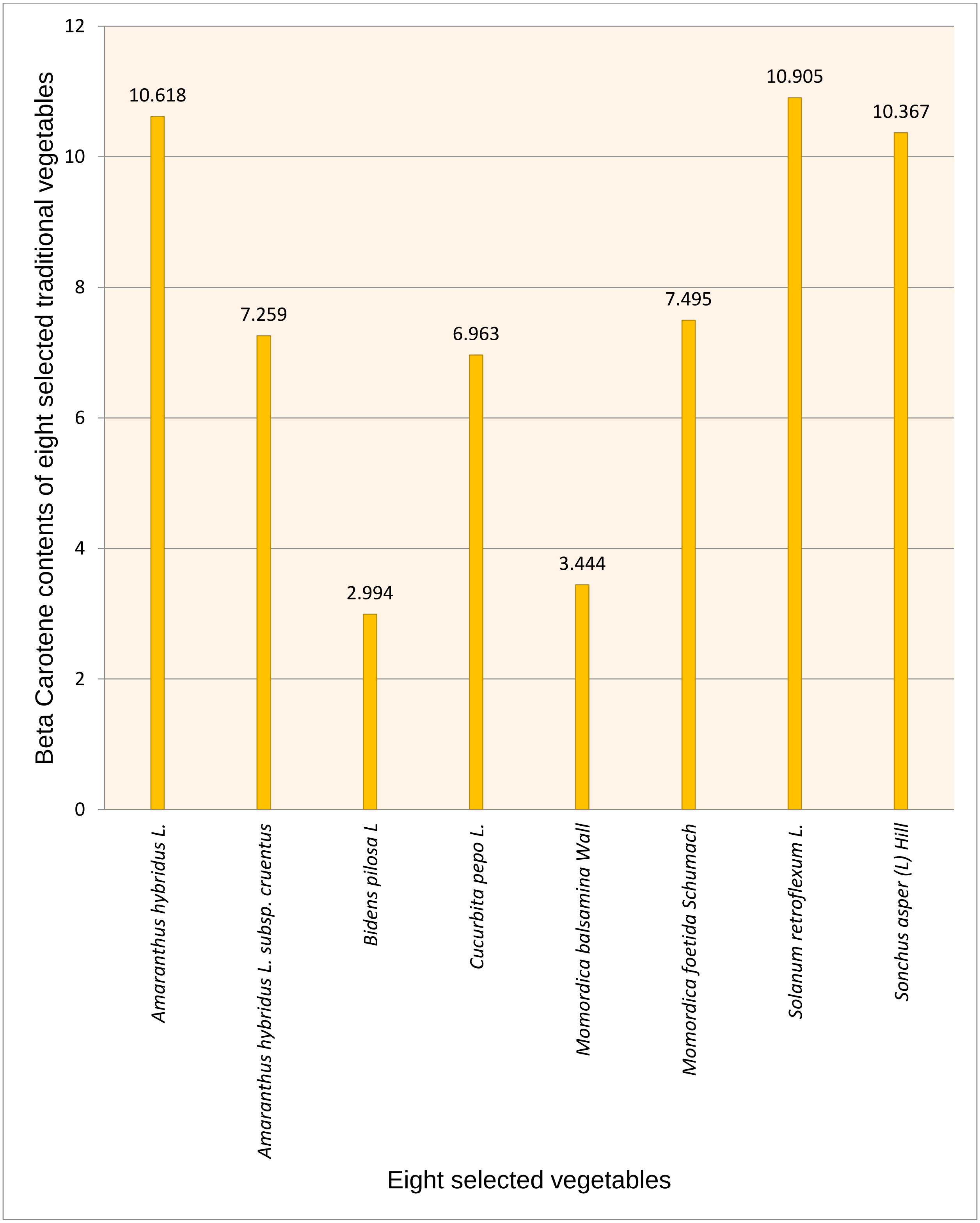

Figure 8.3.2: Beta carotene contents of eight selected traditional edible vegetables.

Exceptionally, leaves of *Solanum retroflexum* contained high level of 10.905 β-carotene. Results of the study conducted by Nesamvuni et al. (2001) also showed *Solanum retroflexum* with highest value of Beta-carotene content as compared to other evaluated plant species which are common to the ones evaluated during the current study.

Levels of Beta-carotene presented are of raw leaves of wild edible vegetables, therefore there is hope of experiencing some increments of these levels due to processing procedures such as cooking for consumption. Khachik et al. (1992) alluded to the fact that cooking leafy vegetables increases the bioavailability of α- and β- carotene. Additionally, Howard et al. (1999) explain that carotenoids are bound to protein, therefore heat treatment such as boiling, or steaming is required to help release the bound carotenoids. Furthermore, they indicated that this method enables carotenoids to be readily extracted. As like Vitamin C, Beta carotene was studied, and results showed its remarkable contributions in human's health (WHO 2009; FAO 2001; Food and Nutrition Board (FNB) 2001).

Fortunately, results of the current study showed the availability of these vital substances from the analyzed wild edible vegetables. Nevertheless, the role of wild edible vegetables as sources of Vitamin A is even more relevant given the prevalence of Vitamin A deficiency in developing countries (WHO 2009). Developing countries are faced with as many as 190 million young children and more than 15 million pregnant women that are Vitamin A deficient (WHO 2009). On the other hand, Aguayo and Baker (2005) estimated that 42.4% of young children living in sub-Saharan Africa are Vitamin A deficient.

Emphasis can thus be done on increasing the intake of Beta carotene rich vegetables such as *Solanum retroflexum*, *Sonchus asper* and *Amaranthus hybridus* to improve Vitamin A intake statuses.

Table 8.3.2 gives a comparison of the Vitamin C and Beta carotene contents of the traditional vegetables analysed in the study conducted by Nesamvuni et al. (2001) and the current study. As indicated in the table, some of the traditional vegetables were not analysed in the previous study conducted in the same study area (i.e. Vhembe District Municipality). Therefore, findings of this study brought forward new nutritional information about some vegetables that are preferred by people of the Vhembe District Municipality.

Although it was shown that there was inclusion of some ingredients which would have increased the levels of analysed micronutrients; results depicted in table 8.3.2 show high levels of Vitamin C and Beta carotene from raw vegetables. Values of Vitamin C of cooked and raw vegetables are extremely different; hence this proves the effect of cooking process. According to Uusiku et al. (2010) micronutrients are affected differently by processing. For example, thermal processing of leafy vegetables reduces levels of ascorbic acid.

Vitamin C concentration found in the leaves of *Amaranthus thunbergii* and *Amaranthus hybridus* with 69.106 mg/100g and 43.299 mg/100g respectively. Edible parts of these vegetables are tender leaves that can be included in salads. Uusiku et al. (2010) further advocate the antioxidant attributes provided by raw African leafy vegetables which afford them potential to be used as cheap natural sources for reducing cellular oxidative damage. Results of published Beta-carotene and Vitamin C contents of traditional vegetables that are also cited during the current study are depicted in table 8.3.3. Table 8.3.4 illustrates traditional vegetables that are cited by less than five informants. Beta-carotene and Vitamin C contents of these vegetables were not published.

Table 8.3.2: Comparison of Vitamin C and Beta carotene of traditional edible vegetables analysed by Nesamvuni et al. (2001) and those that were analysed in this study.

Plant Name		**Nutrient content per 100g of plant**			
Botanical	**Local**	**Beta-carotene(01)**	**Beta-carotene(02)**	**Vitamin C (01)**	**Vitamin C (02)**
Amaranthus esculentus	Delele Mandade	0.2	-	2.4	-
Amaranthus dubius	Vowa	4.81	-	22.3	-
Amaranthus hybridus	Thebe	6.23	10.618	2.7	43.299
Amaranthus hybridus L. subsp. Cruentus	Mugango	-	7.259	-	69.106
Bidens pilosa	Mushidzhi	5.81	2.994	2.9	34.942

Plant Name		Nutrient content per 100g of plant			
Botanical	Local	Beta-carotene(01)	Beta-carotene(02)	Vitamin C (01)	Vitamin C (02)
Cleome gynandra	Murudi	9.22	-	37.0	-
Cleome monophyla	Mutohotoho	3.98	-	13.2	-
Corchorus tridens	Delele lupfumo	3.20	-	2.5	-
Cleome maxima	Phuri/Thanga	4.63	6.963	24.4	21.903
Momordica balsamina	Tshibavhe	-	3.444	-	20.08
Momordica foetida	Nngu	5.41	7.495	20.6	10.105
Solanum retroflexum	Muxe	7.56	10.905	7.5	30.629
Sonchus asper	Shashe	-	10.367	-	10.886

Table 8.3.3 Values of Beta-carotene and Vitamin C of traditional vegetables analysed by other researchers.

Family	Scientific name	Beta-carotene	Vitamin C	References
Amaranthaceae	*Amaranthus dubius* C. Mart ex Thell	327[a]	46- 126[a]	Odhav et al. 2007; Uusiku et al. 2010
Amaranthaceae	*Amaranthus hydridus* L.	327[a]	46- 126[a]	Odhav et al. 2007; Uusiku et al. 2010
Amaranthaceae	*Amaranthus hydridus* L. subsp. *cruentus* (L.) Thell	327[a]	46- 126[a]	Odhav et al. 2007; Uusiku et al. 2010
Amaranthaceae	*Achyranthes aspera* L. var. *aspera*	-	-	-
Apocynaceae	*Pentarrhium insipidum* E. Mey.	-	-	-
Aracea	*Colocasia esculenta* (L.) Scott	-	-	-
Asteraceae	*Bidens bipinnata* L.	-	-	-
Asteraceae	*Bidens pilosa* L.	985-305[a] 74[a]	23[a] 1908[a]	Uusiku et al. 2010 Agea et al. 2014
Asteraceae	*Sonchus asper* (L.) Hill subsp *asper*	-	-	-
Brassicaceae	*Cleome gynandra*	1200[b]	13-50[b]	van der Walt et al. 2008; Uusiku et al. 2010; Mishra et al. 2011.

Brassicaceae	*Cloeme monophylla* L.	1200[b]	13-50[b]	Odhav et al. 2007; Uusiku et al. 2010.
Convolvulaceae	*Ipomoea batatas*	-	6.15- 4.28[b]	Ogunlesi et al. 2010
Convolvulaceae	*Ipomoea obscura* (L.) Ker Gawl. var. *obscura*	-	-	-
Cucurbitaceae	*Citrullus colocynthis* L.	-	-	-
Cucurbitaceae	*Citrullus lanatus*	-	-	-
Cucurbitaceae	Cucumis africanus L.f.	-	-	-
Cucurbitaceae	*Cucurbita pepo* L	194[b]	11[b]	Kim et al. 2012
Cucurbitaceae	*Momordica charantia*	-	-	-
Cucurbitaceae	*Momordica foetida* Schumach	5.4[a]	26.6[a]	Nesamvuni 2000
Cucurbitaceae	*Momordica balsamina*	-	3.6[a]	Nesamvuni 2000
Cucurbitaceae	*Lagenaria siceraria*	-	-	-
Euphorbiaceae	*Tragia dioica* Sond	-	-	-
Fabaceae	*Vigna subterranea*	-	-	-
Fabaceae	*Arachis hypogaea*	-	43.74-42.95[b]	Ogunlesi et al. 2010
Fabaceae	*Vigna unguiculata* (L.) Walp	47[b] 99[b]	5880[b] 50[b]	Agea et al. 2014 Uusiku et al. 2010

Malvaceae	*Abelmoschus esculentus* (L.) Moench	0.2[1a]	2.4[a]	Nesamvuni et al. 2001
Malvaceae	*Corchorus olitorius* L. var. *olitorius*	-	40.21	Ogunlesi et al. 2010
Malvaceae	*Corchorus tridens* L.	-	-	-
Pedaliaceae	*Dicerocaryum senecoiides* (Klotzsch) Abels	-	-	-
Polygonaceae	*Oxygonum dregeanum* Meisn	-	-	-
Solanaceae	*Lycopersicon esculentum* Mill	-	-	-
Solanaceae	*Nicandra physalodes* (L.) Gaertn	-	-	-
Solanaceae	*Solanum nigrum* L.	1070[b] 141.01[b]	2[b] 9047[b]	Uusiku et al. 2010 Agea et al. 2014
Solanaceae	*Solanum retroflexum* Dunal	1070[b]	2[b]	Uusiku et al. 2010

Findings of the comparison between Beta-carotene and Vitamin C values of eight traditional vegetables studied in this research evident slight similarity with those studied in South Africa. Most of the traditional vegetables studied during the current study contain significant amounts of Vitamin C. Significant amounts of vitamin C have been reported in *Amaranthus hybridus* L. subsp *cruentus* and *Amaranthus hybridus* (Table 8.3.2). Other vegetables had less amounts of vitamin C; however, this is an indication that bioavailability of vitamin C amounts vary with vegetable species and processing methods (Njume et al. 2014).

Beta-carotene and Vitamin C values of plant species studied in Vhembe and those studied in other places within and outside South Africa are different. It is however, not suprising to encounter this discrepencies which are caused by differences in the methods used for quantification, units of measurement, time of plant samples collection, seasonal conditions and geographical regions (Uusiku et al. 2010). Values of vitamin A and vitamin C of the plant species studied in the current research were obtained through the use of HPLC and chromatographic separation was achieved using a C_{18} Luna ® Column. In the case of studies conducted by Kruger et al. (1998) (Study conducted in Cape Town, South Africa); Mosha and Gaga (1999) (Study conducted in Tanzania); Ejoh et al. (2007) (Study conducted in Cameroon), vitamins of the plant species were determined by HPLC with flourometry procedures which resulted in different vitamin A and vitamin C values.

Table 8.3.4: List of traditional vegetables cited by less than five informants.

Family	**Scientific name**	**Vernacular(V) and Common name(E)**	**New uses**	**Growth form**
Amaranthaceae	*Hypoestes forskaolii* (Vahl) R. Br.	Nnyoyambudzi(V)		Herb
Amaranthaceae	*Alternanthera sessilis* (L.)	Vowamulambo(V)		Herb
Apocynaceae	*Telosma Africana* (N. E. Br.) N.E.Br.	Nyendanyendane(V)		Climber
Commelinaceae	*Commelina benghalensis* L.	Damba(V), Benghal commelina		Herb
Convolvulaceae	*Ipomoea dichroa Choisy*	Tshipokoto(V)		Climber
Cucurbitaceae	*Coccinia rehmannii* Cogn.	Tshifhafhe(V), wild cucumber (E)		Herb
Cucurbitaceae	*Momordica boivinii* Baill	Mbandatshilale(V)		Herb
Ebenaceae	*Euclea divinorum* Hiern.	Mutangule(V), Magic guarri(E)		Herb
Euphorbiaceae	*Erythrococca menyharthii* (Pax) Prain	Tshinzie(V)		Shrub
Icacinaceae	*Pyrenacantha kaurabassana* Baill	Galange		Creeper
Lophiocarpaceae	*Lophiocarpus tenuissimus* Hook.F.	Tshitangwi(V), Narrow-leaved(E)		Herb

Malvaceae	*Corchorus asplenifolius* Burch	Delelelunanzwanowa(V), Jute plant(E)		Herb
Malvaceae	*Malva sylvestris* L.	Tshiteaduvha(V), Cheese weed(E)		Herb
Malvaceae	*Trimfetta annua* L.	Tshimbvubvu(V)		Herb
Moraceae	*Morus alba* var *alba*	Mutebeila(V), Mulberry(E)	Vegetable	Tree
Solanaceae	*Solanum campylancanthum* Hochst. ex A. Rich. subsp *panduriforme* (Drege ex Dunal) J. Samuels	Mututulwa(V), Poison apple(E)	Milk thickener	Herb

8.4 CONCLUSIONS

African leafy vegetables contain substantial levels of micronutrients that are essential for human health (Uusiku et al. 2010). Nutritional analyses of the eight selected wild edible vegetables revealed that some of these plant species are good sources of Beta-carotene and Vitamin C. *Amaranthus hybridus* L subsp. *cruentus* (L) Thell.and *Amaranthus hybridus* showed high levels of Vitamin C than *Solanum retroflexum* and *Sonchus asper* which had high levels of Beta-carotene. Fortunate enough, there are possibilities of combining the above-mentioned vegetables for human consumption. In that case, simultaneous consumption of these vital substances is possible hence the decrease in their deficiencies. Outstandingly, results revealed the exceptionality of *Amaranthus hybridus* as it possessed high levels of both Vitamin C and Beta carotene. Henceforth, the consumption of this unique leafy vegetable should be encouraged to young children and pregnant women. Further recommendation will be to continue with promotive campaigns of these vegetables as South African and other developing countries crops to assist in combating malnutrition.

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Chapter 9

QUANTIFICATION OF USE PATTERNS OF SOME WILD EDIBLE PLANTS OF THE VHEMBE DISTRICT MUNICIPALITY, LIMPOPO PROVINCE, SOUTH AFRICA

ABSTRACT

In the past, most of the ethnobotanical studies concentrated more on recording vernacular names and use of plant species with little emphasis on quantitative studies. The current study aimed at quantifying the wild edible plants use patterns by people of the Vhembe District Municipality of the Limpopo Province, South Africa. Permission was requested and obtained from the tribal authorities of the surveyed villages. Furthermore, consent was requested and obtained from members of the Vhembe communities who were willing to participate in the study. A total of 160 members participated in interviews used to collect ethnobotanical data.

Plant species mentioned during the survey belong to 40 different plant families with Malvaceae at the top of the list. Malvaceae was followed by Cucurbitaceae which had majority of plants with attributes of bitter taste. Of the five plant growth forms mentioned during interviews, wild edible trees were mostly used for various purposes. Plant parts preferred by people of the Vhembe region were leaves, seeds, flowers, barks, fruits, tubers and corms. Nonetheless, leaves were mostly used as food and medicine. It was mentioned that plant parts like leaves and fruits can be preserved

for future use; two preservation methods namely collect, cook and dry and collect and sun dry were utilized. In view of the local municipality with more indigenous knowledge, Mutale Local Municipality *had people who still hold the precious indigenous knowledge than other local municipalities.*

Keywords: *Ethnobotanical studies, Quantitative studies, Plant family, Plant growth forms, Plant parts, Preservation methods, Collect, cook and dry, Collect and dry.*

9.1 INTRODUCTION

In the past, most ethnobotanical studies focused much on recording vernacular names and use of plant species with little emphasis on quantitative studies (Hoft et al. 1999). The importance or preferences of wild plants differ from one person to another. The same scenario applies to the preference of plant parts by users or consumers. Measuring the “importance” of plants or/and vegetation to people is a crucial centralized concern to deal with, in what is termed “quantitative ethnobotany” (Hoffman and Gallaher 2007). Views coined by Phillips et al. (1994) about quantitative ethnobotany corroborate that it is a field of study which came about as a response to the perceived subjectivity of descriptive approaches. Their arguments further adjudicate that quantitative ethnobotany must include studies that connect ethnobotanical information with floristic and phytosociological inventories. In addition, Monteiro et al. (2006) and Reyes-Garcia et al. (2007) are defining quantitative ethnobotany as an area which includes studies that are designed to quantify local botanical knowledge using popular indices of relative or cultural importance.

The importance of quantifying ethnobotanical knowledge is for the improvement of everyday life in rural populations, as well as assisting with decision making concerning the sustainable use of the plants. This idea was quite frequently pointed out by researchers such as Shackleton et al. (2002) and Albuquerque (2004). Furthermore, the understanding of patterns of wild edible plants use and cultural significance value is important when setting priorities for conservation and domestication of these plants (Ghorbani et al. 2012). Most importantly to accomplish this, the so-called cultural domain studies are considered. According to Ghorbani et al. (2012), cultural domain is a group of elements or items that are categorized following culturally determined rules. For examples, plants can be organized as “medicinal plants” or “edible food”. Additionally, Gausset (2004) attests that many used indices tend to pool specific uses cited by informants into “use categories”. These use categories include “construction”, “food”, “medicine”, “technology”, “firewood” and “others” (Gausset 2004). Another significance of the use of cultural indices is to compare and test hypothesis concerning the “importance” of vegetation zones, plant families or growth forms (Albuquerque et al. 2005; Phillips et al. 1994). The present study aimed at quantifying the knowledge on ethnobotanical use pattern of some wild edible plants by the inhabitants of the four local municipalities of the Vhembe region.

9.2 METHODS AND MATERIALS

Ethnobotanical survey

Consent of engaging with members of the communities was obtained from a meeting with representatives of the tribal authorities before entering into villages. Secondly, prior informed consent was obtained with the interviewees before commencement of interviews. Four remote villages from each local municipality were randomly selected. In each selected village, ten homesteads (households) were also randomly sampled by skipping ten between samples. Sampling of participants was done purposively to ensure combination of different ages and gender.

Data analysis

Observations of the interview results are that most of the members of the youth generation and elderly people were less knowledgeable about the wild edible plants. Therefore, for the sake of this section we decided to consider analyzing information collected from informants who managed to cite six and more wild edible plants.

Wild edible plants preferences of inhabitants of the four local municipalities of the Vhembe district were determined by checking the number of times particular plants and their different use categories were mentioned. Parameters considered in this case were plant growth forms (habits), plant parts and use categories such as food (vegetables and fruits), medicine, construction, firewood, beer, juice and others. Free lists were analyzed at the local municipality level where relative frequency of citations and use values were determined using Microsoft Excel. Student-test for independent by variables test was performed at $p<0.05$ using STATISTICA 13.2.

9.3 RESULTS AND DISCUSSIONS

Profile of wild edible plants utilized

Information from respondents who managed to cite six and more edible plants was considered for this chapter; therefore, a total number of 87 plant species were recorded during this survey (Appendix 5). A list of plant species which were mentioned less than five times are given in Appendix 6. The 87 plant species listed in Appendix 5 are distributed in 34 different botanical families. Figure 9.3.1 gives an illustration of different plant families use patterns in the four local municipalities of Vhembe District Municipality. Of the thirty-four mentioned families, plants of the family Malvaceae were mostly mentioned followed by plants of families Cucurbitaceae, Rubiaceae, Solanaceae and then Amaranthaceae, Apocynaceae, Fabaceae and Urticaceae with a tie of four species each. Therefore, these families make the top seven families out of the total of 35 inventoried plant families. According to Welcome and Van Wyk (2019) plants of the family Malvaceae are mostly preferred by VhaVenda with Cucurbitaceae as the second preference.

The popularity of Cucurbitaceae has been attributed to the bitter taste that most of the plant species possess which is believed to provide medicinal values. Results of the study conducted by Thomas et al. (2009) found Cucurbitaceae as the most popular family of medicinal plants used in Apillapampa, Bolivia. These results are in an agreement with the argument of people of the Vhembe which articulates the importance of taste towards the plant species selection or preferences. Furthermore, the work of Casagrande (2002) supports this trend as it revealed the presence of typical bitter phytochemicals that are often contained by plants of family Cucurbitaceae.

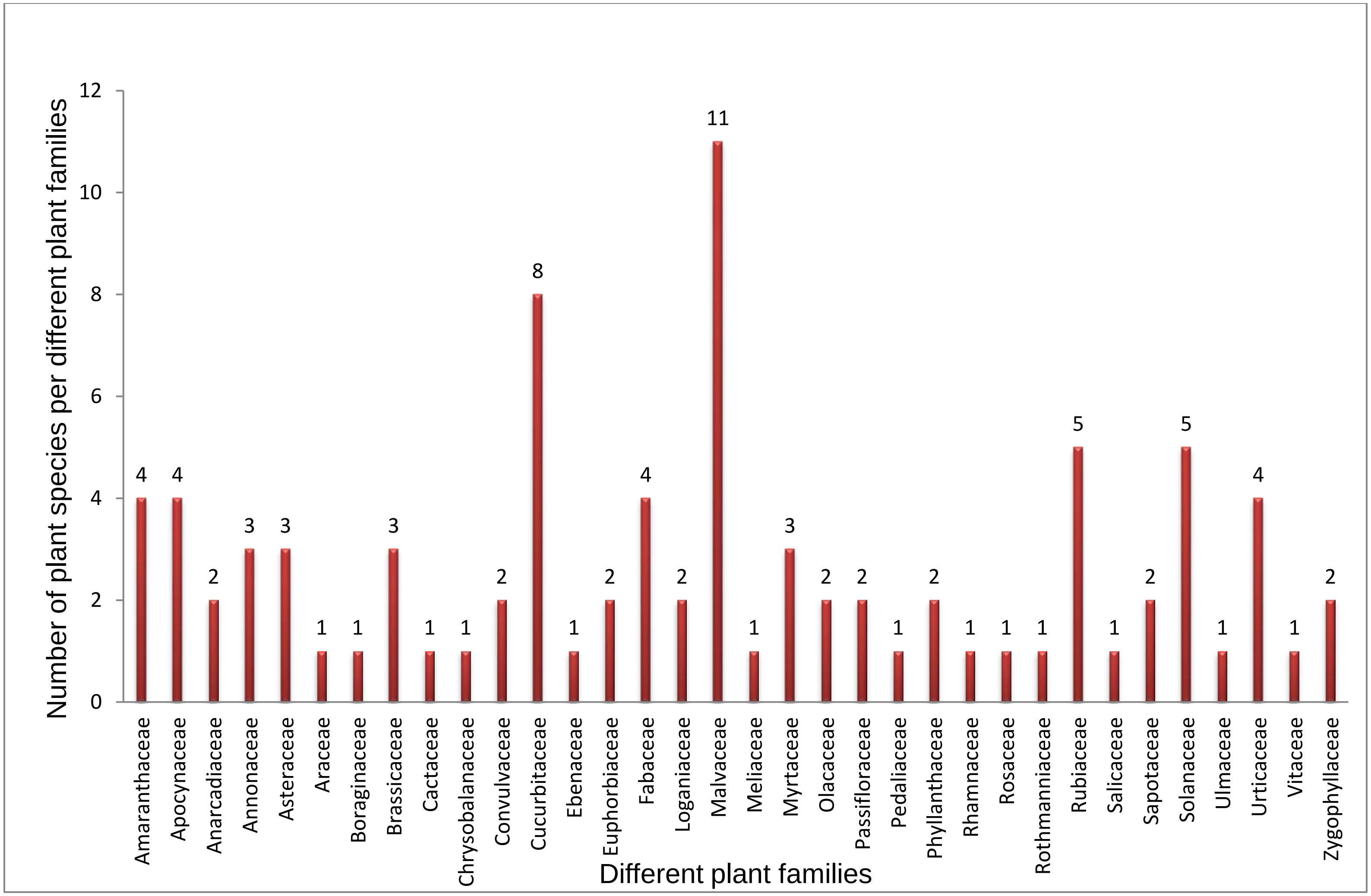

Figure 9.3.1: Number of wild edible plant species per plant family.

Plant growth forms preferred by people of Vhembe District Municipality

The results showed herbaceous plants as the most preferred plant growth form in Mutale Local Municipality than in other three local municipalities of Vhembe District Municipality. However, trees, climbers and creepers were also found to be highly utilized in Mutale than in other three local municipalities. Surprisingly, the usage of shrubby plants by people of the Vhembe region seemed very low except of the case of the dwellers of Thulamela Local Municipality who showed a higher preference of wild edible shrubs than other plant growth forms (Figure 9.3.2).

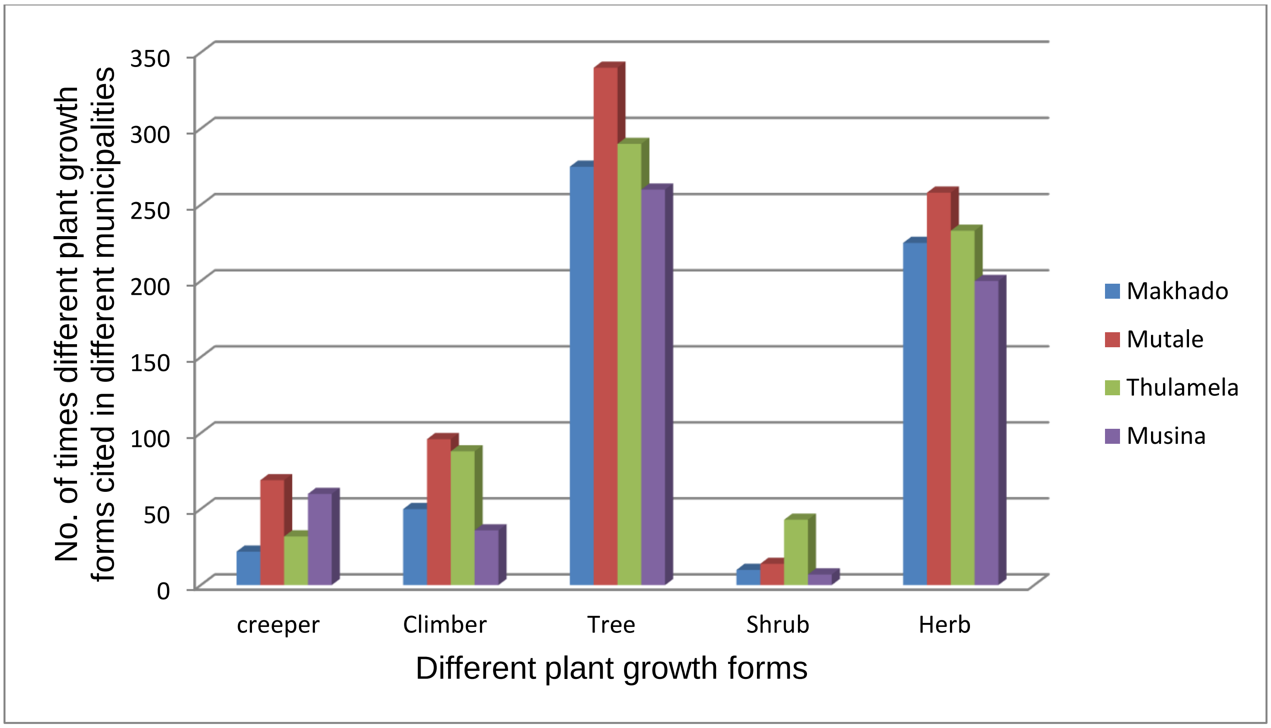

Figure 9.3.2: Different plant growth forms preferred by people of Vhembe District Municipality.

Out of the five mentioned plant growth forms mentioned, tree species were mostly preferred by the respondents. These results are supported by report of the study conducted from four villages, namely Mafukani, Matshena, Tshaulu and Vuvha in the Vhembe District Municipality by Magwede et al. (2018). Their results indicated the tree species as the mostly reported plant growth form as compared to other plant growth forms. Furthermore, the fact that tree species were found to be the most cited wild edible plants growth form in the Vhembe district is not a coincidence as the study conducted with Kara and Kwego people in Ethiopia affirms that most of the tree species are regarded as wild edibles (Teklehaymanot and Giday 2010).

No significant difference was shown when statistically comparing knowledge on plant growth forms preferences of Thulamela vs Mutale, Thulamela vs Musina and Musina vs Makhado. Nevertheless, statistical comparison results of plant growth forms used by respondents of Thulamela as compared to respondents of Makhado, Mutale vs Musina and Mutale vs Makhado were significantly different (Table 9.3.1).

Table 9.3.1: T-test for wild edible plants growth forms in the four local municipalities of Vhembe District Municipality. Marked differences ns, * and ** refer to not significant, significantly different and highly significantly different at P< 0.05.

Local municipalities	Means	STD. DEV	P Value	Statistical differences	N
Thulamela vs Mutale	137.2000 vs 155.4000	117.1397 vs 137.4693	0.254162	Ns	92
Thulamela vs Makhado	137.2000 vs 116.4000	117.1397 vs 124.0859	0.027866	*	92
Thulamela vs Musina	137.2000 vs 112.6000	117.1397 vs 110.8503	0.146715	Ns	92
Mutele vs Musina	155.4000 vs 112.6000	137.4693 vs 110.8503	0,043801	*	92
Mutele vs Makhado	116.4000 vs 112.6000	137.4693 vs 124.0859	0.018269	*	92
Musina vs Makhado	112.6000 vs 116.4000	110.8503 vs 124.0859	0.747493	Ns	92

Plant parts preferred by people of Vhembe District Municipality

Leaves, seeds, flowers, barks, fruits, tubers and corms were plant parts mentioned to be mostly used by people of the Mutale Local Municipality more than being used by people of other three local municipalities (Figure 9.3.3). Respondents of Mutale and Thulamela local municipalities shared the same pattern of roots usage (Figure 9.3.3.). Low usage of roots is also shown in the results of the review done by Welcome and Van Wyk (2019); however, results of this study revelead high preference of leaves against fruits. Most significantly, respondents of Thulamela and Mutale mentioned the use of flowers of *Sonchus asper* and *Cleome gynandra* as edible parts than respondents of Makhado and Musina who only were aware of the use of flowers of *Cucurbita pepo*.

Urbanization and climatic conditions are considerably regarded as contributing factors to these less knowledge of wild edible plants use attributed in Thulamela and Musina respectively. Respondents of Mutale Local Municipality are living in deep rural areas and therefore have access to the wild edible plants than people living in Thulamela were the household's setup is mostly that of township. Most of households visited in both Mutale and Makhado had enough space in their backyards where they cultivate their maize plants. In those gardens, wild edible plants such as *Amaranthus dubius, Cloeme gynandra, Cloeme monophylla, Urtica dioica, Momordica foetida, Cucumis africanus* were seen growing.

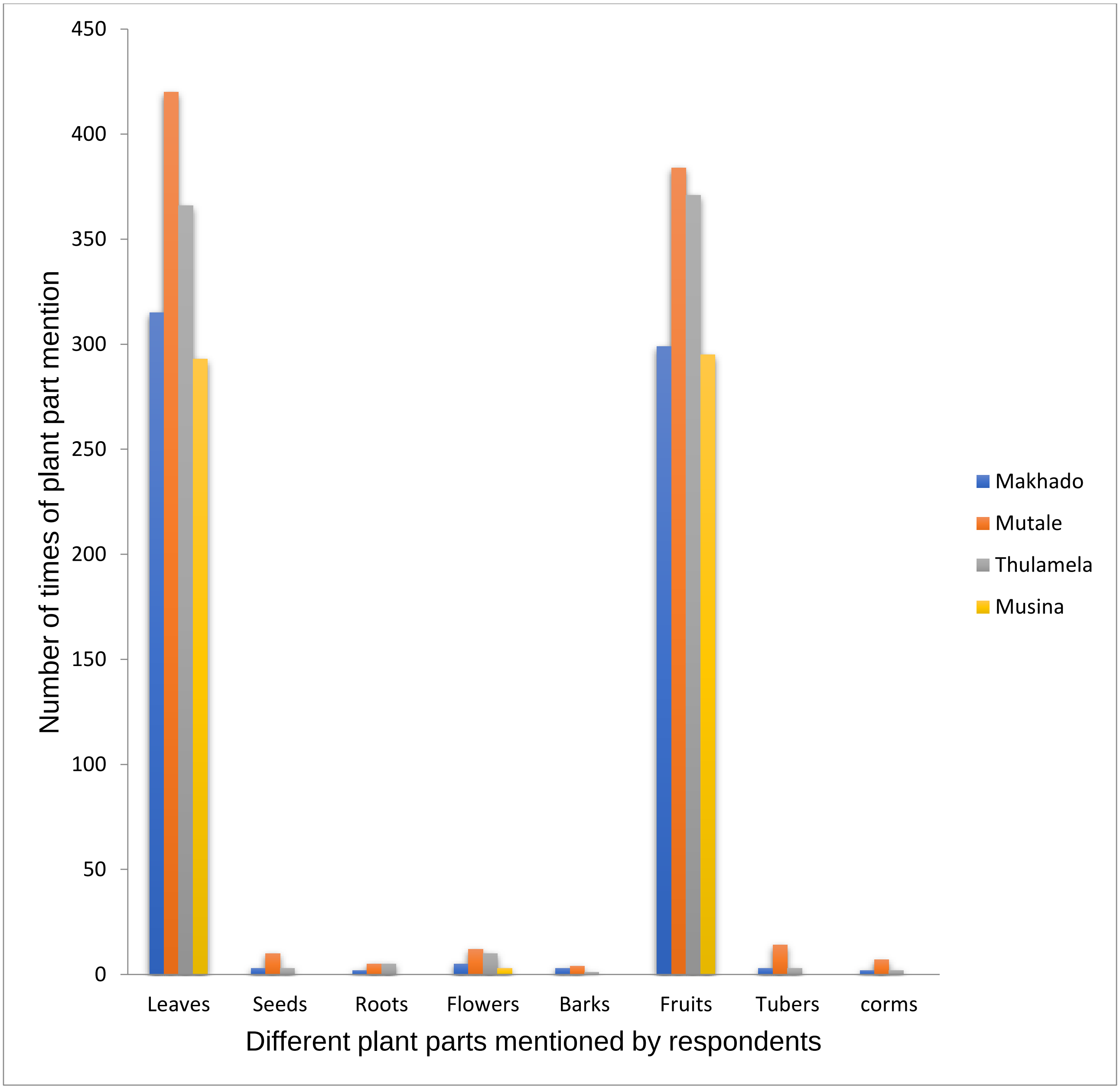

Figure 9.3.3: Number of different plant parts used as cited by respondents of the four local municipalities of Vhembe District Municipality.

Comparison of plant use categories in local municipalities of the Vhembe District Municipality

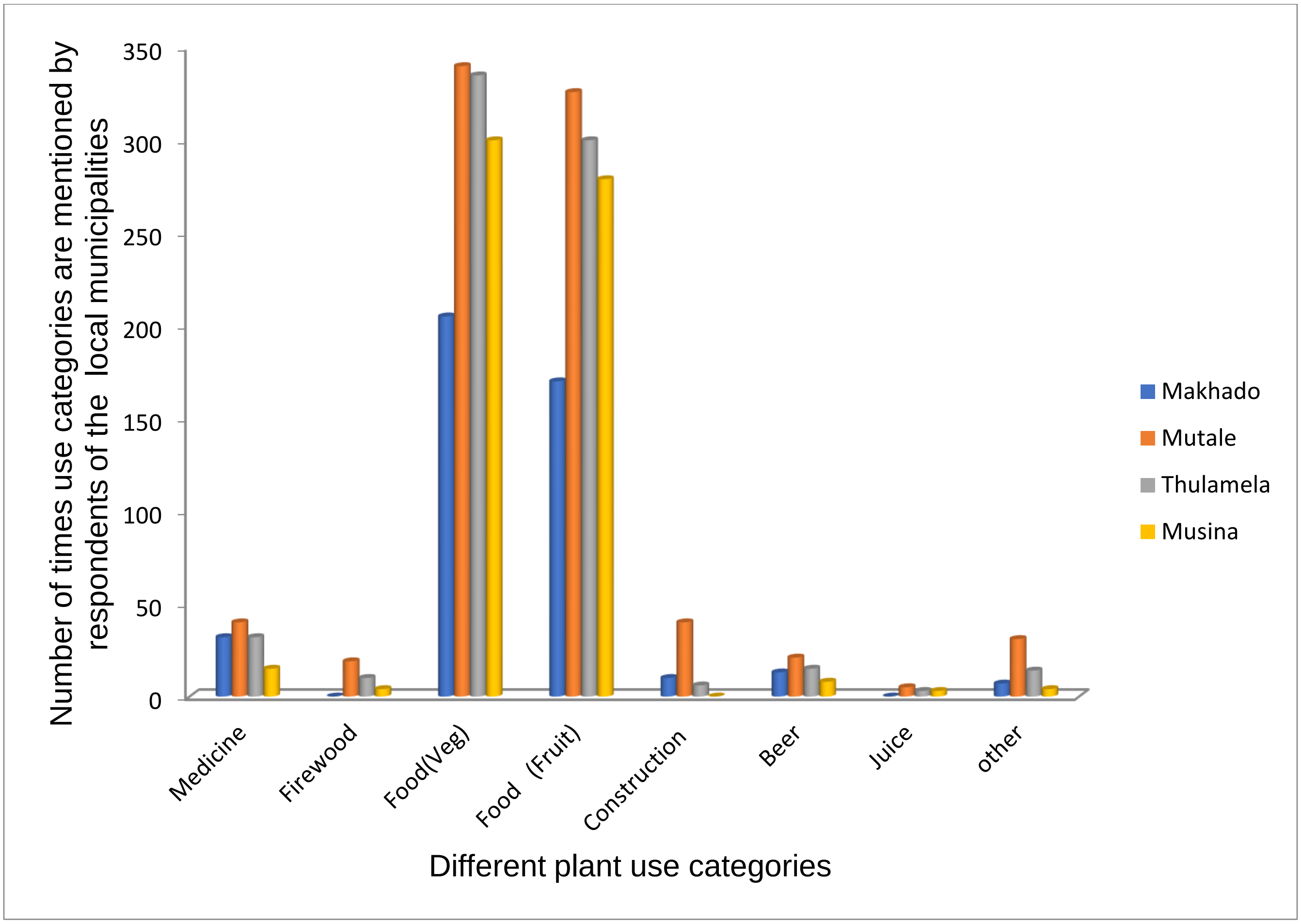

Figure 9.3.4: Number of times respondents of the four local municipalities of Vhembe District Municipality mentioned different use categories of wild edible plants.

The wild edible plants use categories depicted in figure 9.3.4 emphasized the unique indigenous knowledge portrayed by people of the Mutale Local Municipality as they managed to provide the highest numbers of the wild edible plants use categories more than other three local municipalities. The similar pattern of use categories vegetables and fruits was seen as Mutale was always at the top followed by Thulamela, Musina and then Makhado. Similarly, respondents of Mutale Local Municipality mentioned other use categories more than respondents of other three municipalities. In the study conducted by Ghorbani et al. (2012) wherein comparison of the wild food plant use knowledge of the four ethnic minorities in Naban River in South Western China was considered; it was found that one ethnic group (Dai) was different from other groups in terms of information provided as happening to respondents of Mutale Local Municipality.

The indication of statistical results displayed in table 9.3.2 is of different wild edible plants use categories which were mentioned by respondents of the four local municipalities of Vhembe. Use categories mentioned in Thulamela vs Makhado, Mutale vs Makhado and Musina vs Makhado were not much different. As indicated in table 9.3.2, significant differences are seen between the plants use categories mentioned by respondents of Thulamela vs Mutale and Thulamela vs Musina. A highly significant difference was found between use categories mentioned by respondents of Mutale vs Musina. In this case, respondents of Mutale Local Municipality reported far much more wild edible plants use categories than respondents of Musina Local Municipality.

Table 9.3.2: T-test for wild edible plants use categories in the four local municipalities of Vhembe District Municipality. Marked differences ns, * and ** refer to not significant, significantly different and highly significantly different at P< 0.05.

Local municipalities	Means	STD. DEV	P Value	Statistical differences	N
Thulamela vs Mutale	89.3750 vs 102.7500	141.3768 vs 142.6301	0.012479	*	92
Thulamela vs Makhado	89.37500 vs 54.62500	141.3768 vs 83.1486	0.139330	ns	92
Thulamela vs Musina	89.3750 vs 76.62500	141.3768 vs 131.5837	0.014560	*	92
Mutale vs Musina	102.7500 vs 76.62500	137.4693 vs 110.8503	0,002107	**	92
Mutale vs Makhado	102.7500 vs 54.6250	142.6301 vs 83.1486	0.060748	ns	92
Musina vs Makhado	76.62500 vs 54.62500	131.5837 vs 83.1486	0.253141	ns	92

Preservation techniques of wild edible plants

Respondents of this study indicated that they preserve their vegetables for future's sake. The two preservations methods which are collect and dry and collect, cook and dry were used in Vhembe region (Figure 9.3.5), however, collect, cook and dry method was preferred by most people of the study area. People of the Vhembe District Municipality showed a general trend of the preferred preservation methods as respondents of all the four local municipalities seemed to prefer using collect, cook and dry method. These results are statistically echoed by the results shown in table 9.3.3 since they show no significant differences between comparisons of all the four local municipalities.

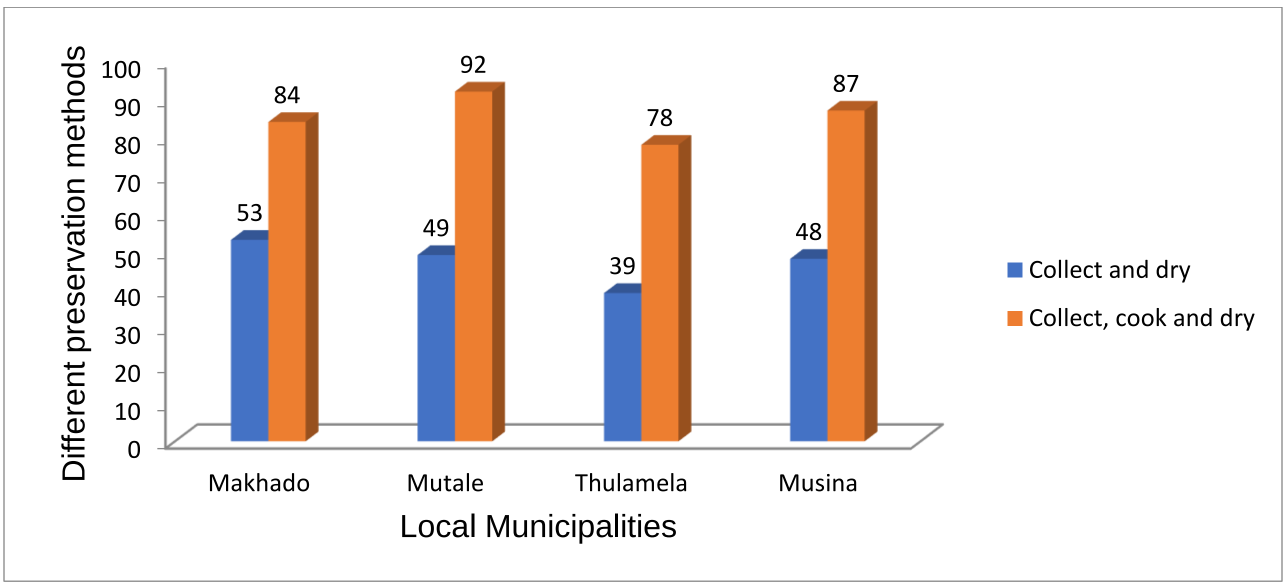

Figure 9.3.5: Different preservation methods practiced by respondents of Makhado, Mutale, Thulamela and Musina local municipalities.

Table 9.3.3: T-test for wild edible plants preservation methods in the four local municipalities of Vhembe District Municipality. Marked differences ns, * and ** refer to not significant, significantly different and highly significantly different at P< 0.05.

Local municipalities	Means	STD. DEV	P Value	Statistical differences	N
Thulamela vs Mutale	58.50000 vs 83.50000	27.57716 vs 48.79037	0.344042	ns	92
Thulamela vs Makhado	58.50000 vs 68.50000	27.57716 vs 21.92031	0.242238	ns	92
Thulamela vs Musina	58.50000 vs 67.50000	27.57716 vs 27.57716	0.423310	ns	92
Mutale vs Musina	83.50000 vs 67.50000	48.79037 vs 27.57716	0,479471	ns	92
Mutale vs Makhado	102.7500 vs 54.6250	48.79037 vs 21.92031	0.574554	ns	92
Musina vs Makhado	76.62500 vs 54.62500	27.57716 vs 27.57716	0.844042	ns	92

Results of this study are in concurrence with the findings of the research conducted in Botswana by Legwaila et al. (2011) which articulated the principal method of extending the shelf-life of indigenous vegetables through sun drying fresh or boiling in water before sun drying. The same is practiced amongst Vhavenda with an addition of few fruits that were preserved through sun drying. Respondents of Mutale Local Municipality mentioned preservation of fruits of plants like *Lannea discolor* (Munie), *Vangueria infausta* (Muzwilu), *Diospyros mesipiliformis* (Musuma) and *Grewia villosa* (Muphunzu) through sun drying. On the other hand, it was mentioned that fruits of *Hexalobus monopetalus* (Muhuhuma) can be ground to powder called *Mugumo* which can be used even when the fruits are out of season. The results give an indication of possibilities of common practice throughout the Sub-Saharan region.

Comparison of wild edible plants knowledge in local municipalities of the Vhembe District Municipality

Results displayed in Figure 9.3.7 illustrate the total number of times the plant species were cited, however, the statistical analysis performed showed a significant difference between responses from respondents of Thulamela and Makhado (Table 9.3.4). On the other hand, statistical comparison of total number of citations of respondents of Thulamela vs Musina and Mutale vs Musina was found to be highly significantly different (Table 9.3.4). Table 9.3.4 further illustrates no significant difference between total number of citations of wild edible plants by respondents of Mutale vs Makhado, Musina vs Makhado and Thulamela vs Mutale. The nature of results portrayed in table 9.3.4 is also affirmed by the correlation matrices findings shown in Figure 9.3.6 A, B, C, D, E and F which simply indicate no correlation between citations in comparison of municipalities with r value less than 0.35. These results then indicate that people of Mutale Local Municipality are more knowledgeable about the wild edible plants use as compared to other local municipalities.

Table 9.3.4: T-test for a total number of wild edible plants citations in the four local municipalities of Vhembe District Municipality. Marked differences ns, * and ** refer to not significant, significantly different and highly significantly different at P< 0.05.

Local municipalities	Means	STD. DEV	P Value	Statistical differences	N
Thulamela vs Mutale	1.000000 vs 0.967033	0.745356 vs 0.795132	0.727586	ns	92
Thulamela vs Makhado	1.000000 vs 0.802198	0.745356 vs 0.618597	0.015318	*	92
Thulamela vs Musina	1.000000 vs 0.725275	0.745356 vs 0.746338	0.0011836	**	92
Mutele vs Musina	0.967033 vs 0.725275	0.795132 vs 0.746338	0,007826	**	92
Mutele vs Makhado	0.967033 vs 0.802198	0.795132 vs 0.618597	0.079065	ns	92
Musina vs Makhado	0.725275 vs 0.802198	0.746338 vs 0.618597	0.373026	ns	92

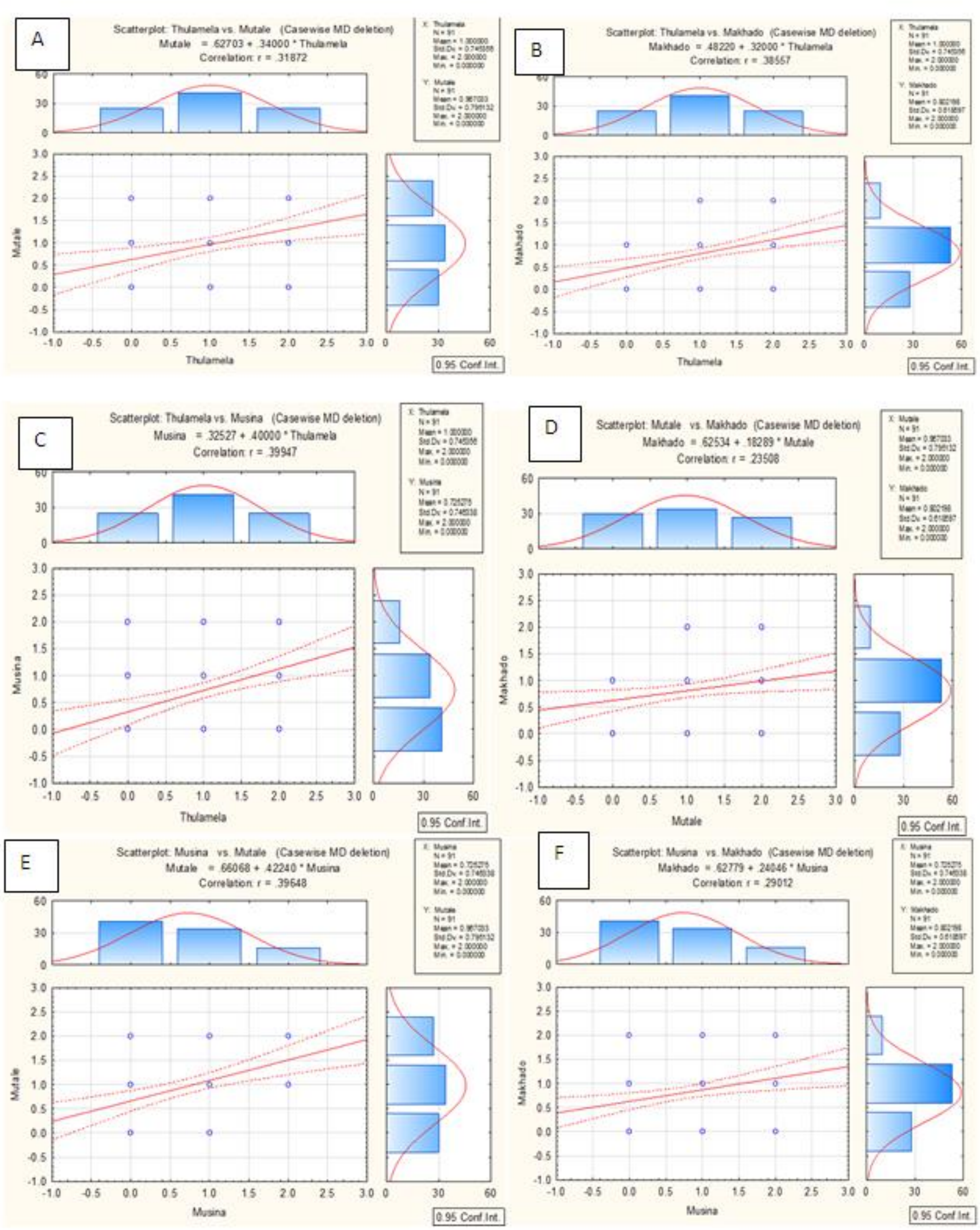

Figure 9.3.6: Correlation matrices of wild edible plant use in the four local municipalities of Vhembe District Municipality. Correlation is at r=0.5.

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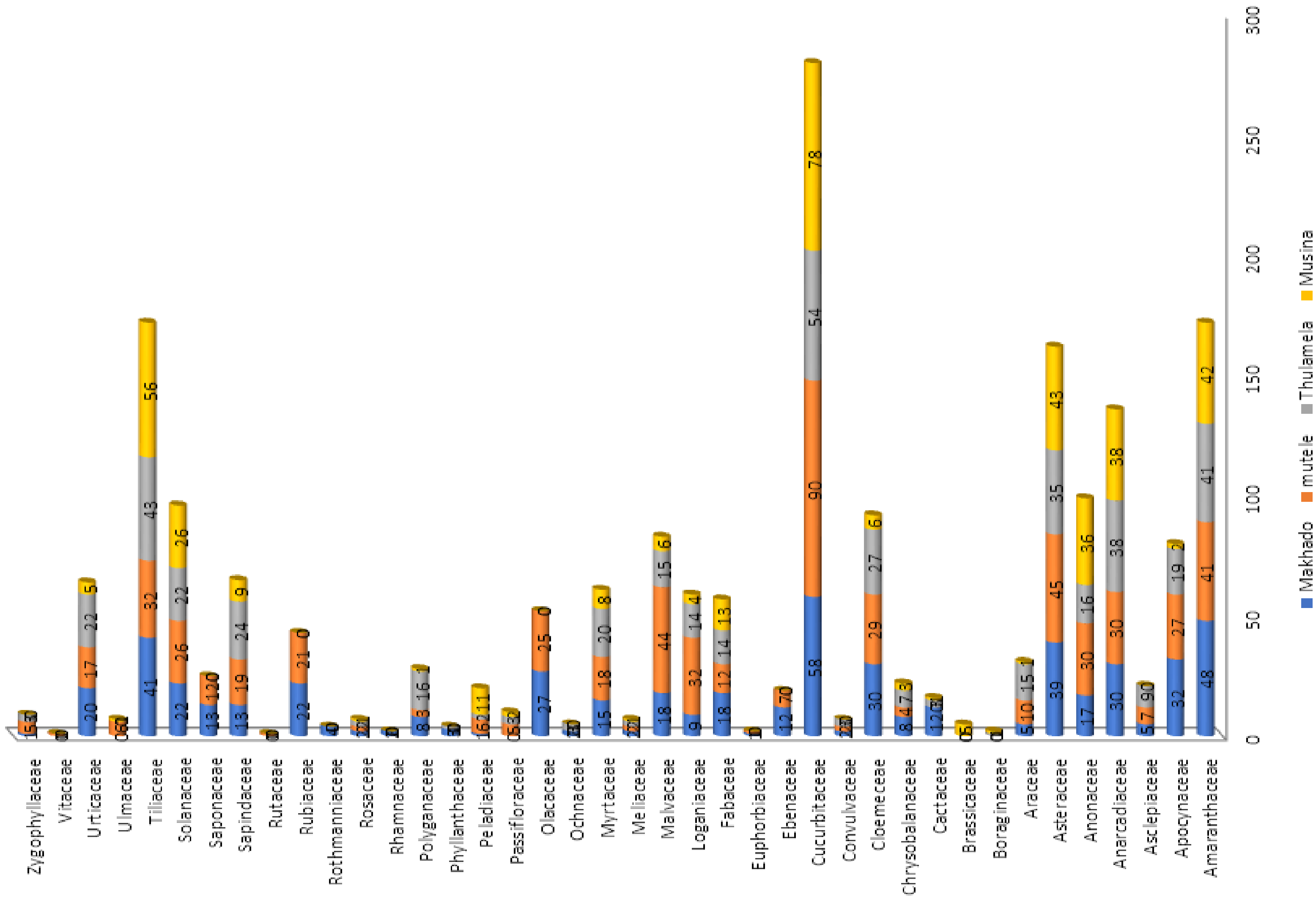

Figure 9.3.7: Total number of citations of wild edible plants of different plant families per local municipality.

Relationship of wild edible plants knowledge of local municipalities of the Vhembe District Municipality

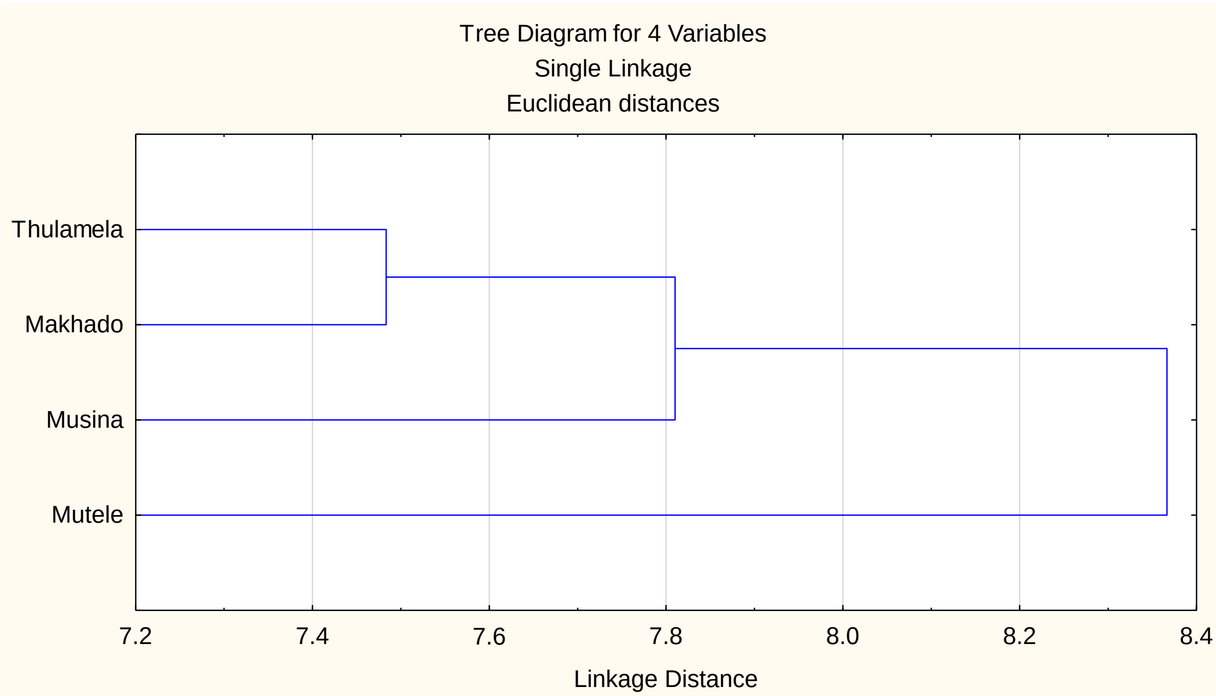

Figure 9.3.8: A dendrogram showing the result of clustering of wild edible plants use of Vhembe District Municipality.

The report of dendrogram displayed as figure 9.3.8 visually shows a cluster with an indication of close relation between the wild edible plants use of the respondents of Thulamela and Makhado local municipalities. The two sampled villages of Makhado municipality (i.e. Tshakhuma and Ha-Masia) are closer to villages of Thulamela, therefore there is an active wild edible plants use knowledge exchange. It was also discovered during interactions with respondents through interviews that people from certain villages change their locations due to marital issues, thus promoting knowledge exchange. Most interestingly, the dendrogram still shows Mutale Local Municipality to be the stand alone simply because of the respondents who were found to be more knowledgeable than respondents of other local municipalities. The noticeable reason of the outstanding wild edible plants use knowledge provided by the respondents of Mutale is their location setups. For example, respondents of Dzimauli (Pile) village are surrounded by beautiful mountainous range of which still allow them access to varies wild edible plants. Tshivhongweni and Mutele-A respondents were also amazing in terms of knowledge they provided. Ghorbani et al. (2012) 's findings are in full agreement with the results of the current study as they found the Dai to a stand-alone ethnic group simply because they live in lower elevations hence different access to the wild edible plants than other groups.

9.4 CONCLUSIONS

Results of the current investigation clearly demonstrated that indigenous knowledge transfer happens in some areas of the Vhembe district Municipality. This is due to the prevalence of immense indigenous knowledge shared by informants of the Mutale Local Municipality. Knowledge holders of this local municipality are not only elders as it was a trend in other local municipalities. In view of the trend prevailed in the three local municipalities, it is therefore obligatory to initiate educational campaigns that will engage youth members of other local municipalities to impart the knowledge about wild edible plants use. Furthermore, findings of this study revealed leaves as most commonly used parts by informants of the Vhembe region. As a valuable echo of these findings, Ghorbani et al. (2012) showed leaves as plant parts mostly used by Dai people of the South

Western China. Inhabitants of the Vhembe region used leaves for consumption as food and used them as medicine. Nevertheless, these results will therefore provide locals of the study area a suitable guidance to choices of leafy wild edible plants which can assist with their medicinal attributes.

Availability of leafy wild edible plants is seasonal; however, it was revealed that people of the Vhembe can consume these plants in all seasons. Sun drying of cooked or uncooked of leafy plants was said to be the preferred preservation methods. These findings therefore lead to the suggetions of utilization of other preservations methods like freezing of fresh cooked or uncooked leaves. This method can retain more nutrients contained in the plant more than the drying method.

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Chapter 10

GENERAL SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

10.1 GENERAL SUMMARY

10.1.1 Documentation of wild edible vegetables and fruits used by VhaVenda of the Vhembe District Municipality, Limpopo Province.

To address this objective, four sub-objectives were formulated, and summaries of findings are outlined below.

10.1.1.1 Documentation of wild edible plants.

Questionnaire surveys were conducted with a total of 160 informants who were randomly sampled from 4 different villages of each of the four local municipalities. Majority of informants were females (n = 107). Although some of the informants lacked education and some had primary education, they managed to list an array of wild edible plants (Appendix 1).

10.1.1.2 Evaluation of wild edible fruit plants with additional uses.

A total of 92 wild edible plant species were mentioned during this project. Twenty-seven of these plants were mentioned to have additional uses. The plant species with additional uses were represented in 21 different plant species [i.e. Anonnaceae (n = 2), Apocynaceae (n = 2), Anarcadiaceae (n = 2), Loganiaceae (n = 2) and Tiliaceae (n = 2)]. The remaining 16 plant families are represented by only one species. The additional use categories mentioned during the survey included cosmetic, beverages, construction, firewood, dye, medicine and artifacts.

10.1.1.3 Evaluation of wild edible vegetables with other uses.

A total of 23 species belonging to 15 plant families were recorded as wild edible vegetables with additional uses. Cucurbitaceae was found to at the top with 7 plant species. Amongst all recorded wild edible vegetables, 36% were herbs followed by 27% creepers, 23% climbers, 9% trees and 5% shrubs. Of all 23-plant species mentioned during the survey, leaves of 21 plant species were edible as potherb. Additional use categories were medicine, condiments, snacks and artifacts.

10.1.1.4 Traditional preparation of some selected wild edible vegetables.

Results of this chapter were obtained from two female informants who mentioned 90% of the wild edible vegetables. A total of 46 vegetables was recorded, however, top ten species with high frequency of citation were considered. Plant parts listed to be edible were leaves, fruits, tubers, flowers and seeds. Leaves were found used predominantly by the inhabitants of the Vhembe region. Two preservation methods (i.e. collect, cook and sun-dry and collect and sun-dry) were mentioned as the way VhaVenda follow to improve the shelf-life of their vegetables. Fifty percent of the ten considered in this study were preserved by collect, cook and sun-dry method whereas the other 50% was preserved by collect and sun-dry method. It was clearly indicated that these wild vegetables are normally prepared in pairs. Reasons of these blendings are to enhance flavour and to reduce bitterness of some bitter vegetables. In some other combinations, fruits, flowers and ground nuts or seeds are added to also enhance the flavour.

10.1.2 Quantification of use patterns of some wild edible plants.

Information gathered from informants who managed to mention six and more wild edible plants was considered. A total of 87 wild edible plant species distributed in 40 different botanical families were evaluated to quantify their use patterns by inhabitants of the Vhembe District Municipality. Of the forty mentioned families, plants of the family Malvaceae are mostly mentioned followed by plants of the families Cucurbitaceae, Solanaceae and then Amaranthaceae and Fabaceae with a tie of two species each. Five different plant growth forms were mentioned, and trees were mostly used as food followed by fruits which were also used as food. Regarding the preservation of these plants species, informants of this study preferred collect, cook and dry method. Informants of Mutale local municipalities were found to be more knowledgeable as compared to informants of other three local municipalities.

10.1.3 Knowledge transfer between elders and youth members of the vhembe District

Totals of 57, 29 and 74 were adults aged between 36 and 64, 65 and older and male and female youth members respectively. Majority of youth members had secondary education, but they indicated lack of knowledge about wild edible plants use. It was clearly indicated that female respondents of middle ages (i.e. between 36 and 65) still have knowledge about wild edible plants use. Therefore, they are regarded as knowledge holders.

10.1.4 Nutritional analysis of some selected documented wild edible vegetables

Reasons of analysing Vitamin C and Vitamin A are indicated in chapter 8. Of the eight analysed vegetables, *Amaranthus thunbergii* was found with high levels of Vitamin C (69.106%). On the other hand, *Solanum retroflexum*, *Sonchus asper* and *Amaranthus hybridus* were found to have high levels of Beta carotene of 10.905, 10.367 and 10.618 respectively.

10.2 CONCLUSIONS

Findings of the present study highlighted the use of wild edible plants which is mostly by elderly members of the Vhembe communities. The nature of these findings is providing fundamental information about the rapid erosion of indigenous knowledge amongst youth members of the Vhembe District Municipality. Imparting and sustaining indigenous knowledge about various uses of wild edible plants can contribute in improving nutrient imbalances found in children living in deep poor rural sections of the study area.

Several plant species profiled during this project indicated the opportunity for the manufacturing of new drugs. For example, plants like *Bidens pilosa*, *Momordica charantia*, *Momordica balsamina*, *Momormodica foetida* and *Lagenaria siceraria* showed beneficial medicinal properties to people of the Vhembe region. Medicinal attributes of these plants are essential towards mitigation of diabetes and hypertension which is a problem not only to the Vhembe Municipality but to Limpopo Province and whole of South Africa. Promoting consumption of medicinal vegetables, particularly by people with diabetes and hypertension can substantively contribute in reducing prevalence of these diseases.

The current study further underlined two various methods used in preserving wild edible plants to ensure their availability even when they are out of season. Most outstandingly to note, the two methods mentioned during the survey were only about sun drying either cooked or uncooked which realistically compromise nutrient contents of the plants. Introduction of new methods of preserving the wild edible plants with limited compromised nutrients can be of great help to retaining desirable nutrients for good health. These new methods include freeze-drying and freezing of uncooked fresh plant material.

10.3 RECOMMENDATIONS

In view of the results obtained in chapter 4, most of youth members who have been interviewed lacked adequate knowledge about the use of wild edible plants. Campains disseminating wild edible plant uses are recommended. This exercise can be achieved by engaging learners from local schools and churches with informative flyers like the one attached as Appendix 7. Furthermore, promotions of wild edible plants consumption by young members of Vhembe communities will be addressed by including nutrition values of these plants in the flyers. It is well known that youth members of now adays prefer social media to acquire information; therefore I created a website page with the address www.vendateplants.co.za. (Appendix 8) which will also aid with the different recipes for preparations of traditional cuisines.

For further research, production of food stuffs which are results of mixing wild edible plant parts with food liked by children is recommended. For example, vetkoekies that are produced from a mixture of powered leaves of Amaranthus and flour. It is indicated in chapter 5 that pulp from fruits of *Sclerocarya birrea* is used to make candies which can be favoured by school children. Consumption of these candies will promote intake of Vitamin C which is found to be high in the fruits of Marula tree. Part of results emanating from chapter 7 and 9 of this study revealed sun drying of cooked and uncooked wild vegetables serve as the only preservation method employed by people of the Vhembe region. Sun drying method can promote infestation of microorganisms that can change the healthy status of the vegetables; therefore, utilization of solar dryers which are affordable and vegetables health status promoters is recommended.

Nutritional evalution conducted during the current study concentrated on only limited number of wild edible vegetables. For further nutritional analysis study, more surveys are therefore recommeded to cater wild edible fruit plant species which were not analyzed in the current study. Lastly, it was mentioned during the survey that some plants species can be cultivated in backyards of informants' homesteads. Nevertheless, to enhance huge availability of these plants, a research focusing on large scale wild edible plants cultivation needs to be considered. A survey of this nature can assist in job creation and with the enhancement of the growth of the economy.

APPENDICES

APPENDIX 1

University of Venda

Questionnaire for the study entitled '**Documentation and Nutritional Analysis of some wild edible vegetables and fruits of the Vhembe District Municipality. Limpopo Province, South Africa'.**

Informants' consent for the participation in the study:

I.. (name of informant) hereby give my full consent and conscious to participate in this study and declare that to the best of my knowledge the information that I have provided are true, accurate and complete.

Date.......................................

Informants' details:

Gender..

Age..

Occupation...

Education...

Ethnicity …………………………………………………………………………………

Location/Residence...

Plant (local name					
Habit					
Method of consuming the fruit.					
Cultivated / uncultivated					
Availability high, moderate or less available?					
Method of storage for future use					
Conservation needs					
Conservation efforts by Government and Tribal authority					
Season of the plant's availability					
How does it taste like? (Good, Moderate, Bitter)					
where did you get information about wild edible fruits					
Other uses					

APPENDIX 2

University of Venda

Questionnaire for the study entitled '**Documentation and Nutritional Analysis of some wild edible vegetables and fruits of the Vhembe District Municipality. Limpopo Province, South Africa'.**

Informants' consent for the participation in the study:
I [illegible] (name of informant) hereby give my full consent and conscious to participate in this study and declare that to the best of my knowledge the information that I have provided are true, accurate and complete.

Date 18/04/2015

Informants' details:

Gender: female

Age: 24

Occupation: unemployed

Education: GRD 9

Ethnicity: Black

Location/Residence: Madimbo

Data about wild edible vegetables

Plant (local name	Shauhe ✓	Deledele ✓	Vowa ✓		
Habit	herb ✓	✓	✓		
Plant part	leaves ✓	✓	✓		
Cultivated / uncultivated	uncultivated ✓	✓	✓		
Availability high, moderate or less available?	high	✓	✓		
Method of storage for future use	collect cook * sundry	collect sundry	* collect cook sundry		
Method of cooking the vegetables	mixed with Vowa *	None ✓	*		
Season of the plant's availability	Summer ✓	✓	✓		
How does it taste like? (Good, Moderate, Bitter)	Bitter	good ✓	✓		
Other uses	None	✓	✓		

Data about wild edible fruits

Plant (local name	Mbuyu	kraakraa	Guumari	Mahuhuma	Magwada
Habit	Tree	–	–	–	–
Method of consuming the fruit.	pulp	–	–	–	–
Cultivated / uncultivated	uncultivated	–	–	–	–
Availability high, moderate or less available?	high	–	–	–	–
Method of storage for future use	None	collect dry	–	–	–
Conservation needs	yes for people to enjoy this fruits in the future				
Conservation efforts by Government and Tribal authority	yes they are not allowed to cut down this trees by T.A				
Season of the plant's availability	summer	–	–	–	–
How does it taste like? (Good, Moderate, Bitter)	Good	–	–	–	–
where did you get information about wild edible fruits	from parents				
Other uses	None	–	–	–	–

APPENDIX 3


13


KFC offers a hot side
order for Mother's Day

APPENDIX 4a

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Medicinal uses of selected wild edible vegetables consumed by Vhavenda of the Vhembe District Municipality, South Africa

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ABSTRACT

The use of wild vegetables as a source of food is well-documented all over the world. However, some of the wild vegetables have since found their way into the database of medicinal plants. The purpose of this study was to assess the medicinal value of wild vegetables consumed by local people of Vhembe District Municipality of South Africa.

Thirteen wild vegetables reported to have medicinal value were assessed in this study. The 14 wild vegetables with medicinal values were found to be distributed within 10 plant families. Cucurbitaceae was found to be the dominant family followed by Malvaceae. Leaves were the main part used in preparation of medicines from wild vegetables. The use of leaves is found to be the most sustainable mode of medicinal preparation since it do not impact negatively on wild vegetables. The consumption of wild vegetables with medicinal values as food should be encouraged since they may assist in the well-being of communities.

1. Introduction

Wild plant species have been used worldwide over many years as part of human diet. Several studies dealt with the identification and classification of wild edibles including vegetables (Bonet and Valles, 2002; Pieroni et al., 2002). Their findings frequently indicated the medicinal uses and nutritional properties of these wild edibles. Wild plant species are plant species that are neither managed nor cultivated (Tardío et al., 2006). Other works have pointed out that there is unquestionable strong relationship between food and medicine (Etkin 1994; Pieroni 2000). The relationship is in such a way that the possibilities of separating food use from medicinal use appear slim.

In Africa, wild edible vegetables have been seen as a contributor of significance when it comes to socioeconomic well-being of societies. The use of wild edible vegetables for medicinal purposes was also documented in Zimbabwe (Maroyi, 2011). Many studies conducted in the Vhembe region of the Limpopo Province in South Africa concentrated on the documentation and evaluation of some of the wild edible vegetables (Nesamvuni et al., 2001; Maanda and Bhat, 2010). The fact that nothing is being done on the medicinal vegetables of this region aroused a need to survey the wild edible vegetables with medicinal uses that can help local people. Documentation of wild edible vegetables with medicinal value may go a long way in the discovery of drugs from these wild vegetables whose leaves can be easily harvested in a sustainable manner. The aim of this study was to assess the medicinal use of selected wild edible vegetables consumed as a source of food by local people of Vhembe District Municipality of South Africa.

The traditional medicine use is not a new practice since it was seen receiving a remarkable attention in the 1990s (FAO, 1997). In other parts of the world such as USA, Europe and Australia, the health roles of wild edible vegetable consumption are also receiving attention as functional foods, nutraceuticals or phyto-nutrients (Craig, 1999). Additionally, Chen (2000) emphasized that the issue of thinking about food as medicine existed in the Chinese medical theories and Chinese food therapy as far back as time immemorial. Falconer and Arnold (1991) emphasize the fact that many wild plants have multiple uses, for example, providing nutrients, and promoting dietary variety, feeding livestock and providing medication for humans.

2. Materials and methods

2.1. Study area

The study was conducted in the Vhembe District Municipality region in the Limpopo Province of the Republic of South Africa. Limpopo is the northernmost province of the nine provinces in South Africa and shares its borders with Zimbabwe and Botswana. To the East, Limpopo is bordered by the Kruger National Park and Mozambique. The climate is variable with temperate and subtropical areas, and most of the population lives in rural villages and survives by subsistence farming in maize and livestock. Vhembe District Municipality lies between 22°56′ S and 30°28′E (Netshifhefhe et al., 2017).

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The current study focused on selected four deep rural villages situated in each of the four local municipalities of the Vhembe district municipality namely; Makhado, Mutale, Thulamela and Musina local municipalities. A total of 16 rural villages were therefore visited for data collection. The general vegetation of Vhembe District is classified as Mopani Bushveld (Low and Rebelo 1998). This vegetation type is characterized by *Colophospermum mopane* (J.Kirk ex Benth.) J.Léonard shrubs. The humidity of the area is ±40%. The district municipality experiences an annual temperature ranges from a minimum of −3.6 °C during cold winter seasons and a maximum of 43.5 °C during hot summer seasons (McFarlane 2017).

2.2. Data collection and analysis

This study was undertaken over a period of 12 months in selected villages of the four local municipalities of the Vhembe district. The purposive sampling approach was followed as investigations were carried out among 160 respondents in their own Tshivenda language. Semi-structured questionnaire was used to interview respondents after Prior Informed Consent was obtained verbally with them before commencing each interview. During the interviews, respondents were asked questions about the names of known wild edible vegetables, methods of preparations, taste, supply system and other additional uses. The collection of voucher specimens assisted in clarifying the confusion that usually arise due to reference by local people to one species by two or more common names. In some cases different species are known by one common name. The pressed voucher specimens were validated and deposited at the University of Venda herbarium housed in Botany department. Validation of authority on botanical names was done through the International Plant Names Index (IPNI) database. http://www.ipni.org/ipni/simplePlantNameSearch.do.

From all the inventoried wild edible vegetable species, 20 mostly cited vegetables were selected by using the relative frequency of citation or quotation index (RFC) which is calculated by the following formula,

$$RFC = (FC/N) * 100,$$

where FC is the number of informants who mentioned the plant species and N is the total number of informants (Madikizela et al. 2012).

3. Results and discussions

3.1. Informants profile

Among the 160 respondents interviewed in this study, most of them were youth aged between 18 and 35 ($n = 74$) followed by elders aged 61 and above ($n = 47$). Adults aged between 36 and 60 ($n = 39$) constituted the least category. The results show that elders contributed more vegetables with medicinal values as compared to other age categories. When looking at gender, females ($n = 107/160$) dominated over males ($n = 53/160$). Fifty six percent of the surveyed respondents hold secondary education while 6, 13 and 25% had tertiary education, no education and primary education respectively.

3.2. Taxonomic diversity, life forms and plant parts used

Forty-five wild vegetables indicated on Table 1 were recorded from the 160 respondents. The recorded vegetables belong to 18 plant families dominated by Cucurbitaceae family ($n = 8$). Amarantaceae ($n = 5$) was the second most family followed by Asteraceae ($n = 4$), Malvaceae ($n = 4$), and Solanaceae ($n = 4$) as the third most documented families. According to Jeffrey (1980), Cucurbitaceae is dominantly represented in tropical Africa, and almost found in every garden where it forms part of diet due to its association with man.

Table 1
Recorded wild edible vegetables consumed by Vhavenda of Limpopo Province.

Family	Botanical name	Common English (E) and Venda (V) names
Amaranthaceae	*Amaranthus dubius* C. Mart ex Thell.	Vowa (V), Spleen Amaranth (E)
Amaranthaceae	*Amaranthus hybridus* L.	Thebe (V), Slim amaranth (E)
Amaranthaceae	*Amaranthus spinosus* L.	Mukhuluvhali (V), Spiny amaranth (E)
Amaranthaceae	*Chenopodium album* L.	Daledale (V), Goosefoot (E)
Amaranthaceae	*Amaranthus cruentus* L.	Mugango (V), Red amaranth (E)
Araceae	*Colocosia esculenta* (L.) Schott	Mufungwi (V), Taro (E)
Asclepiadaceae	*Pentarrhinum inspidum* E. Mey	Phulule (V), African heartvine (E)
Asteraceae	*Bidens pilosa* L.	Mushidzhi (V), Blackjack (E)
Asteraceae	*Sonchus asper* (L.) Hill	Shashe (V), Sowthistle (E)
Asteraceae	*Bidens bipinnata* L.	Mushidzhi donga (V), Spanish needle (E)
Asteraceae	*Taraxacum officinale* F.H.Wigg.	Shashe (V), Dandelion (E)
Capparaceae	*Cleome monophylla* L.	Mutohotoho (V), African Spider Flower (E)
Capparaceae	*Cloeme gynandra* L.	Murudi (V), Stinkweed (E)
Convolvulaceae	*Ipomoea obscura* (L.) Ker Gawl	Muduhwi (V), Wild petunia (E)
Cucurbitaceae	*Momordica foetida* Schumach.	Nngu (V), African Wild Cucumber (E)
Cucurbitaceae	*Cucurbita pepo* L.	Phuri/Thanga (V), Pumpkin (E)
Cucurbitaceae	*Cucumis africanus* L. f.	Tshinyagu (V), African Wild Cucumber (E)
Cucurbitaceae	*Momordica balsamina* L.	Tshibavhe (V), African cucumber (E)
Cucurbitaceae	*Lagenaria siceraria* L.	Muphapha (V), Bottle gourd (E)
Cucurbitaceae	*Citrillus lanatus* L.	Muvani (V), Wild melon (E)
Cucurbitaceae	*Momordica foetida* L.	Nngu (V), French concombre sauvage (E)
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad.	Mutshatsha (V), Bitter cucumber (E)
Euphorbiaceae	*Tragia* spp.	Mbuvambuvane (V),
Euphorbiaceae	*Erythrococca menyharthii* (Pax) Prain	Tshinzie (V), Northern Red-berry (E)
Fabaceae	*Vigna unguiculata* (L.) Walp.	Munawa (V), Cow pea (E)
Fabaceae	*Vigna subterranean* (L.)Verdc.	Phonda (V), Bambara groundnut (E)
Fabaceae	*Arachis hypogaea* L.	Muduhu (V), Groundnut (E)
Malvaceae	*Abelmoschus esculentus* (L) Moench.	Delele Mandande (V), Lady's fingers (E)
Malvaceae	*Adansonia digitata* L.	Muvhuyu (V), Baobab (E)
Malvaceae	*Malva sylvestris* L.	Tshiteaduvha (V), High mallow (E)
Malvaceae	*Hibiscus trionum* L.	Delelemukhwayo (V), Flower of an hour (E)
Passifloraceae	*Adenia digitate* Burtt Davy	Dundu (V), Wild granadilla (E)
Pedaliaceae	*Dicerocaryum zanguebarium* (Lour.)Merr.	Museto (V), Devil's thorn (E)
Polygonaceae	*Oxygonum dregeanum* Meisn	Mutanyi (V),
Solanaceae	*Solanum retroflexum* Dunal	Muxe (V), Wonderberry (E)
Solanaceae	*Capsicum annuum* L.	Muphiriphiri (V), Serrano pepper (E)
Solanaceae	*Solanum nigrum* L.	Xaxadi (V), Black Nightshade (E)
Solanaceae	*Solanum lycopersicum* L.	Mutamatisi (V), Tomato (E)
Tiliaceae	*Corchorus tridens* L.	Delele (V), Wild jute (E)
Tiliaceae	*Grewia occidentalis* L.	Mulembu (V), Cross-berry (E)
Ulmaceae	*Trema orientalis* (L.) Blume	Mukurukuru (V), Pigeon wood (E)
Urticaceae	*Urtica dioica* L.	Dzaluma (V), Stinging nettle (E)
Urticaceae	*Obetia tenax* (N. E. Br.)Friis	Muvhazwi (V), Rock tree-nettle (E)
Urticaceae	*Pouzolzia mixta* Solms	Tshitanzwa (V), Soap nettle (E)
Zygophyllaceae	*Tribulus zeyheri* Sond.	Tseto (V), Calthrop (E)

A total of 13 wild edible vegetables with medicinal uses were observed from the 45 recorded vegetables (Table 1) and were botanically identified into 9 families (Table 2). Cucurbitaceae was found to be the most represented family with four species from

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Table 2
Ethnomedicinal properties of documented medicinal wild edible vegetables.

Botanical and family names	Common English (E) and Venda (V) names	Lifeforms	Plant part(s) used	Citation percentage (%)	Taste	Medicinal applications	Other reported therapeutic uses
Abelmoschus esculentus (Moench) MALVACEAE	Okra (E), Delele-Mandande (V)	Herb	Fruits	58.8	Good	Cooked leaves and fruit pulp eaten as potherb which helps in relieving constipation.	Used as Ayurvedic medicines (Tomar, 2017). Fruits contain monomer compounds with antifungal and cytotoxicity activities (Li et al., 2015).
Adansonia digitata L. MALVACEAE	Baobab (E), Muvhuyu (V)	Tree	Leaves	16.6	Moderate	Cooked leaves are eaten by women as potherb at the same time acting as the period pains reliever.	Treatment of fever and diarrhea (Sugandha et al., 2013). Leaves contain high antibacterial activities (Suliman and Nour, 2017).
Bidens pilosa L. ASTERACEAE	Blackjack (E), Mushidzhi (V)	Herb	Leaves	50.6	Bitter	Squeezed liquid from leaves is applied on wounds and also used as ear drops to relief earache.	Treat inflammation, digestive disorders, cancers and wounds (Bartolome et al., 2013). Leaves contain antioxidant properties (Goudoum et al., 2016)
Cleome gynandra L. CAPPARACEAE	Spider-wisp (E), Murudi (V)	Herb	Leaves	26.9	Bitter	Decoction of leaves is taken orally to reduce the blood pressure.	Stimulation of milk production in breastfeeding mothers (Dansi et al. 2008). Leaves contain antinociceptive and anti-inflammatory activities (Mishra et al., 2011)
Grewia occidentalis L. MALVACEAE	Lavender Starflower (E), Mulembu (V)	Shrub	Leaves	19.6	Moderate	Crushed leaves are used to dress wounds (paste).	Turner (2008) also noted its use of bark in treatment of wounds.
Lagenaria siceraria (Molina) Standl. CUCURBITACEAE	Calabash gourd (E), Muphapha (V)	Creeper	Leaves	24.4	Good	Cooked leaves are eaten by women as potherbs at the same time relieving period pains.	Fruits syrup for pectoral cough, asthma and other bronchial disorders (Shah et al., 2010). It contains biologically active phytoconstituents (Prajapati et al., 2010).
Momordica balsamina L. CUCURBITACEAE	Balsam apple (E), Tshibavhe (V)	Climber	Leaves	10.6	Bitter	Decoction of leaves is taken orally to stabilize blood and sugar levels.	Poultice for burns and in treatment of diabetes (Hutchings et al. 1996).
Momordica charantia L. CUCURBITACEAE	Bitter melon (E), Lugu (V)	Climber	Leaves	19.4	Bitter	Decoction of leaves taken orally to stabilize blood and sugar levels.	Anti-HIV, anti-ulcer, anti-inflammatory, anti-leukemic, anti-microbial, anti-tumor (Paul and Raychaudhuri, 2010). Triterpenoids are major constituents (Li et al., 2015).
Momordica foetida L. CUCURBITACEAE	Nngu (V)	Climber	Leaves	19.3	Bitter	Decoction of leaves is taken orally to stabilize blood and sugar levels.	Treatment of fever, diabetes mellitus, blood pressure and malaria (Froelich et al., 2007). Contains antioxidant activities (Acquaviva et al., 2013).
Obetia tenax (N.E.Br.) Friis. URTICACEAE	Rock tree-nettle (E), Muvhazwi (V)	Tree	Leaves	21.3	Good	Leaves are cooked and used as purgative.	Root pulp applied on snakebites (Neuwinger, 2000; Shackleton et al., 1998).
Pentarrhinum insipidum E. Mey. ASCLEPIADACEAE	African heartvine (E), Phulule (V)	Climber	Leaves	19.4	Good	Infusion of crushed leaves is used to bath a new baby for strengthening purposes.	Decoction used in treatment of anaplasmosis (Nanyingi et al., 2008). It has good antifungal activities.
Solanum retroflexum L. SOLANACEAE	Nightshade (E), Muxe (V)	Herb	Leaves	34.3	Bitter	Squeezed liquid from leaves is used to treat earache in children.	Used medicinally (van Wijk et al., 2017).
Vigna unguiculata (L.) Walp. FABACEAE	Cowpea (E), Munawa (V)	Creeper	Leaves	26.6	Moderate	Cooked leaves are eaten to treat stomach problems.	Roots used in treatment of epilepsy, chest pain and dysmenorrhea (Madamba, et al. 2006; Bryson and Defelice, 2009). Contains hypolipidemic activity (Allah et al., 2017)

two different genera. It was followed by Malvaceae with three species from three different genera. The remaining seven families were represented by one species each. The fact that Cucurbitaceae was found to be represented by the highest number of species with medicinal properties, is in line with findings made by Dansi et al. (2008), in their documentation of traditional leafy vegetables of Benin. In that study, Cucurbitaceae was also found to contribute more species as compared to other documented families.

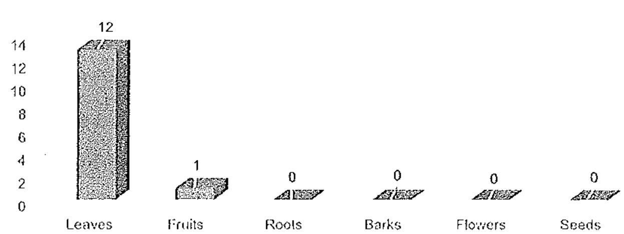

Fig. 1. Plant parts utilization reported respondents of Vhembe District Municipality.

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During the current survey it was apparent that leaves (n = 12) were the most used part in preparation of medicines used in treatment of different diseases (Fig. 1). Fruits of one of the wild vegetable were also reported to have medicinal properties.

Five different life forms were observed from the profile of the 13 selected wild edible vegetables. Among the five life forms were herbs (4), climbers (4), creepers (2), trees (1) and shrubs (2) (Fig. 2). The fact that trees contributed a small percentage is a good sign of medicinal practice since most harvesting techniques of trees for medicinal purposes are usually destructive. Avoiding or reduction of harvesting medicinal materials from tree species may promote their conservation efforts. Threat of extinction as a result of overharvesting of trees and habitat destruction throughout the world and mostly in African countries has also been lamented by Chen et al. (2016).

Fig. 3 shows the different taste attributes measured in relation to bitterness as reported by respondents on vegetables with medicinal properties. Most of the plants have been reported to have bitter taste. Interestingly, it was mentioned during the survey that vegetables with bitter taste are able to ease diseases such as diabetes and hypertension. It was explained further that the anti-diabetic and the lowering of blood pressure properties of bitter tasting vegetables may be due to the fact that "*bitter foods lower the levels of sugar in the blood*".

According to Leonti et al. (2002) and Pieroni et al. (2002), taste of vegetables play an important role in the adaptive behavior of human beings, especially in determining cognitive characteristics of medicinal vegetables. The possible parts that can be used for the preparations of various remedies for various ailments include leaves, roots, barks, flowers, fruits, seeds and whole plant. It is evident from the responses quoted by the respondents of the current survey, that the vegetables with bitter taste are perceived to be very good for maintenance of healthy lives.

3.3. Medicinal applications and dosage

As indicated in Table 2, the majority of the wild edible vegetables reported to be used for medicinal purposes are for treatment of blood pressure and sugar diabetes. In treatment of these various medical conditions, most of the vegetable leaves are eaten when cooked (n = 5) whereas in some of them a decoction (n = 4) is used. Liquid from fresh squeezed leaves (n = 2) is used either in treatment of earache or wounds. The vegetables were also reported to be used as pastes (n = 1) in wounds dressing.

Abelmoschus esculentus (58.8%) and *Bidens pilosa* (50.6%) were the most highly cited wild vegetables as per relative frequency of citation percentage. Although RFC varied among respondents, *Momordica balsamina* (10.6%) was a vegetable cited the least. *Abelmoschus esculentus* which has been highly cited in this study has been reported by Diouf et al. (1999), for its medicinal virtues as well as its rich source of vitamins. Its fruits are also used in preparation of a tonic that is effective against diabetes, rickets, arterial hypertension and constipation.

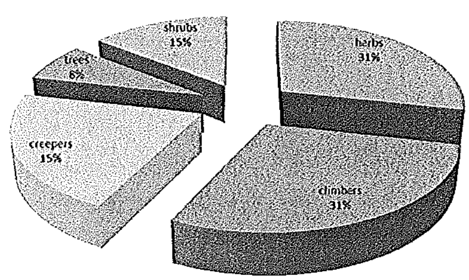

Fig. 2. Different life forms of selected wild edible vegetables.

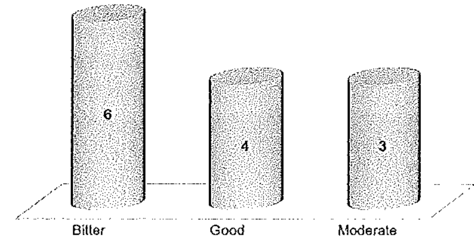

Fig. 3. Number of plant species per different tastes.

According to Diouf et al. (1999), the consumption of leafy vegetables is also linked to the traditions and dietary patterns of each ethnic and socioeconomic group. Arthur et al. (2012) attested that the consumption of the leaves of *B. pilosa* has been reported as a risk factor for esophageal cancer in South Africa. On the other hand, pharmacological studies conducted on this plant showed a number of many bioactive compounds including terpenes, tannins, essential oils amino acids and ascorbic acid that aid in the remedial of many various ailments (Silva et al. 2011). Although *Momordica balsamina* has been least cited, Hutchings et al. (1996) reported that the Zulus in KwaZulu-Natal of South Africa use its infusions for treatment of stomach pains. They also use it in a poultice for burns and in treatment of diabetes.

4. Conclusions

Results of the current investigation clearly demonstrated that wild vegetables are perceived to have medicinal values. Additionally, the results presented in this report will therefore provide locals of Vhembe District municipality with suitable guide to choices of wild vegetables of medicinal importance. Adequate consumption of bitter vegetables of the Cucurbitaceae family is perceived by Vhembe district community members to improve health by minimizing chances of diabetes and hypertension. Rajasree et al. (2016) reported that cucurbit plants are a rich source of protein that poses many biological compounds necessary for good health. As a valuable support of these findings, Rahman and Sousa-Poza (2010) argues that when we consume vegetables we get proper nutrition to live healthy lives.

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APPENDIX 4b

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An evaluation of additional uses of some wild edible fruit plants of the Vhembe District Municipality in the Limpopo Province, South Africa

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The current study documented and evaluated other uses of wild edible fruit plants in one of the district municipalities of South Africa. Data on indigenous uses of wild edible fruit plants collected through a series of semi-structured interviews with 160 informants is presented. Of the 92 wild edible fruit plant species belonging to 20 different plant families, 27 plant species were reported to have other uses. Other use categories mentioned during the interviews were food, medicinal, beverages, construction, firewood, cosmetic, dye and artifacts.

Keywords: Informants, Multiple uses, Use categories, Vhembe District Municipality, Wild edible fruit

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Biodiversity is highly significant in securing different fundamental human needs[1]. Millions of people, mostly in developing countries gathered plant resources to fulfill various daily requirements since time immemorial. It has also been pointed out that most people in developing countries derived a substantial part of their subsistence and income from wild plant products[2]. These natural products also make a significant contribution to the human and animal food web and are often a means of survival for millions of poor rural households[3-7]. It is predominantly paramount to consider the fact that wild plants can be utilized in many different important ways. Not only do wild edible fruit plants contribute to the nutritional value of human diet, but they can also provide many other uses. Some are medicinally important[8,9], whilst others are used for purposes such as beverage production[10]. Multiple uses attest to the importance of these plants for subsistence and as a part of local cultural heritage[11]. Many researchers documented the use of wild foods, in resolving food insecurity and as one of the major coping mechanisms at times of food shortage and famine[12-19]. Indigenous wild fruits remain one of the major options for coping with hunger and nutritional deficiency in diets of poverty stricken communities in Southern Africa. Some uses of indigenous food plants were also documented on the ethnobotany of *Vhavenda* an indigenous community of Vhembe District Municipality[8]. Additionally, some 41 wild food plant species which can be used to produce traditional beverages were also documented from the same region[10]. The aim of the study was therefore to document and evaluate the uses of wild edible fruit plants of the Vhembe district.

Methodology

The current study was conducted in the Vhembe District Municipality of the Limpopo Province, South Africa. Vhembe District covers about 2771 km^2 and has an average altitude of 400 m above mean sea level[20]. Vhembe District Municipality lies between 22°56´S and 30°28´E. It is divided into four local municipalities namely Makhado, Mutale, Musina and Thulamela[21]. It shares borders with Botswana in the North-west, Zimbabwe in the North and Kruger National Park in the East (Fig. 1)[10]. The mean annual rainfall ranges of between 378 mm and 810 mm has been recorded in the area[21]. The state of climatic conditions in most parts of Vhembe District Municipality supports a variety of natural vegetation types. Such vegetation types include the North-eastern mountain bushveld, mixed bushveld, sour mixed bushveld as well as mopane bushveld[22]. All these

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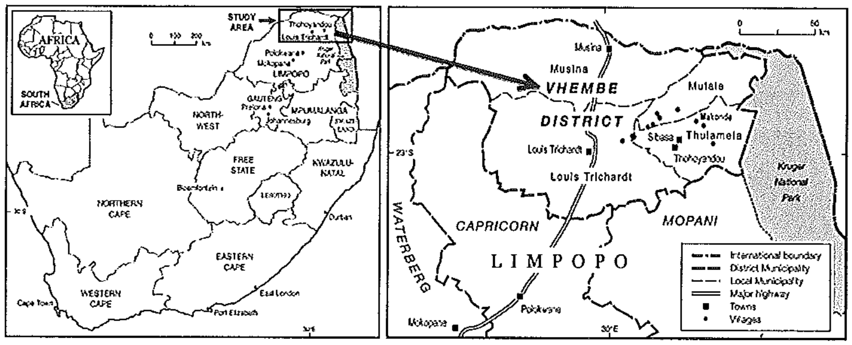

Fig. 1 — A map showing the location of the study area.

vegetation types are located within the savanna biome of the Limpopo Province[23]. In addition, there are some woodlands stretching along the Soutpansberg mountain range that have thickets and pockets resemblance of the well-developed Afromontane forests[21].

The study focused on Tshivenda speaking inhabitants of the selected rural villages within the four local municipalities of the Vhembe District (Table 1). An ethnographical approach and purposive sampling were used during data collection. Due to enormous changing of lifestyles in most rural areas that are gradually becoming urbanized, purposive sampling was used in order to capture indigenous information about different uses of wild edible fruit plants from different informants of different age groups. Subsequently, ten informants were sampled in each community of the selected villages and interviewed using semi-structured interviews. Prior informed consent was obtained before interviews. The information on fruit plants documented for this research included family names, scientific names, local or vernacular names of plants, growth habit, other additional uses, and plant parts utilized for those other uses. Voucher specimens collected were identified and deposited to the University of Venda Herbarium. Photographs of the plants and edible parts were taken using Fujifilm Digital Camera FinePix HS10. Scientific names and more taxonomic information were verified using the International Plant Names Index (IPNI)[24].

Table 1— Outline of the local municipalities, the studied villages and their locations within the municipalities

Name of the local municipality	Villages	Coordinates of the study villages
Makhado	Ha-Nthabalala	-23,286352 ; 29,958219
	Ha-Madodonga	-23,086033 ; 29,683193
	Tshakhuma	-23,060434; 30,308650
	Ha-Masia	-23,216520 ; 30,330353
Mutale	Pile (Dzimauli)	-22,590940 ; 30,435505
	Tshivhongweni	-22,568836 ; 30,594393
	Ha-Makuya	-22,637461 ; 30,874103
	Mutele A	-22,478291 ; 30,870107
Musina	Madimbo	-22,448918 ; 30,562196
	Malale	-22,392859 ; 30,588908
	Tshikhudini	-22,467727 ; 30,595178
	Tanda	-22,451758 ; 30,586934
Thulamela	Vondo	-22,912577 ; 30,390894
	Ha-Begwa	-22,778123 ; 30,806271
	Gondeni (Sterkstroom)	-22,914769 ; 30,608938
	Mukula (Tshirunzini)	-22,860016 ; 30,648178

Results and discussion

Informants' profile

A total of 160 informants participated in this study with the majority being females (n = 107). This type of participation was expected, because women are usually responsible for ensuring that the households have access to food. Table 2 describes the characteristics of these informants. Informants were categorized into three groups of young (n = 74), middle aged (n = 57), and elderly (n = 29). More than half of the informants (55.63 %) had secondary education, even though not all of them reached the exit level. Unemployment rate among the informants was found to be very high at 66.3 %.

Indigenous wild edible fruit plant species inventory

During the research, a total number of 92 wild edible fruit plant species were documented and

Table 2 — Profile of informants (n = 160)

Personal Information	Frequency (n)	Percentage (%)
Age (yrs)		
15 – 35	74	46.3
36 – 64	57	35.6
65 and older	29	18.13
Gender		
Males	53	33.13
Females	107	67
Educational level		
No education	21	13.13
Primary education	40	25
Secondary education	89	55.63
Tertiary education	10	6.3
Work status		
Employed	10	6.3
Unemployed	106	66.3
Self employed	8	23
Retired/Pensioner	36	5

identified. Twenty seven of the documented plant species were found to have more other uses. Table 3 summarizes the information about the 27 wild edible fruit plants that have additional uses.

Wild plant species documented during the study were representative of 21 different plant families (Table 1 & Fig. 2). The most widely represented families were Annonaceae (n = 3), Apocynaceae (n = 2),Tiliceae (n = 2), Anarcadiaceae (n = 2), and Loganiaceae (n = 2). Most of the families quoted in the study (n = 16) are represented by only one species (Fig. 2).

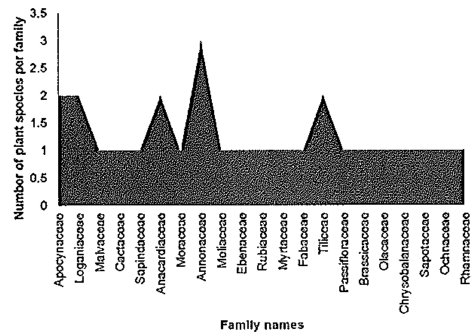

Fig. 2 — A graph showing number of plant species per identified families.

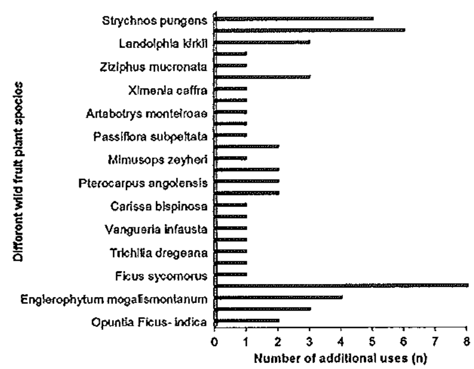

Fig. 3 — A graph showing number of other uses per plant species.

Other use categories

Fig. 3 illustrates number of uses per plant species and *Sclerocarya birrea* (A. Rich.) Hochst was the one with remarkably many other uses as compared to other 27 documented wild edible fruit plants. *Sclerocarya birrea* commonly known as *Marula* is a tropical tree that mainly grows in Southern Africa and it contributes a lot to local communities because of its high nutritional and commercial values[25]. It was not puzzling to find many additional uses from *Marula* tree. The tree is also regarded as a multipurpose tree from Southern Africa, used by local people for its fruit, cosmetic oil from the seed and for medicinal products from the bark and leaves[26]. Amongst the 21 plant families identified during the study, members of the 9 families were found to have medicinal properties (Table 4). The 9 families include Apocynaceae (2), Loganiaceae (1), Anacardiaceae (1), Annonaceae (2), Meliaceae (1), Ebenaceae (1), Rubiaceae(1), Sapindaceae(1), and Olacaceae(1). The main parts used for medicine from these plant species are roots (6 species), followed by fruits (4 species) and lastly usage of the barks of only one plant species. Results shown in Table 4 strengthen the uniqueness of *Marula* tree as three of its parts (the roots, fruits and inner bark) are utilized medicinally.

Medicinal properties are not the only additional use of wild edible fruit plants; they can also have other use categories such as food, beverages, construction, firewood, cosmetic, dye and artifacts. Thirty-four percent of the 27 documented plant species are utilized as firewood. As revealed in Fig. 4 the second mostly reported use category was for food stuffs at 32 %. Food stuffs cited include cooking oil that is extracted from nuts of *Marula* tree, cooking soda made from the skin of *Marula* fruits, candies produced from the pulp of the *Marula* fruits, jam made from prickly pear fruits and *Marula* kernels that can used as snack or for seasoning purposes. Besides

Table 3 — Information on 27 wild edible fruity plants species with additional uses

Families and scientific name	Vernacular and common name	Number of additional uses	Voucher number
Anacardiaceae *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	*Mufula* (V), Cider tree/Marula (E)	8	MMG45
Anacardiaceae *Lannea discolor* (Sond.) Engl.	*Munie* (V), Tree Grape, Wild plum (E)	2	MMG43
Annonaceae *Annona senegalensis* Pers.	*Muembe* (V), Custard apple (E)	1	MMG33
Annonaceae *Artabotrys brachypetalus* Benth.	*Mudzidzi* (V), Purple Hook-berry (E)	1	MMG37
Annonaceae *Artabotrys monteiroae* Oliv.	*Mudzidzi* (V), Red Hook-berry (E)	1	MMG40
Apocynaceae *Landolphia kirkii* T. dyer	*Muvhungo* (V), Rubber Vine/San Apricot-vine (E)	3	MMG35
Apocynaceae *Carissa bispinosa* (L.) Desf. *ex* Brenan	*Murungulu* (V), Fork-spined Carissa/ Red NumNum (E)	1	MMG42
Brassicaceae *Boscia albitrunca* (Burch.) Gilg & Gilg-Ben	*Muthobi* (V), Sheperd's tree (E)	1	MMG59
Cactaceae *Opuntia ficus- indica* L.	*Mudoro* (V), Prickle pear/ Spineless Cactus (E)	2	MMG50
Chrysobalanaceae *Parinari curatellifolia* Planch. *ex* Benth.	*Muvhula* (V), Mobola Plum/Cork tree (E)	3	MMG41
Ebenaceae *Diospyros lycioides* Desf. Subsp. *sericea* (Benrh.) De winter	*Musuma* (V), Quilted Bluebush (E)	1	MMG44
Fabaceae *Pterocarpus angolensis* DC.	*Mutondo* (V), Blood wood (E)	2	MMG62
Loganiaceae *Strychnos pungens* Soler	*Mukwakwa* (V), Spiny-leaved Wild Orange (E)	5	MMG46
Loganiaceae *Strychnos spinosa* Lam.	*Muramba* (V), Monkey orange (E)	3	MMG79
Malvaceae *Adansonia digitata* L.	*Muvhuyu* (V), Cream of tartar tree (E)	2	MMG47
Meliaceae *Trichilia dregeana* Sond.	*Mutshikili* (V), White Mahogany (E)	1	MMG54
Moraceae *Ficus sycomorus* L. subsp. *sycomorus*	*Muhuyu* (V), False Cluster Fig (E)	1	MMG52
Myrtaceae *Psidium guajava* L.	*Mugwavha* (V), Apple Guava/ Yellow Guava (E)	2	MMG57
Ochnaceae *Ochna pulchra* Hook. F.	*Murombe* (V), Wild Pear (E)	1	MMG51
Olacaceae *Ximenia caffra* Sond. var. *caffra*	*Muthanzwa* (V), Blue Sour Plum (E)	1	MMG56
Passifloraceae *Passiflora subpeltata* Ortega	*Mufuranta* (V), Wild granadilla (E)	1	MMG61
Rhamnaceae *Ziziphus mucronata* Willd.subsp. *mucronata*	*Mutshetshete/Mukhalu* (V), Buffalo thorn (E)	1	MMG60
Rubiaceae *Vangueria infausta* Burch	*Muzwilo* (V), Velvet Wild-medlar (E)	1	MMG38
Sapindaceae *Englerophytum magalismontanum* (Sond) Heine & J.H Hemsl.	*Munombelo* (V), Milkplum (E)	4	MMG36

(contd.)

Table 3 — Information on 27 wild edible fruity plants species with additional uses (contd.)

Families and scientific name	Vernacular and common name	Number of additional uses	Voucher number
Sapotaceae *Mimusops zeyheri* Sond.	*Thaladzi/Mbubulu* (V), Red milkwood (E)	1	MMG31
Tiliaceae *Grewia villosa* Willd.	*Mupunzu* (V), Mallow raisins (E)	1	MMG74
Tiliaceae *Grewia microthyrsa* K. Schum. ex Burret	*Mufuka* (V), Sand Raisin (E)	1	MMG53

V = Venda vernacular name as mentioned by informants during the survey.
E = English common names of the mentioned wild edible plant species

Table 4 — List of wild edible plants species that are also used medicinally

Family	Scientific name	Vernacular name	Plant parts used and illnesses cured
Anacardiaceae	Sclerocarya birrea (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro	Mufula	Roots have medicinal properties, Liquid from the fruit heals earache, Roots are used for stomach ache and inner bark is used to cure colds and flu.
Annonaceae	Anonna senegalensis Pers	Muembe	Heal children's' stomach problems.
Annonaceae	Artabotrys monteiroae Oliv.	Mudzizi	The roots are used to treat cows with stomach problem.
Apocynaceae	Landolphia kirkii T. dyer	Muvhungo	Roots have medicinal purposes.
Apocynaceae	Carissa bispinosa (L.) Desf.ex Brenan	Murungulu	Roots have medicinal properties.
Ebenaceae	Diospyros lycioidesDesf. Subsp. sericea (Benrh.) De winter	Musuma	Fruits are used to cure wounds.
Loganiaceae	Strychnos pungens Soler.	Mukwakwa	Roots have medicinal purposes.
Meliaceae	Trichilia dregeana Sond.	Mutshikili	Bark used as laxative and the fruits heal earache.
Olacaceae	Ximenia caffra Sond.var.caffra	Muthanzwa	Pain killer (boil the roots and drink the decoction).
Rubiaceae	Vangueria infausta Burch	Muzwilu	Fruits used to lessen the intensity of the period pain.
Sapindaceae	Mimusops zeyheri Sond.	Mububulu	Medicine.

the use of wild edible plants cited for the above mentioned food stuff, there are other uses as well. For example, other wild edible plants were found to be used for beverage production. Based on information of the wild fruit plant species mentioned by informants to be utilized as beverages, there is a clear agreement with other findings[10]. Most of plant species mentioned in their work were also mentioned during the current study.

Conclusion

The current research outlined the indispensability of wild edible fruit plants as they can be utilized in many beneficial ways. Conducting this type of research helped to prevent the loss of indigenous knowledge on the apparent other uses of wild fruit plants. Since these play a paramount role in the lives of rural communities, the development of appropriate conservation, cultivation and harvesting strategies is suggested. The participation of local community, conservers, educators and other stakeholders in the field of conservation, documentation and application of local indigenous knowledge on the use of medicinal and edible wild fruit plants should be reinforced. Nevertheless, despite the rich indigenous knowledge on the medicinal use of wild plants which has been well documented; more research particularly to serve the concern on socio-economic, cultural, traditional and nutritional aspects of wild edible plants still require adequate attention.

Acknowledgement

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APPENDIX 4c

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INDIGENOUS PREPARATION AND PRESERVATION METHODS OF SELECTED INDIGENOUS WILD EDIBLE VEGETABLES OF THE VHEMBE DISTRICT, MUNICIPALITY

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ABSTRACT

Wild edible plants have been utilized by indigenous communities since time immemorial. Vhavenda situated in the Vhembe District Municipality of South Africa are no exception to the utilization of wild edible plants. This study reports on traditional preparation and preservation methods of selected wild edible vegetables. A total of 160 respondents of different ages were consulted and interviewed through semi-structured interviews. Forty-six wild edible vegetables were listed during the current survey and ten most cited vegetables were considered for the purpose of this report. Results on the preparation methods revealed that locals prefer dishes of combined vegetables (e.g. Cloeme gynandra and Amaranthus dubius). Leaves were the most used part as compared to other plant parts. In some preparation methods, all edible parts can be mixed together to make a delicious relish to accomplished maize-based diets of the respondents. An example of the Vhavenda cuisine is "bovhola" which is prepared from leaves, flowers, fruits of Curcubita pepo and leaves of Momordica foetida or Momordica charantia. Further study to determine the nutritional values of the prepared Venda cuisines is recommended.

Keywords: Wild edible vegetables, Vhavenda, Vhavenda cuisines, respondents, Semi-unstructured interviews.

INTRODUCTION

Wild edible vegetables have been utilized as food since time immemorial by native people all over the world. In many sections of the rural areas, people harvest a wide range of leafy vegetables for their taste, cultural practices, as food supplements or as an aid to ease situations over food shortage (Mahapatra *et al.*, 2012). Guinand and Dechassa (2000) argued that wild plants were recognized to have potential to satisfy the needs on household food security. Foods processed from these plants are distinctive in taste, appearance and ingredients (Tangkanaku and Trakoontivakorn, 2014).

The crisis of food insecurity has become very important considering dry conditions that are being experienced because of climate change. Global impact of climate change has been reported to have an influence on food production as well as food security (Karam and Sarraf, 2011). A resurgence in the use of wild edible vegetables has become very much important in addressing food insecurity that might result from drought. People should also have adequate knowledge on the wild edible vegetables (Satter *et al.*, 2016). Familiarizing communities around wild edible vegetables may give them options in terms of vegetable selection and preferences. Although a lot of work has been reported on indigenous leafy vegetables of South Africa (Nesamvuni *et al.*, 2001; Vorster *et al.*, 2007; Maanda and Bhat, 2010; Ntuli *et al.*, 2012), not much has been reported on preparation and preservation techniques thereof.

Literature on preparation and preservation of leafy vegetables suggest that South African parents who use wild leafy vegetables dry the vegetables in the sun before they store them in sacks (Taleni *et al.*, 2012; van der Hoeven *et al.*, 2013). In Swaziland sun drying of food for future use has been reported as an oldest agricultural technique in food preservation (Masarirambi *et al.*, 2010). In a study conducted in Amuria (Uganda) solar drying was found to be the main technique of preserving wild edible plant species (Ojelel and Kakudidi, 2015).

Wild edible vegetables which are available and harvested seasonally, may need to be preserved for future use. Therefore, people find ways of preparing and preserving them to be enjoyed during out of seasons. Maximum utilization of available wild edible vegetables during their season may go a long way in terms of sustainable utilization of natural resources.

Indigenous knowledge on the use of wild vegetables should be documented and promoted. WHO and FAO proposed that there should be ways to promote increased production, availability and access, and greater consumption of fruits and vegetables (Smith and Eyzaguirre, 2007). According to Maseko *et al.* (2018) the loss of indigenous knowledge results in the low utilization of indigenous vegetables. Due to lack of knowledge, youth considers indigenous vegetables to be poisonous. The documentation of preparation techniques will therefore go a long way in stimulating wild vegetables utilization among the communities and youths in particular. In this study, the theory that youth are not interested in indigenous knowledge of wild vegetables did not hold since they participated in the research in large numbers. It is also understood that the provision of acceptable vegetables preparation recipes can influence their utilization (Darkwa and Darkwa, 2013). The way in which vegetables are prepared should also be documented and presented as part of indigenous knowledge that should be preserved. Preparation and preservation techniques that enable sustainable utilization of wild vegetables was well documented in the current study.

The purpose of the research was therefore to document indigenous knowledge on preparation and preservation of wild edible vegetables in Vhembe district municipality through semi-structured interviews. Collected data was then analyzed through tables and graphs in order to observe the trends which can assist in identifying preferred techniques that are being applied by indigenous communities in such practices. It is envisaged that indigenous communities of Vhembe district municipality are still using indigenous techniques of processing and preserving wild edible vegetables. Preservation of wild edible vegetables may therefore lead to conservation thereby ensuring continuous provision of household food security (Bahru *et al.*, 2013).

MATERIALS AND METHODS

The study was conducted in the Vhembe District Municipality of Limpopo Province, South Africa. The district covers about 2771 km^2 and has an average altitude of 400 m above mean sea level (Lombard *et al.*, 2006) and it lies between 22 56'S and 30 28'E (LSOER, 2004). Ethnobotanical data was gathered through semi-structured interviews where 160 participants were interviewed with an aid of a standard questionnaire. Semi-structured interviews allow for open ended questions which can give the informant enough opportunity to elaborate on answers. The main reason for using standard questionnaires was to obtain comparable data for analysis (Bortolotto *et al.*, 2015). The questionnaires focused on indigenous knowledge on wild edible vegetables and other various uses. Interviews were carried out in the local Tshivenda language.

RESULTS AND DISCUSSIONS

Informants profile

The majority of the 160 participants as indicated in figure 1 were youth aged between 18 and 35 years (n=74), followed by adults aged between 36 and 60 years (n=47), and finally adults of 61 years and above (n=39). The study was dominated by female participants (n=107).

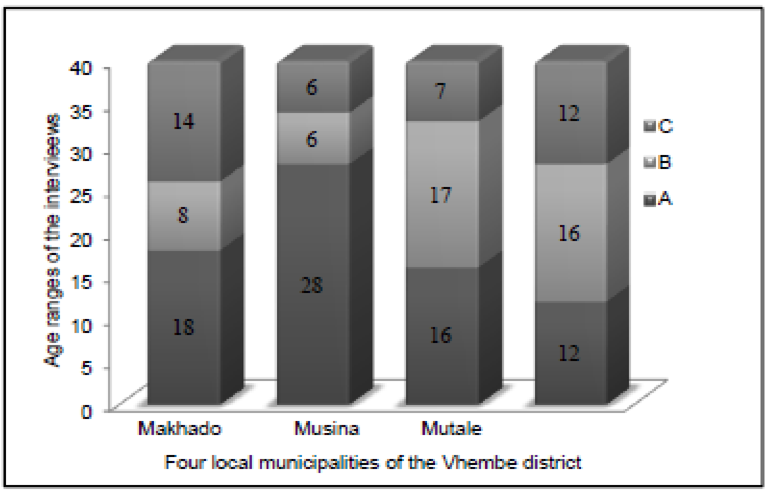

Figure 1: Age ranges of interviewees of the four local municipalities of the Vhembe District. A = (ages between 18 and 35), B = (ages between 36 and 60) and C = (ages > 61).

Taxonomic diversity

A total of 46 wild edible vegetables were recorded and identified. In their study on wild vegetables use by Vhavenda in the Venda region of Limpopo province, Maanda and Bhat (2010) documented 40 wild vegetables. In this study the botanical identification was confirmed with an aid of the International Plant Names Index (IPNI). Ten of the most frequently cited vegetables were selected for documentation of preparation and preservation techniques. The top ten plants belonged to six different plant families with Amaranthaceae having three species, followed by Capparaceae and Cucurbitaceae with two species each and Asteraceae, Convolvuceae and Fabaceae with one species each (Table 1). Five broad plant parts categories identified were leaves, fruits, tubers, flowers and seeds. Amongst the five mentioned categories, leaves were predominantly consumed, followed by fruits and lastly flowers, tubers and seeds (Figure 2).

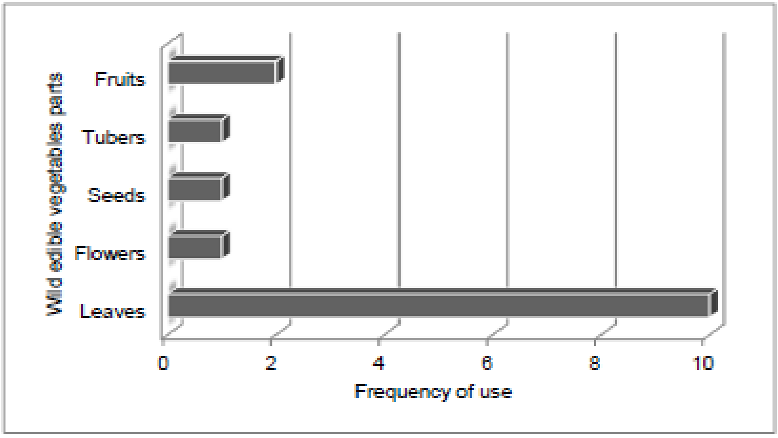

Figure 2: Frequency of use of five different parts of wild edible vegetables.

In support of the findings of the current survey, Musinguzi *et al.* (2006) demonstrated utilization of leafy vegetables by over 80% of their survey's respondents. It was apparent from the respondents of the current study that flowers, tubers and seeds are utilized mostly as snacks.

Unemployment rate of the informants was found to be very high and it compelled the use of wild edible vegetables. Other researchers such as Vorster *et al.* (2007) argued that in winter food prices are inflated in a way that unemployed citizens are faced with serious hunger.

Table 1: List of selected wild edible vegetables of the Vhembe District Municipality.

Family	Botanical names	Local Venda names	Life form	Part used	Frequency of citation	Mode of storage
Amaranthaceae	*Amaranthus dubius* C. Mart ex Thell.	Vowa	Herb	Leaves	56.9	Leaves are sun dried
Amaranthaceae	*Amaranthus hydridus* L.	Thebe	Herb	Leaves	47.2	Leaves are collected and sun dried
Amaranthaceae	*Amaranthus spinosus* L.	Mukhuluvhali	Herb	Leaves	30.1	Leaves are sun dried
Asteraceae	*Bidens pilosa* L	Mushidzhi	Herb	Leaves	50.6	Leaves are cooked and sun dried
Capparaceae	*Cloeme monophylla* L.	Mutohotoho	Herb	Leaves	32.4	Leaves are cooked and sun dried
Capparaceae	*Cloeme gynandra* L.	Murudi	Herb	Leaves	34.7	Cooked and sun dried
Convolvulaceae	*Ipomoea batatas* (L.) Lam.	Murambo	Creeper	Leaves and tubers	19.6	Leaves are collected and sun dried
Curcubitaceae	*Mormodica foetida* Schumach	Nngu	Climber	Leaves	34.4	Leaves are collected cleaned to removed soil and sun dried
Curcubitaceae	*Cucurbita pepo* L.	Phuri	Creeper	Leaves, flowers, seeds and fruits	38.1	Leaves, flowers and fruits are cooked and sun dried
Fabaceae	*Vigna unguic-ulata* (L.) Walp.	Munawa	Creeper	Leaves and fruits	44.1	Leaves are cooked with *Cucurbita pepo* fruits and sun dried

Preservation and preparation methods

Fifty percent of documented wild vegetables were found to be preserved by sun drying while the preservation of the remaining half was through a combination of cooking and sun drying. The fact that Vhavenda use the sun drying methods as their way of preserving wild edible vegetables was supported by Legwaila *et al.* (2011), who reported principal methods of extending the shelf life of wild edible vegetables such as sun drying fresh leaves or boiling in water before sun drying.

Wild edible vegetables that are cooked before being sun dried are normally placed on the corrugated iron as shown in figure 3. Fresh fruits of Cucurbita pepo can be added to the leafy vegetables to serve as condiments. The use of reed mats or sacks was also reported to serve as drying surfaces (Nguni, 2007). During the interviews it was indeed observed that some informants utilize sacks of maize meal as their drying surface. Furthermore, some informants even mentioned the use of reed basket or tray which is called "*Luselo*" in Tshivenda.

Figure 3: A Picture showing an elder arranging her cooked wild vegetable on the corrugated iron for sun drying.

In the preparation of vegetables, informants acknowledged cooking methods of boiling vegetables for different durations. Boiling of vegetables like *Amaranthus hydridus* and *Ipomoea batatas* consumes less than 30 minutes whereas that of vegetables such as Cloeme monophylla and Cloeme gynandra can go beyond 60 minutes. Results of research conducted by Flyman and Afolayan (2006) and Nguni (2007) in Botswana and Zambia respectively are in full consensus with the current study as they also found Cloeme gynandra and Cloeme monophylla to take long to cook. Another unique preparation method attested during the survey is that of the cow pea leaves which are sun dried before being cooked. Alternatively, cow pea leaves can also be blended with the leaves of Amaranthus hybridus to improve the texture of the dish. The current survey revealed that wild edible vegetables are sometimes prepared individually or as a mixture. Informants were able to give vegetable blending with reasons for such choices (Table 2).

Table 2: Different wild vegetables combinations and the motivations of their blending.

Blending	Reason
Cucurbita pepo leaves, fruits, flowers and Momordica charantia leaves.	Improvement of the flavour
Ipomoea batatas leaves and leaves of Amaranthus hybridus.	Enhancement of Amaranthus hybridus flavor.
Leaves of Bidens pilosa and leaves of Amaranthus hybridus.	Reduction of the bitter taste of Bidens pilosa.
Leaves of Cloeme gynandra and leaves of Amaranthus hybridus.	Reduction of the bitter taste of Cloeme gynandra.

Combinations mostly rely on three reasons which are an improvement of vegetable texture, flavour and reduction of bitter taste. Informants indicated much of their interest in the consumption of the Vhavenda's favourite cuisine called "*bovhola*". This cuisine is prepared by mixing the leaves, flowers and fruits of Cucurbita pepo and Mormodica foetida leaves. Momordica foetida leaves are added to enhance the taste and its bitter taste is of medicinal importance. Ingredients like tomatoes, pounded peanuts, bicarbonate of soda and salt are used in *"bovhola"* (Figure 4). Cucurbita pepo can be mixed with tender leaves of Cochorus tridens to prepare another delicious relish to go with the stiff maize-meal porridge. Leaves of Cucubirta pepo were reported to contain 43.8% protein which compares well to that of soybean (Oloyede, 2012).

Leaves of Ipomoea batatas are mixed with tender leaves of Amaranthus hybridus to prepare a delicious relish. Ipomoea batatas leaves have high fibre and crude oil content and also contain several nutrients and bioactive compounds (Sun *et al.*, 2014). Its consumption in developing countries like South Africa may reduce malnutrition.

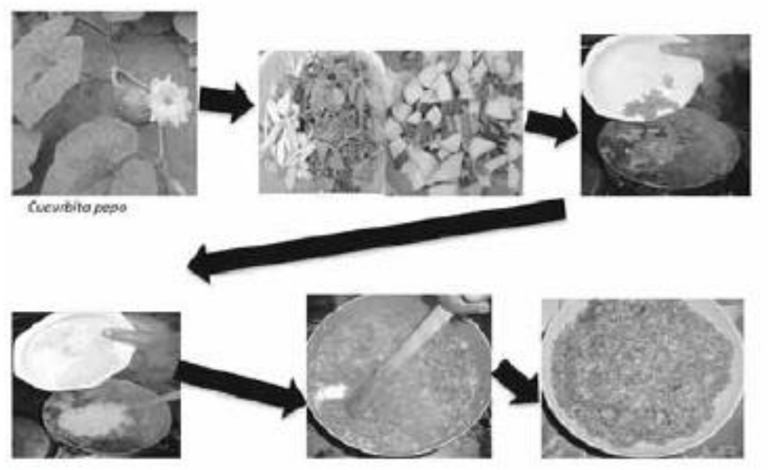

Figure 4: Preparation of Vhavenda's favourite cuisine *bovhola*.

All mentioned bitter vegetables were blended with Amaranthus hybridus for lessening the bitterness. Tordoff and Sandell (2009) in their study on vegetables bitterness in relation to calcium content, found that bitterness is positively associated with most of the nutrients in vegetables. Being aware of steps needed to be taken when preparing vegetable dishes may make the consumer more aware on how to get maximum nutrition and flavours (Fabbrin and Crosby, 2016).

CONCLUSIONS AND RECOMMENDATIONS

The study revealed that the selected wild edible vegetables are still utilized, although at different scales. The study noted and emphasized the importance of preservation of wild edible vegetables since most of them are seasonal. Another important issue raised as a reason for the conservation and preservation of these vegetables was that they serve as food during times of droughts. To guarantee availability of these wild vegetables it is recommended that some of them be introduced into agriculture. Cultivation of these vegetables can also create employment for the unemployed youth members of our society. With proper marketing the vegetables can be placed into the open markets industry in big towns.

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APPENDIX 5

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Amaranthaceae	*Amaranthus dubius* C. Mart ex Thell	Vowa(V), Pig-weed(E)	Cooking soda	Herb
Amaranthaceae	*Amaranthus hydridus* L.	Thebe(V), Common-pigweed(E)		Herb
Amaranthaceae	*Amaranthus hydridus* L. subsp. cruentus (L.) Thell	Mugango(V), Common-pigweed(E)		Herb
Amaranthaceae	*Achyranthes aspera* L. var. *aspera*	Mukhuluvhali(V), Chaff flower(E)		Herb
Anacardiaceae	*Sclerocarya birrea* (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro	Mufula (V), Cider tree, Marula (E)	Jam, Candies	Tree
Anacardiacea	*Lannea discolor* (Sond.) Engl.	Munie (V), Tree Grape, Wild plum (E)	Firewood	Tree
Annonaceae	*Annona senegalensis* Pers	Muembe (V), Custard apple (E)		Shrub
Annonaceae	*Artabotrys monteiroae* Oliv.	Mudzidzi (V), Red Hook-berry (E)		Climber

Family	**Scientific name**	**Vernacular(V) and Common name(E)**	**New uses**	**Growth form**
Annonaceae	*Artabotrys brachypetalus* Benth.	Muhuhuma (V), Purple Hook-berry (E)		Climber
Apocynaceae	*Pentarrhium insipidum E. Mey.*	Phulule(V), Heart vine(E)	Medicine	Herb
Apocynaceae	*Landolphia Kirkii* T. dyer	Muvhungo (V), Rubber Vine (E), San Apricot-vine (E)	Firewood	Climber
Apocynaceae	*Carissa bispinosa* (L.) Desf.ex Brenan	Murungulu (V), Fork-spined Carissa, Red Num Num (E)		Shrub
Apocynaceae	*Tabernaemontana elegens* Stapf.	Muhatu(V), Toad-tree (E)		Shrub
Aracea	*Colocasia esculenta* (L.) Scott	Mufhongwe		Herb
Asteraceae	Bidens bipinnata L.	Mushidzhidonga(V), Spanish blackjack(E)	Medicine	Herb
Asteraceae	*Bidens pilosa* L.	Mushidzhi(V), Blackjack(E)		Herb
Asteraceae	*Sonchus asper* (L.) Hill subsp asper	Shashe(V), Annual sow-thistle(E)		Herb
Boraginaceae	*Ehertia rigida (Thunb.)* Druce *subsp. nervifolia* Retief and A.E van Wyk.	Murovherovhe, Mutepe(V), Puzzle bush(E)		Tree

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Brassicaceae	*Boscia albitrunca* (Burch.) Gilg & Gilg-Ben	Muthobi (V), Sheperd's tree (E)	Medicine	Tree
Brassicaceae	*Cleome gynandra*	Murudi(V), African cabbage(E)		Herb
Brassicaceae	*Cloeme monophylla* L.	Mutohotoho(V), Spider plant (E)		Herb
Cactaceae	*Opuntia ficus-indica* Mill	Mudoro(V), Sweet-prickle pear(E)	Jam	Shrub
Chrysobalanaceae	*Parinari curatellifolia* Planch. Ex Benth	Muvhula(V), Mobola-plum(E)	Porridge cooking	Tree
Convolvulaceae	*Ipomoea batatas*	Murambo(V), Sweetpotato(E)		Creeper
Convolvulaceae	*Ipomoea obscura* (L.) Ker Gawl. var. *obscura*	Muduwi(V), Wild petunia(E)		Herb
Cucurbitaceae	*Citrullus colocynthis* L.	Muvani(V), Watermelon(E)	Medicine	Creeper
Cucurbitaceae	*Citrullus lanatus*.	Mutshatsha (V), Bitter melo (E)	Condiment	Creeper
Cucurbitaceae	Cucumis africanus L.f.	Tshinyaku(V), Wild cucumber(E)		Creeper

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Cucurbitaceae	*Cucurbita pepo* L	Phuri		Creeper
Cucurbitaceae	*Momordica charantia*	Tshibavhe (V), Balsam pear (E)		Climber
Cucurbitaceae	Momordica foetida Schumach	Nngu (V), Gifappel (E)		Herb
Cucurbitaceae	*Momordica balsamina*	Lugu (V), Balsam apple (E)		Herb
Cucurbitaceae	*Lagenaria siceraria*	Muphapha(V), African calabash	Period painkiller	Herb
Ebenaceae	*Diospyros mespiliformis* Hochst.ex A.DC.	Musuma (V), Jackal-berry(E)		Tree
Euphorbiaceae	*Tragia dioica* Sond	Mbuwambuwane(V)		Herb
Fabaceae	*Pterocarpus angolensis* DC	Mutondo (V), Blood wood (E)	Beer, Porridge cooking	Tree
Fabaceae	*Vigna subterranea*	Phonda(V), Bambara groundnut(E)		Herb
Fabaceae	*Arachis hypogaea*	Muduhu(V), groundnut (E)		Herb
Fabaceae	*Vigna unguiculata* (L.) Walp	Munawa(V), Cow pea(E)		Herb

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Loganiaceae	*Strychnos spinosa* Lam.	Muramba (V), Spiny monkey orange (E)		Tree
Loganiaceae	*Strychnos pungens* Soler	Mukwakwa (V), Spiny-leaved Wild Orange (E)	Juice, firewood, artifact, Beer	Tree
Malvaceae	*Abelmoschus esculentus* (L.) Moench	Delele Mandande(V), Okra(E)	Purgative	Herb
Malvaceae	*Adansonia digitata* L.	Muvhuyu (V), Cream of tartar tree (E)	Firewood	Tree
Malvaceae	*Corchorus olitorius* L. var. *olitorius*	Delelelupfumo(V), Jute plant(E)		Herb
Malvaceae	*Corchorus tridens* L.	Delele(V), Wild jute plant (E)		Herb
Malvaceae	*Grewia bicolor Juss. Var bicolor*	Murapfa(V), White-leaved raisin(E)		Shrub
Malvaceae	*Grewia flavescens* Juss.	Mupharatsheni(V), Sandpaper raisin (E)		Shrub
Malvaceae	*Grewia Hexamita* Burret	Gukhuna(V), Gaint raisin(E)		Shrub
Malvaceae	*Grewia microthyrsa* K. Schum. Ex Burret	Mupfuka (V), Sand Raisin (E)		Shrub

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Malvaceae	*Grewia monticola* Sond.	Murabva(V), Silver-raisin(E)	Porridge cooking	Tree
Malvaceae	Grewia occidentalis L.	Mulembu		Shrub
Malvaceae	*Grewia villosa* Willd	Mupunzu (V), Mallow raisins (E)	Porridge cooking	Shrub
Meliaceae	*Trichilia dregeana* Sond	Mutshikili (V), White Mahogany (E)		Tree
Myrtaceae	*Psidium guajava* L.	Mugwavha (V), Apple Guava, Yellow Guava (E)	Beer, Juice	Tree
Myrtaceae	*Syzygium cordatum Hochst. ex C.Krauss subsp.cordatum*	Mutu(V), Waterberry(E)		Tree
Myrtaceae	*Syzygium legatii* Burtt Davy and Greenway	Mutawi(V), Mountain waterberry		Tree
Olacaceae	*Ximenia americana L. var microphylla* Welw. Ex Oliv.	Muthanzwa (V), blue sourplum (E)	Firewood	Shrub
Olacaceae	*Ximenia caffra* Sond. var. *caffra*	Mutshili (V), large sourplum (E)		Shrub
Passifloraceae	*Adenia gummifera* (Harv.) Engl.	Beleha (V), Monkey rope (E)		Climber

Family	**Scientific name**	**Vernacular(V) and Common name(E)**	**New uses**	**Growth form**
Passifloraceae	*Passiflora edulis* Sims	Mufuranta (V), granadilla (E)		Climber
Pedaliaceae	*Dicerocaryum senecoiides* (Klotzsch) Abels	Museto(V), Devil's thorn(E)		Herb
Phyllanthaceae	*Bridelia Micrantha* (Hochst.) Baill	Munzere(V), Mitzeerie(E)		Tree
Phyllanthaceae	*Flueggea virosa* (Roxb. Ex Willd.) Voigt subsp. *virosa*	Mutangauma(V), Whiteberry-bush		Shrub
Polygonaceae	*Oxygonum dregeanum* Meisn	Muthanyi(V)		Herb
Rhamnaceae	*Ziziphus mucronata* Willd.subsp. *mucronata*	Mutshetshete (Mukhalu) (V), Buffalo thorn (E)		Tree
Rosaceae	*Rubus pinnatus* Willd	Munambala(V), Wild bramble(E)		Climber
Rubiaceae	*Afrocanthium mundianum* (Cham and Schltdl.) Lantz	Mutomboti (V), Rock-alder(E)		Shrub
Rubiaceae	*Cephalanthus natalensis* Oliv.	Murondo(V), Strawberry-bush(E)		Shrub
Rubiaceae	*Hyperacanthus amoenus* (Sims) Bridson	Murombe (V), Spiny-gardenia(E)		Tree

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Rubiaceae	*Ochna pulchra* Hook. F.	Muzwilungala(V), woodland pendent-medlar(E)		Tree
Rubiaceae	*Ochna pulchra* Hook. F.	Muzwilungala(V), woodland pendent-medlar(E)		Tree
Rubiaceae	*Vangueria infausta* Burch	Muzwilu (V), Velvet Wild-medlar (E)		Tree
Salicaceae	*Dovyalis caffra (Hook.f. and Harv.) Warb*	Mutunu (V), Kei-apple(E)		Shrub
Sapotaceae	*Englerophytum mogalismontanum* (Sond) T.D.Penn	Munombelo (V), Milk plum (E)	Jam	Tree
Sapotaceae	*Mimusops zeyheri* Sond.	Thaladzi/ Mbubulu (V), red milkwood (E)		Tree
Solanaceae	*Capsicum annuum* L. var glabriusculum (Dunal) Heiser and Pickersgill	Phiriphiri(V), Chilli pepper(E)		Shrub
Solanaceae	*Lycopersicon esculentum* Mill	Mutamatisi(V), Tomato(E)		Herb
Solanaceae	*Nicandra physalodes* (L.) Gaertn	Tshirungudane(V), Apple of Peru(E)		Herb
Solanaceae	*Solanum nigrum* L.	Xaxadi(V), Common nightshade(E)		Herb

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Solanaceae	*Solanum retroflexum* Dunal	Muxe(V), Wonder berry(E)		Herb
Ulmaceae	*Trema orientalis* (L) Blume	Mukurukuru(V), Pigeon wood(E)		Tree
Urticaceae	*Obetia tenax* (N.E. Br.) Friis	Muvhazwi(V), Mountain nettle(E)	Purgative	Shrub
Urticaceae	*Urtica dioica* L.	Dzaluma(V), Common stinging nettle(E)		Herb
Urticaceae	*Pouzolzia mixta* Solms	Muthanzwa(V), Soap nettle(E)		Shrub
Urticaceae	*Pouzolzia parasitica* (Forssk.) Schweinf.	Makhuluwadzaluma(V), Small stinging nettle(E)		Herb
Vitaceae	*Rhoicissus tomentosa* (Lam.) Wild and R.B.Drumm	Mundirivhe(V), Forest grape(E)		Climber
Zygophyllaceae	*Tribulus terrestris* L.	Tsetwana(V), Devil-thorns(E)		Herb
Zygophyllaceae	*Tribulus zeyheri* Sond. subsp. zeyheri	Tseto(V), Devil-thorns(E)		Herb

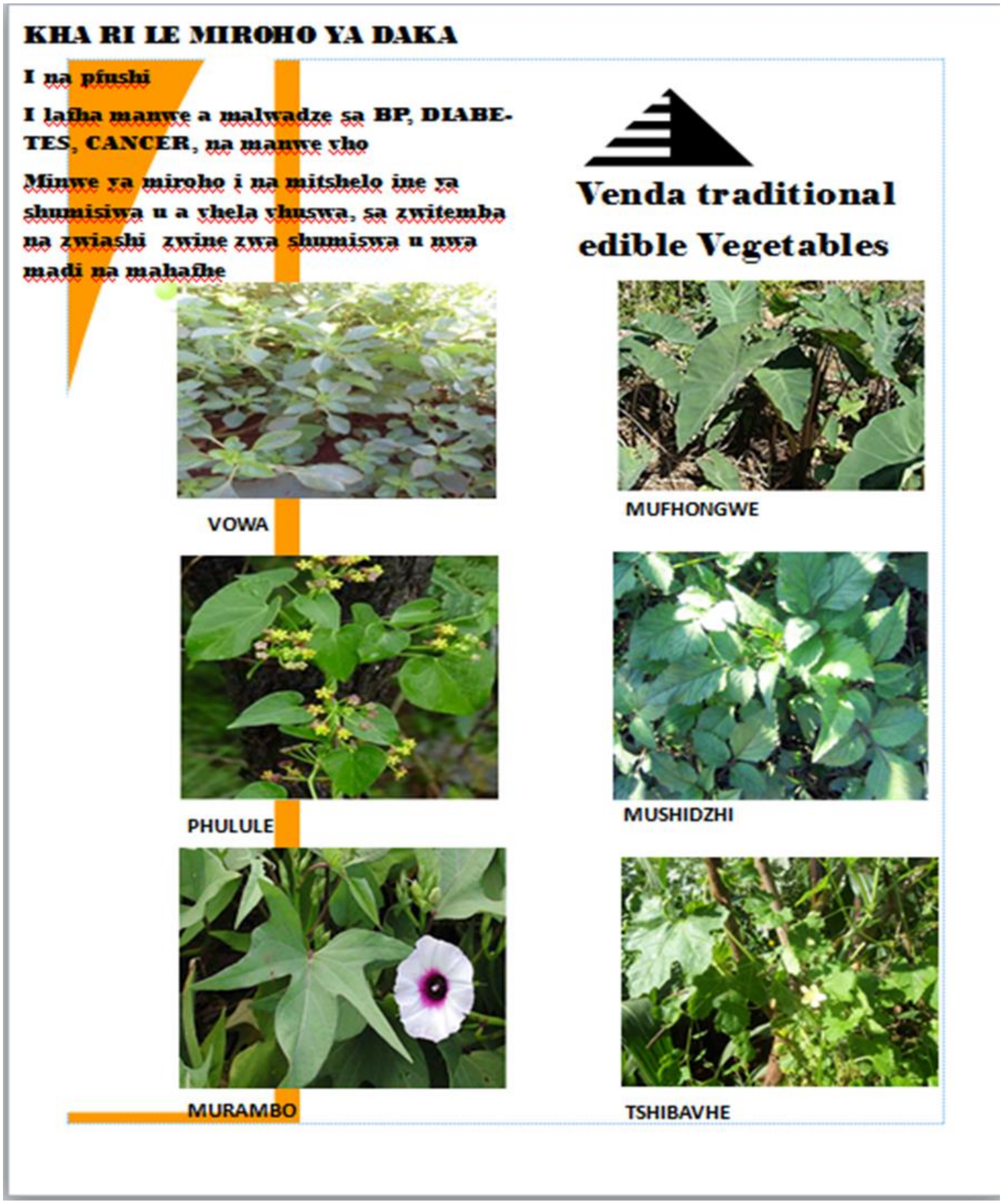
APPENDIX 6

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Amaranthaceae	*Hypoestes forskaolii* (Vahl) R. Br.	Nnyoyambudzi(V)		Herb
Amaranthaceae	*Alternanthera sessilis* (L.)	Vowamulambo(V)		Herb
Anacardiaceae	*Searsia magalismontana* (Sond.) Mollett subsp. *Coddii* (R. and A. Fern.) Moffett.	Tshidzimba		Shrub
Apocynaceae	*Cryptolepis obtuse* N. E.Br.	Mutanzwakhamelo(V), Monkey rope(E)		Climber
Apocynaceae	*Telosma Africana* (N. E. Br.) N.E.Br.	Nyendanyendane(V)		Climber
Celastraceae	*Elaedendron transvaalense* (Burtt Davy) R.H.Archer	Mulumanamana (V), Bushveld saffron(E)		Tree
Clusiaceae	*Garcinia livingstonei* T. Anderson	Muphiphi(V), Lowveld mangosteen(E)		Tree
Commelinaceae	*Commelina benghalensis* L.	Damba(V), Benghal commelina		Herb
Convolvulaceae	*Ipomoea dichroa Choisy*	Tshipokoto(V)		Climber
Cucurbitaceae	*Coccinia rehmannii* Cogn.	Tshifhafhe(V), wild cucumber (E)		Herb
Cucurbitaceae	*Momordica boivinii* Baill	Mbandatshilale(V)		Herb

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Ebenaceae	*Diospyros lycioides* Desf. Subsp. *lycioides*	Muthala(V), Karoo blue bush		Shrub
Ebenaceae	*Euclea divinorum* Hiern.	Mutangule(V), Magic guarri(E)		Herb
Euphorbiaceae	*Erythrococca menyharthii* (Pax) Prain	Tshinzie(V)		Shrub
Fabaceae	*Piliostigma thonningii* (Schumach.) Milne-Redh	Mokolokote(V), Camels-foot(E)		Tree
Fabaceae	*Senna petersiana* (Bolle) Lock	Munembenembe(V), Monkey pod(E)		Shrub
Icacinaceae	*Pyrenacantha kaurabassana* Baill	Galange		Creeper
Lophiocarpaceae	*Lophiocarpus tenuissimus* Hook.F.	Tshitangwi(V), Narrow-leaved(E)		Herb
Malvaceae	*Corchorus asplenifolius* Burch	Delelelunanzwanowa(V), Jute plant(E)		Herb
Malvaceae	*Malva sylvestris* L.	Tshiteaduvha(V), Cheese weed(E)		Herb
Malvaceae	*Trimfetta annua* L.	Tshimbvubvu(V)		Herb
Meliaceae	*Melia azedarach* L.	Muserenga(V), Syringa(E)		Tree
Moraceae	*Ficus burkei* (Miq.) Miq.	Muumo(V), Common wild fig.(E)		Tree
Moraceae	*Ficus sansibarica* Warb. Subsp. *sansibarica*	Mutambvu(V), Knobbly fig.(E)		Tree

Family	Scientific name	Vernacular(V) and Common name(E)	New uses	Growth form
Moraceae	*Ficus sur* ForssK	Muhuyungala(V), Broom cluster(E)		Tree
Moraceae	*Ficus sycomorus* L.	Muhuyu(V), Sycamore(E)		Tree
Moraceae	*Morus alba* var *alba*	Mutebeila(V), Mulberry(E)	Vegetable	Tree
Proteaceae	*Macadamia integrifolia* Maiden and Betcher	Mutebvu(V), Macadamia nut(E)		Tree
Rhamnaceae	*Berchemia discolor* (Klotzsch) Hemsl	Munie(V), Brown ivory(E)		Tree
Rhamnaceae	*Berchemia zeyheri* (Sond) Grubov.	Munieniane(V), Red ivory(E)		Tree
Solanaceae	*Solanum campylancanthum* Hochst. ex A.Rich. subsp *panduriforme* (Drege ex Dunal) J. Samuels	Mututulwa(V), Poison apple(E)	Milk thickener	Herb
Verbenaceae	*Lantana rugosa* Thunb.	Tshidzimbavhalisa(V), Bird's brandy(E)		Shrub

APPENDIX ~~5~~7


KHA RI LE MIROHO YA DAKA
I na pfushi
I lafha manwe a malwadze sa BP, DIABETES, CANCER, na manwe vho
Minwe ya miroho i na mitshelo ine ya shumisiwa u a vhela vhuswa, sa zwitemba na zwiashi zwine zwa shumiswa u nwa madi na mahafhe
Venda traditional edible Vegetables
VOWA
MUFHONGWE
PHULULE
MUSHIDZHI
MURAMBO
TSHIBAVHE


Venda traditional edible Vegetables
NNGU
MUPHAPHA
MUVANI
MUTSHATSHA
PHURI
MURUDI

Venda traditional edible Vegetables

MUDUHU

PHONDA

MUNAWA

MUVHUYU

DELELEMANDANDE

MULEMBU

Venda traditional edible Vegetables

MUSETO

MUTHANYA

MUXE

DELELE

MUVHAZWI

FOR MORE INFORMATION CONTACT : 0733243890

Email: molotja@univen.ac.za

www.vendateplants.co.za

APPENDIX ~~5~~8

APPENDIX 7

KHA RI LE MIROHO YA DAKA

I na pfushi

I lafha manwe a malwadze sa BP, DIABETES, CANCER, na manwe vho

Minwe ya miroho i na mitshelo ine ya shumisiwa u a vhela vhuswa, sa zwitemba na zwiashi zwine zwa shumiswa u nwa madi na mahafhe

Venda traditional edible Vegetables

VOWA

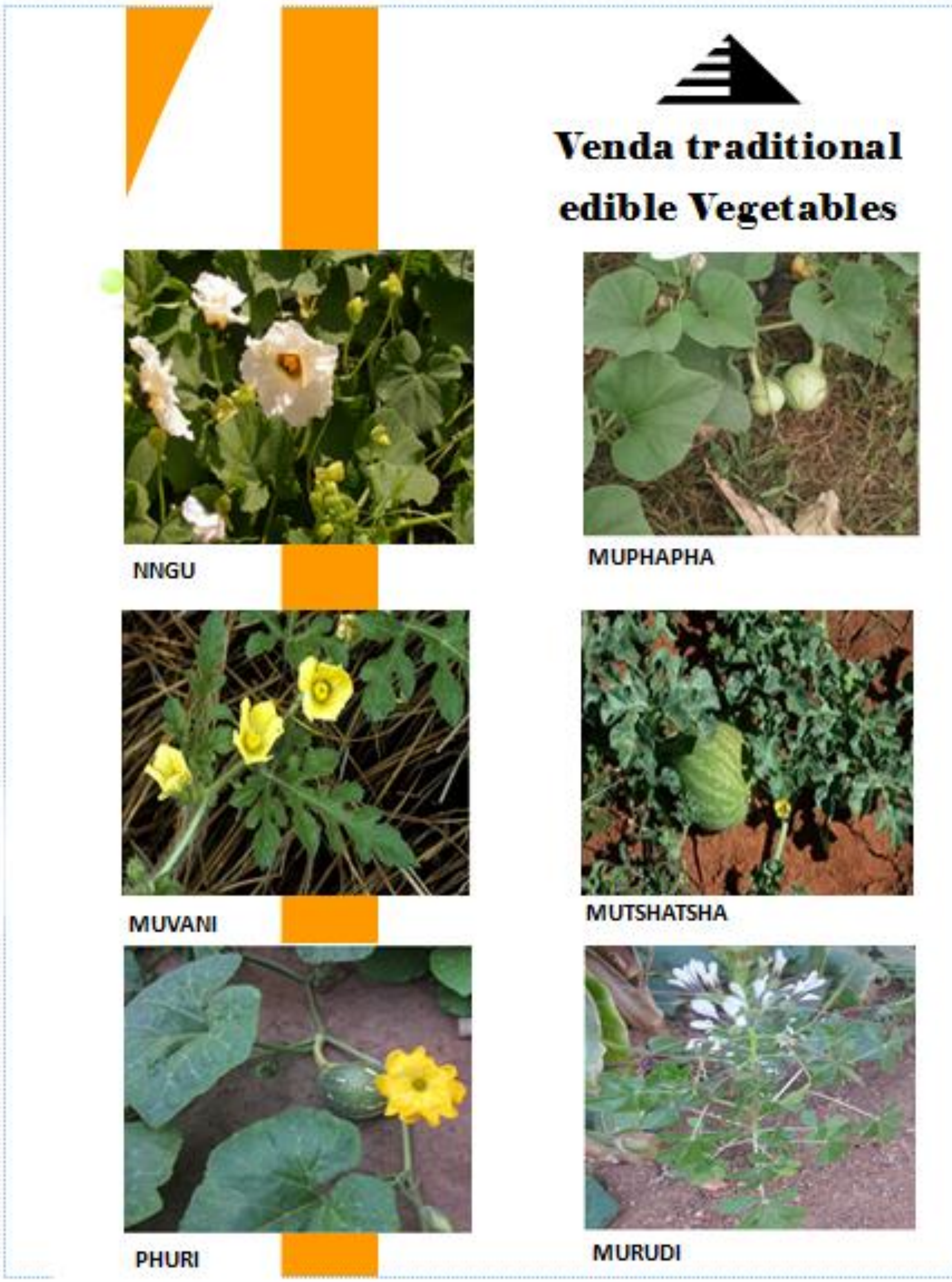
MUFHONGWE

PHULULE

MUSHIDZHI

MURAMBO

TSHIBAVHE


Venda traditional edible Vegetables
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APPENDIX 8


VENDA TRADITIONAL EDIBLE PLANTS
Home
About Us
Venda TE Plants
Recipes
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Publications
Events
Welcome to Venda Traditional Edible Plants
Venda traditional edible plants disseminate pivotal information about wild edible fruit plant species and traditional edible vegetables consumed by VhaVenda people of the Vhembe District Municipality.
VENDA TE PLANTS
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University of Venda
Creating Future Leaders

Home About Us Venda TE Plants Recipes Contact Us Publications Events

About The Founder of Venda TE Plants

Mrs. M. G. Mokganya

Mrs. M. G. Mokganya [MSc (Univen)]

Lecturer in Foundation Biology

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Mrs. Mokganya is an ethnobotanist who specializes with traditional edible plants of the Venda region. She attended several international and national conferences related to plant science where she gave oral and poster talks. She has been in teaching and learning activities like participation in Teaching and Learning conference from 2010 to date. Her participation afforded her opportunities to enter and win Vice- Chancellor's excellence awards in teaching and learning in 2013 and 2016 respectively. One of her teaching strategies is to involve students in advising them regarding the careers that are related to the module she teaches. She supervised and graduated two Honours students in Botany. She also co-supervised a Master of Science student in Botany.

VENDA TE PLANTS

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PHONDA

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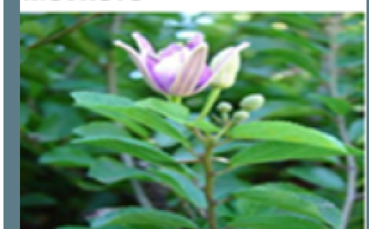

MULEMBU