Tackling food and nutrition insecurity using leafy wild vegetables: The nutritional compositions of some selected species

C. Bvenura and **A.J. Afolayan**

Medicinal Plants and Economic Development (MPED) Research Center, University of Fort Hare, P Bag X1314, Alice, 5700, South Africa

Fourteen wild vegetable species were analysed to determine their proximate compositions and mineral constituents. Fibre crude content ranged between 0.39 and 1.79 g/100 g; crude protein between 0.48 and 1.53 g/100 g; crude lipid between 0.02 and 3.83 g/100 g; phytate between 0.92 and 8.92 g/100 g and ash content was between 0.39 and 1.79 g/100 g. *Solanum nigrum*, *Tulbaghia violacea*, *Chenopodium album* and *Chenopodium murale* had the highest concentrations of fibre, protein, lipid, phytate and ash respectively. Calcium, magnesium, potassium, sodium, phosphorus, copper, iron, zinc, manganese and vitamin C ranged between 6.70-34.84; 1.54-22.79; 50.6-125.97; 0.25-18.73; 2.10-4.76; 0.01-.0.02; 0.21-2.60; 0.12-0.60; 0.04-0.60 and 41.67-225.00 g/100 g respectively. *Chenopodium murale* had the highest concentration of Mg, K and P while *Physalis peruviana* had the highest concentration of Fe and vitamin C. Copper was remarkably low in all the wild vegetables. This study revealed the potential of wild vegetables to meet the daily requirements of nutrients needed for human health. The nutritional content suggests that inclusion of these vegetables in the diet may help alleviate hunger and nutritional deficiency in the Eastern Cape by enhancing the function and nutritional properties of food and food products. Also, the supplementing the diet with these nutrient rich foods is in line with global and government programmes aimed at drastically reducing food and nutrition insecurity.

Keywords: Mineral; proximate; wild vegetables; nutrition; anti-nutrient; food security

1. Introduction

Wild vegetables have been a part of the human diet since the beginning of time. Human consumption of these vegetables and the ability of the species to meet nutrient needs have been documented for a long time. It is estimated that, at least, one billion people globally still include wild foods in their diets (Aberoumand and Deokule, 2010). In South Africa, Wehmeyer and Rose (1983) identified more than 100 plant species that are being used as wild vegetables.

In many places of the developing world, there has been a low trend in the consumption of wild vegetables. This reduction in the consumption of wild vegetables has been attributed to seasonal availability and culture in Nigeria, while in South Africa, culture, taste and affordability have been cited as the major causes (WHO, 2003; Hart et al., 2005; Shackelton et al., 2009; Faber et al., 2010). Wild vegetables are usually consumed by the rural populace as supplements to their diet since the vegetables usually naturally grow on cultivated or fallow fields thereby making them easily accessible. However, the urban populace pay less attention to wild vegetables in favour of the conventional ones because of easy accessibility of the later. The use of herbicides, pesticides, as well as excessive cultivation of the fields has led to the decline in the availability of wild vegetables and subsequent decline in their knowledge (Odhav et al., 2007). Also, the perception, especially among young people, that such vegetables are foods for the poor, causes lack of interest in the cultivation and nutritional importance of these plants (Vorster et al., 2007).

Yet studies have revealed that wild vegetables have numerous beneficial nutritional values often better than the domesticated exotic breeds like spinach and cabbage (Odhav et al., 2007; Lewu and Mavengahama, 2010). The use of wild vegetables could be lost with time if their knowledge, especially on the identification, nutrient value, methods of preparation and preservation are not passed down to the younger generations and properly documented. Therefore, this study was conducted to investigate the nutritional compositions of some of the wild vegetables growing in the Eastern Cape Province of South Africa, in an effort to create an awareness of some important aspects of these neglected food plants. The inclusion of these vegetables in the diet could help alleviate food and nutrition security concerns being faced by the inhabitants of the province.

2. Materials and methods

2.1 Plant collection and preparation

Fourteen, wild vegetables were collected fresh from the Mbashe and Nkonkobe Municipalities of the Eastern Cape during the rainy season when the wild vegetables were vegetatively growing in home gardens and the fields. The plants were initially identified by their vernacular names (Xhosa) and later validated at the

University of Fort Hare Herbarium (Bvenura and Afolayan, 2014). Young and tender shoots were plucked from the mother plant as practised locally, stored in khaki paper sampling bags and transported to the laboratory where they were washed thoroughly with distilled water. Leaves of the same plant from the two municipalities were combined to make a single composite sample, oven dried at 40^{o}C to a constant weight and homogenised using a 2 mm sieve Polymix (PX-MFC 90 D) electric grinder, after which they were sealed in polyethylene bags and stored in the refrigerator at 4^{o}C until needed for the various analysis.

2.2 Proximate analysis

2.2.1 Determination of ash content

About 5 g of the powdered plant leaf sample was weighed into a previously weighed crucible. This was incinerated in an E-Range muffle furnace with TOHO P4 programme at 550^{o}C for 12 h. The final weight of the sample was used to calculate the ash content as follows:

Ash content (%) =$(final\ weight\ of\ sample\ after\ incineration\ (g))\ /\ (5\ g)$ x 100 % (Antia et al, 2006).

2.2.2 Determination of crude lipid

Crude lipid was determined as described by Antia et al. (2006). About 5 g of the powdered sample was measured into a 250 ml beaker, 100 ml of diethyl ether was added, covered with aluminium foil and shaken in an orbital shaker for 24 h. Filtration followed this process and the supernatant was decanted. Another 100 ml of diethyl ether was added to the residue and shaken for another 24 h. The residue obtained after filtration was the lipid free sample and was calculated as:

$$\text{Crude lipid} = \frac{Weight\ of\ sample\ after\ diethyl\ ether\ extraction}{Initial\ weight\ of\ sample} \text{ x } 100\ \%$$

2.2.3 Determination of crude fiber

The AOAC (1984) method was used in estimating the crude fibre. About 5 g of the powdered sample was weighed into a beaker and digested in 100 ml of 1.25 % sulphuric acid for 30 min. The acid digested sample was allowed to cool, and then filtered. The residue was collected into a beaker and further digested in 100 ml of 1.25 % sodium hydroxide. The sample was filtered and the residue dried in an oven at 100^{o}C to a constant weight. The dried residue was then incinerated in a muffle furnace for 24 h at 550^{o}C. The crude fiber was obtained from the loss in weight on ignition of dried residue remaining after digestion of fat free samples (AOAC, 1984):

$$\%\ \text{fiber} = \frac{Loss\ of\ weight\ on\ ignition}{Weight\ of\ sample\ used} \text{ x } 100\ \%$$

2.2.4 Determination of vitamin C

Preparation of iodine solution

The iodometric titration method was used to determine the vitamin C content. About 5 g of potassium iodide and 0.268 g potassium iodate were dissolved in 200 ml distilled water in a 400 ml beaker, followed by addition of 30 ml of 3 M sulphuric acid. The mixture was poured into a 500 ml graduated cylinder and then diluted to a final volume of 500 ml with distilled water. Vitamin C standard solution was prepared by dissolving 0.250 g vitamin C in 100 ml water. This was made up to 250 ml with distilled water.

Standardisation of iodine with Vitamin C standard solution

About 25 ml of vitamin C standard solution was measured into a 125 ml Erlenmeyer flask, following which 10 drops of 1 % starch solution were added as the indicator. This was titrated against the acidified potassium iodide iodine solution until the end point (the first blue colour that showed after at least 20 s of swirling) was reached.

Vitamin C determination in the samples

About 5 g of fresh leaf samples were macerated in 20 ml of distilled water. The mixture was filtered and the filtrate collected in a 50 ml volumetric flask and made to the mark with distilled water. About 10 ml of the sample solution was transferred into an Erlenmeyer flask and 10 drops of 1 % starch added and titrated against the acidified potassium iodide solution.

2.2.5 Determination of phytate components

Phytate was determined according to the method of Wheeler and Ferrel (1971). A sample of finely ground plant material measuring 4 g was soaked in 100 ml of 2 % hydrochloric acid for 3 h and then filtered through Whatman No. 43 filter paper. About 25 ml of the filtrate was measured into a conical flask and 5 ml of 0.3 % ammonium thiocyanate solution was added as indicator, followed by addition of 53.5 ml distilled water. This was titrated against a 1000 ppm standard iron (III) chloride solution until a brownish yellow colour persisted for 5 min. The Phytate content was calculated from the iron determinations, assuming a 4:6 iron to Phytate molecular ratios and multiplied by a constant of 3.55 (Vijayakumari et al., 1996).

2.2.6 Determination of protein

About 0.5 g of finely ground vegetable samples was placed in dry, clean digestion tubes and 5 ml of the digestion mixture comprising 1 part $HClO_4$ + 2 parts HNO_3 added. This mixture was digested at 230^{o}C on a digestion block for 70 min, allowed to cool down and made up to 100 ml volume with distilled water. The concentration of nitrogen was then determined using the Inductively Coupled Plasma - Optical Emission Spectrometer (ICP OES). Percentage crude protein was obtained by multiplying the nitrogen value by a factor of 6.25 (AGRILASA, 2008).

2.3 Mineral analysis

Macro-minerals (Phosphorus, Potassium, Calcium, sodium and Magnesium) and micro-minerals (Copper, Iron, Zinc and Manganese) were determined using the method described above for the determination of nitrogen.

2.4 Statistical analysis

Data of the nutrient concentrations of various wild vegetables were subjected to statistical analysis using MNITAB Release 12. A one-way analysis of variance was used to compare the means of various nutrient concentrations among the wild vegetables. Means were segregated using Duncan's multiple range test. The means were treated as significantly different at $p < 0.05$.

3. Results

3.1 Proximate composition

The proximate compositions of the wild vegetables gathered from Mbashe and Nkonkobe municipalities in the Eastern Cape Province of South Africa varied significantly ($p < 0.05$) among the vegetables (Table 1). Crude fibre ranged between 0.91 and 6.79 g/100g; crude protein between 0.47 and 1.53 g/100g; crude lipid between 0.14 and 3.83 g/100g; phytate between 1.09 and 8.92 g/100g and ash content was between 0.38 and 1.79 g/100g. *Tulbaghia violacea* had the highest protein and *Sonchus oleraceus* the highest lipid content. The lowest protein content was recorded in *Chenopodium murale* while the highest fibre and ash contents were recorded in *Solanum nigrum* and *Chenopodium murale* respectively. The lowest ash values were observed in *Solanum nigrum*.

3.2 Mineral composition

The mineral compositions of the 14 vegetables significantly differed among the vegetables as shown in Table 2. The mean concentration of nutrients in all the vegetables decreased in the order Vit C > K > Ca > Mg > Na > P > Fe > Zn > Mn > Cu. *Chenopodium murale* contained the highest K, Mg and P, while *Physalis peruviana* contained the highest concentration of Fe and Vit C. Cu was remarkably low in all the wild vegetables.

Table 1 Proximate compositions (g/100 g) of 14 vegetables in Mbashe and Nkonkobe Municipalities in the Eastern Cape Province of South Africa .

Vegetable species	†Phytate	Crude protein	Crude lipid	Crude fibre	Ash
Bidens pilosa L.	2.4±6.51^{c}	1.19±0.03^{ab}	1.60±0.22^{d}	2.14±0.32^{c}	0.38±0.03^{b}
Centella coriacea Nannfd.	2.31±1.31^{a}	1.1±0.05^{ab}	0.52±0.02^{b}	1.09±0.03^{a}	1.74±0.05^{c}
Chenopodium album L.	8.92±0.38^{a}	0.48±0.01^{a}	1.15±0.19^{b}	1.68±0.02^{ac}	1.38±0.04^{d}
Chenopodium murale L.	3.07±4.30^{b}	0.47±0.01^{a}	3.50±0.03^{a}	1.35±0.01^{a}	1.79±0.02^{c}
Cotula heterocarpa DC.	2.23±0.57^{ab}	1.02±0.14^{ab}	0.84±0.05^{b}	1.01±0.02^{a}	1.44±0.01^{d}
Galinsoga parviflora Cav.	2.98±0.81^{c}	0.94±0.08^{ab}	2.51±0.46^{e}	1.66±0.29^{c}	0.45±0.03^{b}
Hypochaeris radicata L.	1.09±0.81^{a}	0.82±0.07^{ab}	0.14±0.03^{f}	1.00±0.01^{a}	0.80±0.16^{a}
Physalis peruviana L.	4.19±0.85^{ab}	1.02±0.14^{ab}	1.93±0.51^{de}	1.53±0.03^{ac}	1.39±0.24^{d}
Rumex obtusifolius L.	4.86±1.05^{a}	0.48±0.01^{a}	0.35±0.11^{c}	1.08±0.01^{a}	1.24±0.01^{d}
Solunum nigrum L.	2.34±0.50^{a}	0.56±0.02^{a}	0.58±0.02^{b}	6.79±0.01^{b}	0.39±0.02^{b}
Sonchus oleraceus L.	1.50±5.37^{d}	1.09±0.06^{ab}	3.83±0.04^{a}	1.11±0.02^{a}	0.77±0.05^{a}
Stellaria media L.	4.64±0.61^{b}	0.51±0.00^{a}	2.56±0.06^{e}	1.26±0.01^{a}	1.55±0.01^{d}
Tulbaghia violacea Harv.	1.55±2.14^{c}	1.53±0.13^{ab}	0.64±0.04^{b}	0.91±0.04^{a}	1.29±0.0.02^{d}
Urtica urens L.	2.51±0.90^{a}	0.87±0.13^{ab}	0.64±0.02^{b}	2.35±0.02^{c}	1.67±0.0.01^{cd}

Different letters down the same column represent significant differences at $p < 0.05$.

Table 2 Mineral compositions (g/100 g) of 14 vegetables in Mbashe and Nkonkobe Municipalities in the Eastern Cape Province of South Africa.

Vegetable species	Mineral Element									
	Ca	Mg	K	Na	P	Cu	Fe	Zn	Mn	Vitamin C
B. pilosa	14.70±3.48^{e}	3.46±1.51^{cb}	71.95±74.00^{cd}	0.28±1.99^{a}	2.57±0.67^{f}	0.01±0.01	0.87±0.53^{c}	0.28±2.73^{b}	0.13±0.06^{ab}	0.042±0.06^{a}
C. album	14.39±1.33^{e}	16.69±6.93^{f}	110.88±54.30^{fg}	2.54±0.98^{c}	4.29±0.11^{g}	0.01±0.00	0.26±0.19^{a}	0.15±3.76^{a}	0.15±0.04^{ab}	0.125±0.06^{a}
C. coriacea	10.40±2.70^{cd}	2.69±0.20^{cb}	16.80±21.50^{a}	22.01±1.86^{g}	2.10±0.19^{a}	0.01±0.03	0.68±0.19^{b}	0.12±0.18^{a}	0.21±1.80^{b}	0.050±0.03^{a}
C. heterocarpa	7.27±4.66^{ab}	2.72±0.66^{b}	61.65±29.40^{c}	12.44±2.78^{e}	3.56±0.26^{e}	0.01±0.01	0.76±0.40^{bc}	0.16±0.31^{a}	0.07±0.03^{a}	0.058±0.06^{a}
C. murale	11.34±4.26^{d}	22.79±19.64^{h}	125.97±44.20^{g}	5.37±2.14^{cd}	4.76±0.56^{i}	0.01±0.00	0.59±0.73^{a}	0.14±0.23^{a}	0.05±0.51^{a}	0.117±0.00^{b}
G. parviflora	24.77±3.41^{g}	4.04±1.51^{c}	53.31±114.00^{b}	0.38±1.13^{a}	4.51±0.74^{h}	0.01±0.01	0.53±0.07^{b}	0.14±0.30^{a}	0.13±0.08^{ab}	0.047±0.15^{d}
H. radicata	9.14±6.80^{c}	4.10±0.17^{c}	52.00±11.10^{b}	19.54±6.00^{f}	2.57±0.55^{b}	0.01±0.02	0.42±0.15^{b}	0.28±0.22^{b}	0.07±0.06^{a}	0.048±0.02^{a}
P. peruviana	13.11±7.50^{e}	9.70±7.21^{e}	84.63±85.20^{cd}	0.25±2.82^{a}	2.89±0.91^{c}	0.02±0.01	2.60±2.29^{e}	0.34±0.22^{c}	0.10±0.49^{a}	0.225±0.03^{a}
R. obtusifolius	8.03±3.59^{b}	4.93±1.56^{c}	73.28±63.10^{c}	0.86±0.65^{a}	4.59±0.71^{h}	0.01±0.01	0.44±0.80^{ab}	0.14±0.29^{a}	0.06±0.85^{a}	0.108±0.10^{c}
S. media	6.70±6.98^{a}	6.05±1.56^{d}	121.52±73.80^{g}	3.83±1.79^{c}	4.43±1.18^{g}	0.01±0.00	0.77±0.48^{cb}	0.30±3.91^{bc}	0.08±0.29^{a}	0.042±0.10^{a}
S. nigrum	16.98±4.59^{f}	3.72±1.46^{cb}	76.91±80.40^{d}	0.65±1.09^{ab}	3.88±0.70^{f}	0.01±0.06	0.43±0.66^{b}	0.12±0.50^{a}	0.07±0.02^{a}	0.014±0.04^{a}
S. oleraceus	12.25±4.78^{de}	4.15±0.54^{c}	50.6±5.20^{b}	18.73±2.37^{f}	3.17±0.74^{d}	0.02±.03	0.56±0.59^{b}	0.14±0.39^{a}	0.04±0.41^{a}	0.058±0.15^{b}
T. violacea	7.36±3.98^{ab}	1.54±0.80^{a}	80.44±38.70^{cd}	3.72±2.39^{c}	3.65±1.54^{e}	0.01±0.01	0.21±0.19^{a}	0.19±0.48^{a}	0.02±0.02^{a}	0.162±0.06^{b}
U. urens	34.84±3.65^{i}	4.25±1.58^{c}	66.99±12.90^{c}	0.41±1.20^{a}	4.68±0.56^{ih}	0.01±0.01	0.35±0.17^{ab}	0.16±0.47^{a}	0.10±0.04^{a}	0.045±0.02^{a}

Different letters down the same column represent significant differences at $p < 0.05$

4. Discussion

4.1 Proximate composition

The proximate analysis revealed that all the 14 wild vegetables are rich in the various nutrients investigated but in varying proportions. Ash, protein, lipid and fibre contents in *Sonchus oleraceus* were lower than earlier reported by Jimoh et al. (2011). Odhav et al. (2007) investigated the proximate composition of 20 wild plants and reported higher values for protein (3 - 7 g/100 g) and ash (1.74-4.91 g/100 g), but lipid (0.2 - 2.7 g/100 g) and fibre (1.21 - 2.92 g/100 g) were within the range of the present study. *Sonchus oleraceus* and *Chenopodium murale* showed appreciable lipid contents in this study. Lyimo et al., (2003) reported a lipid range of between 0.1 and 1.0 g/100 g in 30 wild vegetables, but lower than observed in the current study. According to Antia et al. (2006); lipids increase the palatability of food by absorbing and retaining flavours. A diet providing 1 - 2 % of its calorific energy as fat is said to be sufficient for humans, as excess fat consumption is implicated in cardiovascular disorders such as atherosclerosis, cancer and aging (Sharma et al., 2012). The considerable amount of lipids in some of these vegetables in relation to the NHMRC (2005) values would therefore improve the palatability of the vegetables and reduce the risk of some diseases. Lyimo et al. (2003) reported a protein range between of 0.6 and 5.0 g/ 100 g in 30 wild vegetables, again this was higher than the current study with a range of between 0.47 and 1.53 g/100 g. Protein is essential for growth and repair of muscles, bones, skin, tendons, ligaments, hair and eyes amongst other tissues in humans. The protein values from this study indicate that the wild vegetables have the ability to supply a fraction of the Recommended Daily Intake (RDI) values

(NHMRC, 2005). Children need to consume at least 150 g of vegetables per day to harness the required nutrients (NHMRC, 2003). For example; *Sonchus oleraceus, Tulbaghia violacea and Bidens pilosa* can supply 5.0, 5.5 and 7.1 % respectively of children's RDI values. High ash content in plants is a reflection of high mineral content (Aberoumand and Deokule, 2010). The high ash content of *Chenopodium murale* compared to other vegetables in this study is an indication of high mineral value of the vegetable. High fibre diets have been linked with lower serum cholesterol concentrations, lower risk of coronary heart disease, reduced blood pressure, enhanced weight control, reduced risk of certain forms of cancer and an improved gastrointestinal function (Anderson et al., 1994). *Solanum nigrum, Urtica urens and Bidens pilosa* can supply about 67.9, 23.5 and 21.4 % of the required daily amount in men if a quantity of about 300 g is consumed. The concentration of fibre would also presumably not lead to high fibre related conditions and diseases. Phytate is an antinutrient which has a strong ability to chelate multivalent metal ions especially Zn, Ca and Fe, leading to their poor bioavailability (Gupta et al., 2006). Although the presence of phytate could decrease mineral absorption in humans, this antinutrient is said to be heat labile (Akwaowa et al., 2000). It is therefore conceivable that the high phytate content in *Chenopodium album* (8.92 g/100 g) and *Physalis peruviana* (4.19 g/100 g) will be significantly reduced during cooking. Additionally, leafy vegetables are generally considered to be superior sources of mineral supplements and therefore would ideally lower the effect antinutrients would have on the availability of some nutrients (Odhav et al., 2007).

4.2 Mineral and vitamin C composition

Vitamin C was remarkably high in *Physalis peruviana* (0.225 g/100 g) which makes the vegetable a better source of the vitamin C compared to guava (0.188 g) and orange (0.07 g) fruits as well as some leafy vegetables such as broccoli (0.039 g) (Brand et al., 1982). The results of the current study are comparable with what was reported by Lyimo et al. (2003) in a study of 30 wild vegetables in Tanzania. These authors found that *Galinsoga parviflora*, *Bidens pilosa,* and *Solunum nigrum* respectively contained 0.054, 0.059 and 0.234 g/ 100 g vitamin C. *Sonchus oleraceus* which had the lowest vitamin C concentration has the potential to supply about 31 % of vitamin C RDI while *Physalis peruviana* which had the highest concentration can supply about 500 % of the required vitamin C RDI in adults. Vitamin C prevents tissue damage, aids in the recovery of several ailments and diseases including colds, cough, influenza, sores, wounds and skin diseases among others (Ogunlesi et al., 2010). According to Lopez and Martos (2004), vitamin C improves Fe availability, therefore reducing the risk of iron deficiency anaemia. Potassium was also remarkably high in the wild vegetables while Cu was low in the present study. In studies previously conducted by Bvenura and Afolayan (2012) in Nkonkobe Municipality, Cu was low in cabbage, spinach and carrot. The previous and current results possibly indicate the low levels of the mineral in the soil of the study area. Jimoh et al. (2011) and Kawada et al. (2002) reported slightly lower mineral values compared to the present study except for Mn, Cu and Zn, which were slightly higher. In Iran, lower levels of mineral nutrients were found in some wild vegetables as compared to the present study (Aberoumand and Deokule 2010). Research done in Akure, Nigeria indicated a slightly higher concentration of mineral nutrients compared to this study (Aletor et al., 2002). In KwaZulu Natal, South Africa, Odhav et al. (2007) found high levels of Ca, P and Mg with many wild vegetables exceeding 1000 mg/100 g. Variations in the nutrient compositions of edible plants are influenced by various factors including farming practices, prevailing environmental conditions including soil manipulation using organic and inorganic fertilisers and the age of the plants at harvest (Nordeide et al., 1996). In addition, some minerals such as Zn decrease with advancing plant age while other minerals such as Fe and Mn reportedly increase with increasing plant age (Tiffin, 1971). In this study, vegetables were collected from fields where the soil has been manipulated by addition of organic and mineral fertilisers and only young fresh plants were collected. These factors may have contributed to the amount of minerals in the vegetables. Findings of this study also indicated that all vegetable samples had Na: K ratios of less than 1. Yang et al. (2011) linked a high Na: K ratio with increased risk of cardiovascular diseases leading to mortality. These authors further reported that a high Na intake and a low K intake are linked to high blood pressure. The consumption of these vegetables would therefore not only help lower blood pressure especially among the elderly but also boost their immune system. In sub-Saharan Africa, South Africa has the 4th highest number of people living with HIV/AIDS with an estimated 5.6 million (17.8 %) people infected. The Eastern Cape Province is the 6th most affected with 9 % of the population living with the virus (UN/AIDS, 2010). Researchers around the world have strongly linked HIV to nutrition; they view nutrition as a fundamental intervention in boosting the immune system of the infected in the early stages and ongoing treatment of the disease (Elbein, 1995; Tinnerello, 1998; Charles, 2009). Among other nutrients, people living with HIV are more susceptible to low levels of Zn and Fe in their blood (Barnett, 2006). As shown by the appreciable amounts of these minerals in this study, a wild vegetable inclusive diet for example comprising *T. violacea*, *S. oleraceus* and *S. nigrum* would presumably improve the nutrition of HIV/AIDS patients. The high levels of P observed in vegetables from this study may also increase the mineral's availability in human nutrition. Mn is an activator and constituent of several enzymes and occurs in very low quantities in humans though this mineral's importance cannot be overlooked (Medeiros and Wildman, 2000). The Mn content observed in this study, though low, may supplement its presence in the diet.

In humans, Mg is a critical co-factor in more than 300 enzymatic reactions in the body while in plants the most recognised role of the element is in photosynthesis, where the element must be incorporated into the chlorophyll molecule before chlorophyll is effective at gathering light for photosynthetic carbon reduction reactions (Schachter,

2012; Wilkinson et al., 1990). Therefore, the abundance of Mg in wild vegetables is essential in ensuring a healthy plant and the subsequent availability of other minerals and their supply in the human diet. In relation to the RDI values (Table 3.2b) and the NMHRC (2003) recommended quantities for children, the mineral elements can be sufficiently supplied per 150 g cooked portion. However, one of the drawbacks with wild vegetables is their seasonal availability. These nutritionally rich foods are usually available during rainy season but this shortfall can be overcome by gathering in large quantities when available, drying and storing for off-season consumption. Furthermore, a more sustainable solution that may ensure a continuous fresh supply of these wild foods is to cultivate them in home gardens.

5. Conclusion

The results of this study reveal that the leaves of the 14 wild vegetables are rich in minerals. However, the vegetables differ in nutrient contents. However, *Sonchus oleraceus* which had the lowest vitamin C concentration has the potential to supply about 31 % of vitamin C RDI while *Physalis peruviana* which had the highest concentration can supply about 500 % of the required vitamin C RDI in adults per 300 g of serving. *Solanum nigrum, Urtica urens and Bidens pilosa* can supply about 67.9, 23.5 and 21.4 % of the required daily amount of fibre in men per 300 g serving. *Sonchus oleraceus, Tulbaghia violacea and Bidens pilosa* can supply 5.0, 5.5 and 7.1 % respectively of children's RDI values for protein per 150 g of serving. When compared to other vegetables *Chenopodium murale* is a good source of Mg, K and P while *Physalis peruviana* is a good source of Cu and Fe. Furthermore, *Physalis peruviana* is a good source of Vit C as well as protein and *Solanum nigrum* is a good source of fibre. Mixing these vegetables when cooking them as is practised locally has the potential to meet the human requirements of nutrients for growth and development on a daily basis which in turn helps to overcome nutritional deficiency problems which are prevalent especially in poor rural areas. These vegetables are therefore recommended for consumption alone or in combination with other vegetables.

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