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Micronutrient Quality of Two Selected Indigenous African Leafy Vegetables and Their Potential in Reducing Hidden Hunger in Rural South Africa

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Abstract. Micronutrient quality of two indigenous leafy vegetables (ILVs) *Chenopodium album* (*C album*) and *Solanum nigram* (*S nigram*)) commonly used in the rural African Xhosa diet were evaluated using standard laboratory methods. Both leaves were found to have calcium, potassium, Magnesium, sodium and iron as major elements and substantial quantities of zinc and selenium. The results of this study indicate that Solanum nigram and Chenopodium album have the potential to serve as good sources of these elements and alleviate some micronutrient deficiencies in the South African population.

Key words: Indigenous leafy vegetables, Micronutrients, hidden hunger, Xhosa, South Africa

1. Introduction

Food and Agricultural organization [1] reported a reduction in the number of hungry people in developing countries with a concurrent increase in the number of chronically underfed and malnourished population. This is basically attributed to hidden hunger or micronutrient deficiencies. The emergence of simplified diets, lack of diet diversity are pointed out as reasons for the development of this new phenomenon .As in many other developing countries South African rural households depend heavily on carbohydrate rich staple foods. Inclusion of wild leafy vegetables was a common practice of the rural populations in the past. With urbanization the trend of including these wild indigenous leafy vegetables(ILVs) are disappearing at a very rapid rate from the food choices of the poor. The under utilization of these indigenous wild vegetables are mainly due to the lack of scientific information on their nutrient and chemical content. Against this background the proximate composition and micronutrient content of four commonly used ILVs were analysed.

2. Materials & Methods

Indigenous Leafy Vegetables (ILVs) *C album and S nigram* were collected from areas where they grow naturally in the (garden around households, road side and in the open felt) washed, air dried, and acid digested following the procedure of Hussain *et al*[2] . 3g of the sample in a crucible was subjected to 550 ˚C for 4 hours, cooled and 2.5mL 6N HNO3 was added. The solution was filtered and diluted up to 100 mL with distilled water. The solution was analysed for calcium (Ca), Magnesium(Mg), Sodium (Na), Potassium (K), Phosphorus (P), Iron (Fe), Copper (Cu), Zinc(Zn) Selenium (Se), Arsenic(As) Chromium(Cr) Antimony (An) by using Atomic Absorption Spectrophotometery (AAS) and flame absorption spectrometry. The working standard of 1000 ppm for elements were used.

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Chenopodium album, lambsquarter *Solanum nigrum*, nightshade

3. Results

Microelement composition of the selected vegetables are presented in Table I.

Table I: Micro element composition of the selected Vegetables (mg/1000g) DW** dry weight

Element	*C album*	*S nigram*
Calcium	18213.2 ±598	16890.0 ±1488
Potassium	49028.6 ±593	61120.2 ±155
Magnesium	13821.5 ±493	14407.8 ±173
Sodium	68.0 ±3.6	116.9 ±5.3
Arsenic	1.8 ±0.1	1.9 ±0.2
Antimony	0.05	0.05
Copper	9.1 ±0.6	11.2 ±0.4
Chromium	0.90 ±0.0	0.94 ±0.0
Iron	120.4 ±4.1	177.1 ±8.1
Selenium	5.4 ±0.0	5.7 ±0.0
Tin	0.05	0.05
Zinc	23.0 ±1.9	26.1 ±0.9

4. Discussion

The RDA (mg/day) values for calcium, potassium, magnesium and sodium for pregnant and lactating mothers are 1200, 2000, 350, and 500, respectively [3] and [4]. Therefore, all these vegetable species are good sources of these micro elements. The functions of mineral elements are structural, osmotic, catalytic, and signalling. Calcium is a component of bones; plays a role in signal transduction in hormonal action, muscle contraction, blood clotting and has a structural role in proteins. Potassium is a key circulating electrolyte which is also involved in the regulation of ATP-dependent channels along with sodium. These channels are the Na^+/K^+-ATPases and their primary function is in the transmission of nerve impulses in the brain [5]. Sodium and potassium maintains osmotic and water balance as well as membrane potentials. The Na/K ratio in the body is of great concern for prevention of high blood pressure. Na/K ratio less than one is recommended [6]. Magnesium is an important intracellular ion involved in many enzymatic reactions of oxidative metabolism of nutrients and cell constituent synthesis. Iron has a critical role in the transport of oxygen. Iron coordinates the oxygen molecule into heme of haemoglobin so that it can be transported from lungs to the tissues. Therefore, over 65% of body iron is found in haemoglobin. One-third of body iron is a storage form that can be mobilised during times of need. Non-heme sources of iron are found in plant and vegetable products and the absorption from these sources is generally lower and influenced to a greater extent by total diet composition. Vitamin C is the most significant enhancer of non-heme iron absorption, while plant phenolics such as tannins and phytates are some of the most potent inhibitors. Copper is involved in the formation of red blood

cells, the synthesis of hemoglobin, and formation of bone. Copper has a role in energy production, wound healing, taste sensation, skin and hair color. Copper and zinc are both involved in catalytic or structural roles of many different enzymes. Zinc is found as a co-factor in over 300 different enzymes including antioxidant enzymes. Zinc has a role in the regulation blood glucose levels via insulin function. Zinc also promotes wound healing, regulates immune function, and is necessary for protein synthesis. RDA for zinc is 11 mg/day. Selenium is the structural and catalytic component of peroxidases, especially glutathione peroxidase. It is incorporated into the enzyme as the amino acid selenocysteine by reactions that are unique to selenium. Together with vitamin E, selenium, as a structural component of glutathione peroxidase, forms an antioxidant defense against oxidative stress. The Word Health Organization recommended 40 and 30 μg/day for an average man or woman, respectively. Intakes greater 400 μg/day are considered to be the maximum safe level. Selenium is an example of a nutrient that possesses a relatively narrow range of intakes that are safe and that meet requirements

Chromium appears to influence the action of a critical hormone, insulin. Impaired glucose tolerance has been attributed to chromium deficiency. The recommended intakes for adults (50 to 200 μg/day) are uncertain due to lack of reliable methods of assessment

Elements such as lead, chromium, cadmium and arsenic are likely to have cumulative side effects when large quantity of the leaves has been consumed. These elements could also affect the young nervous system of the child thereby adversely affecting the intellectual development and subsequent behaviour of the child.

In addition to the micronutrients *S nigram and C album* are also reported to have many bioactive phytochemicals [7], [8] and [9]. The medicinal properties attributed to these ILVs may be attributed to the presence of micronutirents and bioactive phytochemicals.

5. Conclusion

Solanum nigram and *Chenopodium album* may have the potential to provide the micronutrients present in them to the consumers. Bioavailability of these micronutrients from the above ILVs needs further investigations. Heavy metal accumulation in ILVs grown in different soils to be investigated further to understand the chemical compositional differences

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