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Research Article

Nutritional Profile of Three [3] Selected Underutilised Indigenous Vegetables in Zimbabwe

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Abstract

This research was carried out to analyse nutritional composition of three indigenous and underutilized vegetables commonly found in Zimbabwe. Vegetables are an important part of diet providing essential nutrients. The objective of the study was to determine whether the three vegetables, black jack (*Bidens pilosa*), pumpkin (*Cucurbita maxima*) and spider flower (*Cleome gynandra*) potentially have substantial nutrient content to meet consumption requirements. Focus towards indigenous vegetables that are locally and easily available to the resource-poor families can ensure to the essential nutrients requirements. The vegetables were analysed for crude protein content, mineral content specifically calcium, sodium, iron, zinc and magnesium. The data gathered from the proximate and mineral analysis was subjected to analysis of variance at 5% level of confidence. The spider flower had 22.94% crude protein, 0.33% calcium, 0.07% iron, 0.19% magnesium, 0.08% sodium and 53ppm zinc. Pumpkin leaves had 11.66% crude protein, 0.3% calcium, 0.03% iron, 0.26% magnesium, 0.04% sodium and 61ppm zinc. Blackjack comprised of 16.03% crude protein, 0.03% calcium, 0.04% iron, 0.2% magnesium, 0.019 sodium and 57ppm zinc. It can be concluded therefore that, these indigenous vegetables can be used to help alleviate food insecurity and malnutrition as they contain substantial level of nutrients needed in diets. Spider flower, blackjack and pumpkin leaves can be included or supplemented in diets to help meet Recommended Dietary Allowances.

Keywords: Bidens Pilosa; *Cucurbita maxima; Cleome gynandra*; Nutritional Profile; Indigenous Vegetables

Introduction

Vegetables are extremely important source of micronutrients, fibre, vitamins and minerals and are essential components of a balanced and healthy diet [1]. Indigenous vegetables are those vegetables traditionally grown and consumed in an area. However, the growing and consumption of these indigenous vegetables is not favoured as people prefer the exotic vegetables. The potential of indigenous vegetables has not been fully exploited because of lack of information regarding the nutritional value. Knowledge on the nutritional value assists in encouraging more people to adopt these vegetables into their diets and contribute to alleviate food and nutrition insecurities especially in developing countries. As indigenous vegetables are adapted to local environments, they can be adopted for production and consumption. The current challenge of food insecurity malnutrition is posing a serious threat to the livelihoods of people and children in Sub Saharan Africa (SSA). The Indigenous vegetables in SSA are used to supplement dishes of staple foods such as maize, cassava, millet, sorghum, and wheat. The diversity of wild edible plant species offers a varied diet to rural communities. However, the food value of agricultural weeds as traditional vegetables in Zimbabwe is ignored and receives little recognition from the government [2] [2]. Indigenous vegetables are also believed to be a great source of micronutrients that can supplement nutritional requirements, especially vitamins and micronutrients. Therefore, the vegetables can help alleviate the problem of malnutrition if widely promoted to the population of Zimbabwe.

Indigenous vegetables are well adapted to harsh climatic conditions and disease infestation and are easier to grow in comparison to their exotic counterparts [3]. African indigenous vegetables can produce seed under tropical conditions unlike the exotic vegetables [3]. They have a short growth period with most of them being vegetables ready for harvesting within 3-4 weeks and respond very well to organic fertilizers. Most of them have an in-built ability to withstand and tolerate some biotic and abiotic stresses. They can also flourish under sustainable and environmentally friendly cropping conditions like intercropping and use of organics [3]. Furthermore, because most of them have not been intensively selected, they have a wide genetic bases, which can be important in sourcing for new genotypes and/or genes for adaptation to climate change.

Materials and Methods

Site of study

This analysis was carried out at Africa University (18.8968° S, 32.6013° E), and at the Department of Research and Specialist Services (DR and SS), Harare, Zimbabwe.

Experimental design

Samples were laid out in a completely randomized design (CRD) and replicated three times. The three [3] vegetables were the treatments.

Plant sample collection protocol

Samples were collected from vendors in Mutare, Zimbabwe. Leaf parts of the plant were used as samples. The leaves were cleaned and dried using an oven drier. After drying, the samples were ground into powder for nutrient content analysis.

Nutrient analysis

Crude protein analysis using the Kjeldahl method [20,21]

- **Sample preparation**: A representative sample of the dried vegetable was weighed for analysis. The sample was finely ground to ensure homogeneity.
- **Digestion**: Samples were placed into a digestion flask, digestion mixture that contained concentrated sulfuric acid and Kjeldahl tablets (Selenium) was added as a catalyst. The mixture was heated to digest the sample and convert the nitrogen content into ammonium sulfate.
- **Distillation**: After digestion, the contents were transferred to a distillation apparatus. The ammonium sulfate was then distilled into a receiving flask containing a known amount of boric acid solution. The distillation separated the nitrogen from other components in the sample.
- **Titration**: The distilled ammonium hydroxide was then titrated with a standardized solution of sulphuric acid to determine the amount of nitrogen present in the sample. The amount of nitrogen was then used to calculate the crude protein content of the sample.
- **Calculation**: The crude protein content was calculated using the following formula:
- Crude protein (%) = Nitrogen content (g) x 6.25 / Sample weight (g)
- Analysis for the trace elements, Fe, Zn, Ca, Na, Mg,
- **Sample preparation**: A representative sample of the dried vegetables was weighed for analysis. The sample was grounded into a fine powder and homogenized to ensure that the trace elements are evenly distributed throughout the sample.
- **Digestion**: The sample was digested using an acid digestion method that dissolved the trace elements. Different digestion methods were used depending on the trace element being analyzed. For example, nitric acid digestion was used for calcium and phosphorus, while hydrochloric acid digestion was used for iron and zinc.
- **Analysis**: Trace elements in dried samples were determined using atomic absorption spectroscopy (AAS- Varian Model: 1275 series)
- **Calibration**: A calibration curve was generated for each trace element being analyzed using known standards. The calibration curve was used to determine the quantity of each trace element in the sample.
- **Calculation**: The quantity of each trace element in the dried vegetable sample was calculated based on the results of the analysis and the calibration curve. The quantity of each trace element was expressed in terms of mass per unit of dried vegetable (e.g., mg/100 g).

Data collection

Data was collected on the percentage of present nutrients in the vegetables. The percentages for calcium, magnesium, iron and sodium were converted to mg/100g by multiplying by 1000. For zinc which was given in ppm was converted to mg/100g by dividing by 10.

Data analyses

Data consisting of nutrient content of the three vegetables were subjected to the analysis of variance using the Statistical Analysis System (GENSTAT) following the one-way linear statistical mode. Graphs and tables were used.

Results

Data presentation and analysis

The results obtained from the analysis gave an account of the nutritional profile of all the three vegetables. As shown in figure 2, the crude protein content of the three vegetables were significantly different. The spider flower (cleome gynandra) had the highest concentration (22.94%) followed by black jack (16.03%) then the pumpkin leaves (11.66).

Sample	Calcium%	Iron%	Magnesium%	Sodium%	Zinc (ppm)	Crude protein%
Cleome gynandra	0.33[b]	0.07[b]	0.19[a]	0.08[b]	53[a]	22.94[c]
Cucurbita maxima	0.3[b]	0.03[a]	0.26[b]	0.04[a]	61[b]	11.66[a]
Bidens pilosa	0.03[a]	0.04[a]	0.2[ab]	0.03[a]	57[ab]	16.03[b]
LSD (0.05)	0.056	0.028	0.062	0.019	5.65	2.83

Table 1: Crude protein, Calcium, Iron, Magnesium, Sodium and Zinc content in the three indigenous vegetables.

Additionally, the zinc content in the vegetables were also significantly different. The Duncan test results showed that there was greater significant difference between the spider flower and the pumpkin leaves. As shown in figure 3, the pumpkin leaves had the highest concentration of zinc (61ppm) followed by the black jack (57ppm. The spider flower had the least concentration of zinc (53ppm).

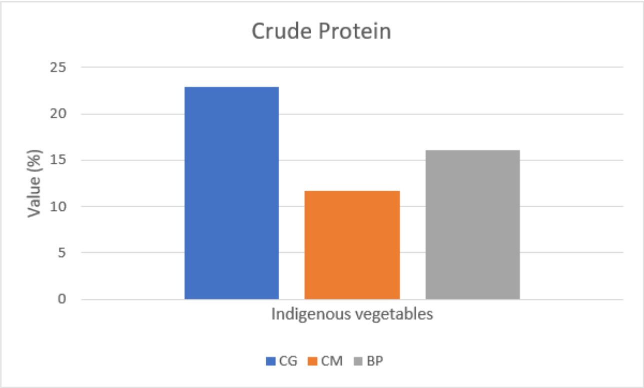

Figure 1: Crude protein content in Cleome gynandra (CG), Cucurbita maxima (CM) and Bidens pilosa (BP).

The spider flower had the highest concentration of calcium (0.33% 0r 330mg/100g) followed by the pumpkin leaves (0.30% or 300mg/100g) which showed that the calcium content between the two vegetables were not significantly different.

As shown in Figure 4, the iron content was highest in the spider flower (0.07%) and the lowest in the pumpkin leaves (0.03). Based on the Duncan test, there was no significant difference between the iron content in black jack (0.04%) and pumpkin leaves. However, the two vegetables were significantly different from the spider flower in their iron levels.

Additionally, the pumpkin leaves had the highest levels of magnesium content (0.26) while the spider flower had the least levels (0.19%). There was significant difference between the levels of concentration of magnesium between the two vegetables. However, there was no significant difference between the two vegetables and the black jack (0.20%) as shown in table 1.

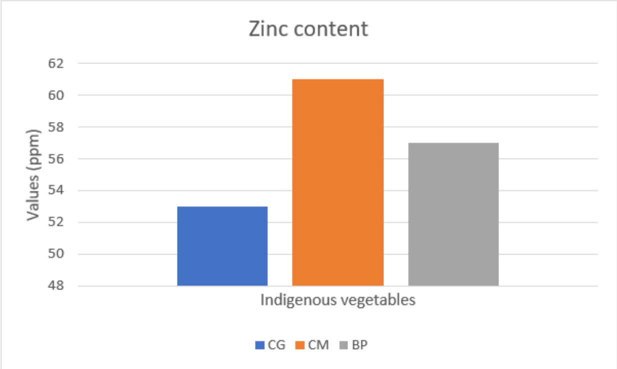

Figure 2: Zinc content in Cleome gynandra (CG), Cucurbita maxima (CM) and Bidens pilosa (BP).

The sodium content was highest in the spider flower (0.08%) and lowest in blackjack (0.03%) as shown in table 1. There was significant difference between the two vegetables in regard to their sodium content. Pumpkin leaves had a concentration of 0.04%.

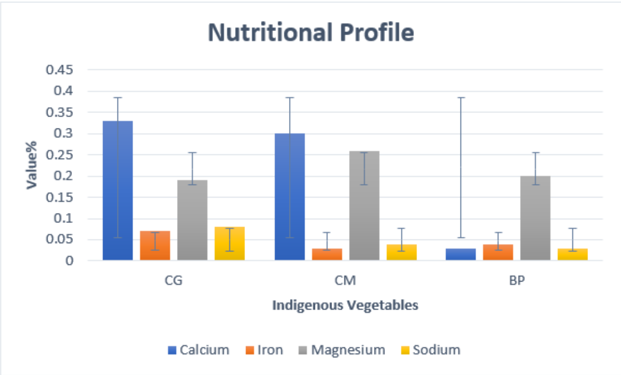

Figure 3: Calcium, Iron, magnesium and sodium content in Cleome gynandra (CG), Cucurbita maxima (CM) and Bidens pilosa (BP).

Discussion

The iron content was highest in the spider flower (0.07% or 70mg/100g) as compared to the other two vegetables. These findings are in line with conclusions arrived at by other scholars like Mishra, Moharana and Dash in 2011 where the iron content of the spider flower ranged from 1-11mg/100g while in pumpkin leaves and black jack the iron levels were found to be 1.55mg/100g [4] and 2.2mg/100g [5] respectively. This shows that the spider flower has the greater potential to deliver the highest levels of iron in diets as compared to the pumpkin leaves and the black jack. Although, all three vegetables could potentially meet the Recommended Dietary Allowances (RDA) of 15-18mg/day [6] [6]. These indigenous vegetables can also assist in alleviation challenges of iron deficiency or anaemia especially in women. A study carried out in 1997 by The Ministry of Health and Child Welfare in Zimbabwe revealed that 9% of the studied population had depleted food stores and Matebeleland north had the highest prevalence of anaemia in pre-school children and pregnant women while Matebeleland South had the highest prevalence in lactating women [7].

The finding that the spider flower also had the highest concentration of calcium (0.33% 0r 330mg/100g) is supported by Mishra [8], who reported the calcium content of spider flower to be 213-434mg/100g. The lowest levels of calcium (0.03% 0r 30mg/100g) in black jack, observed contradicts previous studies which reported it to range from 162-340mg/100g [9]. The minute levels of calcium observed in this study are not able to meet the RDA of calcium which was is set at 800mg/100g-1200mg/100g [6]. Therefore when taking black jack, use of food additives can contribute to dietary calcium [10].

The spider flower from this study had the highest levels of sodium (0.08% or 80mg/100g) as compared to the pumpkin leaves (0.04% or 40mg/100g) and the black jack (0.03% or 30mg/100g). Mashamaite, Manyevere, and Chakauya [11] [11] also reported the sodium content of the spider flower to be 34mg/100g. 100g. Fai, Danbature, and Y.M [12]. reported lower levels of sodium in pumpkin leaves 24mg/100g while Kuo, *et al*, [13]. reported levels in black jack to be 0.54mg/100g. The sodium levels found in this study are unable to meet the RDA of sodium which is set at 2300mg/day [14] [14]. When consuming black jack, food additives can be used to assist in meeting the RDAs for sodium [10].

The observation that pumpkin leaves had the highest level of magnesium (0.26% or 260mg/100g) is an indication that the leaves can be incorporated in diets of children from the ages 9 through 13 to meet their Estimated Average Requirement (EAR) of 200mg/day and their RDA of 240mg/day [15]. Additionally, lactating mothers between the years of 19 and 30 can also consume pumpkin leaves to meet the set EAR of 255mg/100g. Spider flower (0.19% or 190mg/100g) and blackjack (0.2% 0r 200mg/100g) can be incorporated in diets of children between the ages of 4 through 8 years to meet the set RDA of 130mg/day.

The high concentration of zinc in pumpkin leaves (61ppm or 6.1mg/100g) cannot meet the RDA of zinc set at 12mg/day [16]. The high levels of crude protein (22.94%) in spider flower compared to that of pumpkin leaves and black jack indicates the importance of spider flower in meals. Protein plays a role in muscle growth, immune function and overall health [17]. Proteins are also important in maintaining muscle mass and preventing age-related chronic diseases [18]. Many adults do not consume enough protein [19] therefore integrating vegetables such as the spider flower with high protein content addition of spider flower into diets would greatly benefit the health of many people especially in sub-Saharan Africa.

Conclusion and Recommendation

This study has revealed that spider flower, pumpkin leaves and black jack have substantial traces of nutrients in them that can be beneficial to human diets. From this study, it can be concluded that the spider flower (*Cleome gynandra*) has the highest concentration of nutrients on average as compared to pumpkin leaves and black jack. However, pumpkin leaves and black jack can also be utilized more in diets as they have potential to provide adequate magnesium and zinc content for human consumption.

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