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Nutritional evaluation of *Kedrostis africana* (L.) Cogn: An edible wild plant of South Africa

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ABSTRACT

Objective: To evaluate the nutritional composition and elemental constituents of *Kedrostis africana* and their safety aspect.
Methods: Proximate parameters (moisture, ash, crude fibre, crude fat, proteins, and carbohydrate and energy) were evaluated using ALASA methods, and elemental analysis by ICP-OES technique.
Results: The results from nutritional analysis showed that the tuber used for this study had a low content of crude fat and high content of ash, crude protein, crude fibre, carbohydrate and energy having the recommended dietary allowances. The tuber was rich in major minerals Na, K, Ca and Mg, there was sufficient amount of trace elements Fe, Cu, and Zn while the anti-nutrients oxalate, phytate, alkaloids, and saponins were detected in amounts that are not harmful according to Food and Agriculture Organization/World Health Organization.
Conclusions: The outcome of this study suggests that this wild plant has very good nutritional potentials to meet the recommended dietary allowance and it could be a cheap source of essential nutrients that may ameliorate most nutritional challenges and can contribute remarkably to the amount of nutrient intake in human and animal diet.

1. Introduction

With ever-increasing population pressure and fast depletion of natural resources, it has become extremely important to diversify the present day agriculture produce in order to meet various human needs [1]. This diversification of agricultural products and their consumption habits has now shed light on a broader range of plant species, particularly those which are currently identified as underutilized and these could significantly contribute to improved health, nutrition, livelihoods, and ecological sustainability [2].

These edible wild plants as noted by Afolayan and Jimoh [3] and Ali-Shtayeh *et al.* [4] are important sources of dietary nutrients in food and contribute to the proper growth and functioning of the body. Based on FAO reports, about 1 billion people especially in developing countries depend on edible wild plants in their diets [5]. Traditionally, some of these plants are not only edible but also have high medicinal properties [6]. An ethnobotanical study carried out [7] revealed that wild plants play a crucial role in sustenance of life most especially to the rural dwellers as they depend majorly on wild plants for food and medicine [8,9]. This has lead researchers to re-examine each and every plant with a fresh new approach towards their possible use for food or medicine. Plants are generally rich in primary metabolites including proteins, carbohydrates, vitamins, sterol and lipids, which are essential for its survival. These primary metabolites provide the world with food and are the basis of nutrition for the entire world [9].

Trace elements that have been implicated in combating a variety of human ailments and disease are found mainly in indigenous medicinal plants [10,11]. The functional activities of specific organs could be affected by the continuous dietary ingestion of certain elements; which can lead to their bioaccumulation beyond normal or safe levels [12].

Kedrostis africana (Linnaeus) Cogn. (*K. africana*) is a monoecious caudiciform plant, commonly known as “Baboon's

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Cucumber" with lots of herbaceous climbing or creeping vines growing rapidly from the swollen base, resembling an English ivy with a tuber. The shoots emerge from a massive underground tuberous rootstock (or caudex). This tuber is a water-storage organ that is very resistant to drought [13]. The specie is native to Namibia and South Africa (Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West and Western Cape). *K. africana* tuber is widely used in traditional medicine as an emetic, purgative, diuretic, anti-dropsy and to treat syphilis [14]. Also, a decoction from the crushed fresh bulb is taken twice daily for the management of obesity [15,16]. Keeping in mind its medicinal importance, the present investigation was undertaken to ascertain the nutritive potential of the specie harvested from the Eastern Cape of South Africa, which has been lacking in the literature.

2. Materials and methods

The tubers of *K. africana* used for this study were harvested in August 2015 at Fort Beaufort in the Amathole District Municipality, Eastern Cape, South Africa. This area lies at Latitude 32°43′28.66″ and Longitude 26°34′5.88″. The plant's identity was validated by Mr. Tony Dold of Selmar Schonland Herbarium, Rhodes University, South Africa, and a voucher specimen (Unuofin Med, 2015/2) was prepared and deposited in the Giffen Herbarium, University of Fort Hare. The bulb was rinsed with deionised water and gently blotted with paper towel, chopped into small bits, oven-dried (LABOTEC, South Africa) at 55 °C for 72 h until constant weight was achieved and then ground into powder (Polymix® PX-MFC 90D Switzerland).

2.1. Determination of moisture content

The moisture content was determined as published methods [17]. An empty weighing vessel was oven dried at 105 °C for one hour, cooled in a desiccator and weighed (W1). A dry sample weighing (2.000 ± 0.001) g (W2) was put into the vessel and oven dried at 105 °C until constant weight was attained. This was then cooled in a dessicator, after which it was weighed (W3). The percentage moisture was calculated as:

$$\%\ \text{Moisture content} = \frac{W2 - W3}{W2 - W1} \times 100$$

2.2. Measurement of ash content

The ash content was determined as described methods [17]. A porcelain crucible marked with a heat resistant marker was dried at 105 °C for 1 h, left to cool in a desiccator and weighed (W1). Then 2 g of the ground sample was placed in the previously weighed crucible and reweighed (W2). The crucible with its content was then ashed first at 250 °C for an hour and at 550 °C for 5 h in a muffle furnace. The samples were allowed to cool in a desiccator and then weighed (W3). The percentage ash was calculated as:

$$\%\ \text{Ash content} = \frac{W2 - W3}{W2 - W1} \times 100$$

2.3. Determination of crude fat

The powdered sample (5 g) was extracted in 100 mL of diethyl ether and then placed on an orbital shaker for 24 h. The extract was then filtered and the ether extract was collected in a previously weighed (W1) clean beaker. It was thereafter equilibrated with 100 mL diethyl ether and shaken for another 24 h; the filtrate was collected in the same beaker (W1). The ether was concentrated to dryness in a steam bath and dried in an oven at 40–60 °C and the beaker was reweighed (W2). The crude fat content was calculated as:

$$\%\ \text{Crude fat} = \frac{W2 - W1}{\text{Weight of original sample}} \times 100$$

2.4. Determination of crude fibre

A modification of the method described by Aina et al. [18] was used where 2 g of sample was digested by boiling with 100 mL of 1.25% sulphuric acid solution for 30 min, then filtered under pressure. The residue was rinsed four times with boiling water. This process was repeated on the residue using 100 mL of 1.25% NaOH solution. The final residue was then dried at 100 °C, cooled in a desiccator and weighed (C1). It was thereafter incinerated in a muffle furnace at 550 °C for 5 h, then transferred to cool in a desiccator and reweighed (C2). The percentage crude fibre was calculated as:

$$\%\ \text{Crude fibre} = \frac{C2 - C1}{\text{Weight of original sample}} \times 100$$

2.5. Determination of crude protein

The powdered sample (2 g) was digested in a Kjeldahl flask by boiling with 20 mL of concentrated H_2SO_4 and a digestion tablet (catalyst) until the mixture was clear. The digest was filtered and made up to mark in a 250 mL volumetric flask, then distilled. The aliquot plus 50 mL of 45% sodium hydroxide solution was transferred into a 500 mL round bottom flask and distilled. 150 mL of the distillate was collected into a flask containing 100 mL 0.1 N HCl. This was then titrated against 2.0 mol/L NaOH using methyl orange as indicator. The end point was indicated by a colour change to yellow.

The % nitrogen content was calculated as:

$$\frac{[(\text{mL standard acid} \times \text{N of acid}) - (\text{ml blank} \times \text{N of base})] - (\text{ml std base} \times \text{N of base}) \times 1.4007}{\text{Weight of sample in grams}}$$

where, N = normality, percentage crude protein was obtained by multiplying the nitrogen value by a factor of 6.25. % crude protein = Nitrogen in sample × 6.25.