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Research paper

Proximate, minerals and anti-nutritional composition of daniellia oliveri (maje) tender leaves

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Abstract

The Nutritional and anti-nutritional composition of tender leaves of Daniellia oliveri were analyzed in this study. The results of the proximate analysis were as follows, moisture content (78.67±2.31%), ash (4.67±0.29%), crude lipid (2.67±0.29%), crude protein (7.23±0.13%), crude fibre (2.33±0.29%), available carbohydrate (4.43±2.59%) and the energy value (70.67±12.45 kJ/kg). In elemental analysis, potassium has the highest concentration (3766.67±57.74 mg/100g), zinc (0.1502±0.00020 mg/100 g) is the lowest and lead (0.2352±0.00015 mg/100g). The anti-nutritional parameters analyzed includes; phytate (6.7592 mg/100g), oxalate (0.0023mg/100g), saponin (1.20mg/100g), tannin (430.80mg/100 g), hydrocyanic acid (122.73 mg/100g). The anti-nutrients to nutrients ratio show the bioavailability of some essential minerals, with the exception of [cyanides] and [tannin] in the tender leaves. These reach significant levels and are expected to reduce bioavailability of iron, magnesium and zinc in tender leaves.

Keywords: *Daniellia Oliveri; Tender Leaves; Food; Mineral; Oxalate;Phytate.*

1. Introduction

There are several studies on medicinal plants which have exhibited their benefits such as vegetables, spices, and medicine (Okwu, 2005; Muhammed et al., 2011). Plant resources are commonly eaten in rural areas as another source that contributes to the supply of essential nutrients to the body (Muhammad et al., 2015). Nearly 30% of plant-based foods provide more than 90% of nutritional needs (Hassan et al., 2011). Irrespective of the nature of the use, whether by consumed raw, cooked or ingredient of sauce preparation, they are not only nutritious but also abundant and easily available (Hassan et al., 2011).

Undernourishment is a universal problem in the midst of rural communities, particularly the expectant women and children in developing countries (Jacob et al., 2015). In response to the problem of malnutrition due to growing global population, the leaves are common and well known for their benefits, thus providing an excellent source of nutrients and nutritional supplements (Angeline et al., 2015; Anuradha et al., 2013).

However, these plants are underutilized because people do not know the medicinal plants needed to fight malnutrition and do not meet the required nutritional levels. The plant leaves with proximate, minerals, anti-nutritional and functional properties are being increasingly studied and lots of plants with abundant functional properties are now succeeding (Otunola and Afolayan, 2019).

Daniellia oliveri (maje) an unused multipurpose plant is belongs to the family of Caesalpiniaceae with 48 meters height and deciduous leaves to the torch (Alagbe, 2021). Scientific research have shown that all branches have considerable antimicrobial, anti-inflammator, cytotoxic, antihyperglycaemic, antioxidant, anti-diarrheal, immunostimulatory, hepatoprotective and miracicidal activities (Wenk, 2012; Fascina et al., 2012; Hong et al., 2012; Alagbe, 2019 ; Alagbe et al., 2019). Furthermore, despite there are many studies on the nutritional value of Daniellia oliveri leaves, presumably there is no report on the proximate, mineral and anti-nutritional compositions of Daniellia oliveri tender leaves. Consequently, the present study is aimed at examined the proximate, minerals and anti-nutritional composition of Daniellia oliveri tender leaves.

2. Materials and methods

2.1. Sample collection

Tender leaves of Daniellia oliveri are obtained from different parts of the branch (that is, top, middle and base) collected in BirninYauri area in Kebbi State. After harvesting, the leaves are removed from the branches, separated to separate the bad from good. The sample was taken to a laboratory in a 50kg Golden Penny sack and certified by a botanist at the herbarium centre of the Biological science department of Kebbi State University of Science and Technology Aliero, Kebbi State, Nigeria. The freshly picked tender leaves of Daniellia oliveri are rigorously washed with sterile distilled water and air dried in the shade for about two weeks at room temperature to remove the moisture content and to avoid loss of active compounds. The sample was grounded into finery powdered using Nigerian made

wooden mortar and pestle, and sieved in a mesh size of 0.5mm to ensure smooth and homogenous surface. The powdered sample was transferred in to the clean and dried plastic container and labeled as D. oliveri powdered sample and stored in a right place until it was needed for analyses.

2.2. Proximate analysis

The proximate compositions such as moisture content, ash content, crude protein, lipid and fibre of D. oliveri tender leaves were determined according to the procedures of AOAC, (1990). Ash content was determined at 550 ^{0}C. Kjeldhal procedure was adopted to determine the crude protein and obtained crude protein content by increasing the nitrogen value by a factor of 6.25 while total carbohydrate concentration was calculated by the difference as shown in equation 1 below:

$$\text{CHO} = 100 - (\%\ \text{ash} + \%\ \text{crude protein} + \%\ \text{crude lipid} + \%\ \text{fibre}) \quad (1)$$

The whole energy value in the leaf of D. Oliveri in Kcal/100 g was calculated following the method of FAO (2003) as given in equation 2 below:

$$\text{Energy (Kcal)} = [(\%\ \text{CHO} \times 4) + (\%\ \text{CP} \times 4) + (\text{CL} \times 9)] \quad (2)$$

Where CHO = Carbohydrate, CP = crude protein and CL = crude lipid (Hassan et al., 2008).

2.3. Mineral analysis

Sample of D. oliveri tender leaves were digested in solution by wet digestion using a concentration mixture of Nitric, perchloric and sulphuric acid in a ratio of 9:2:1 respectively. Fe, Zn, Cr, Co, Mg, Ca, Cu, Mn and Pb were measured by AAS, while Na and K were measured using an atomic emission spectrometer and phosphorus was determined using colorimetric method (Unuofin et al., 2017).

2.4. Anti-nutritional analysis

Anti-nutritional analysis of D. oliveri tender leaves was done as follows, oxalate was according to Unuofin et al., [17] procedure, phytate and hydrocyanic acid was according to procedure of AOAC, (1990) and nitrate, IITA (1988).

3. Results and discussion

Table 3.1: Proximate Content of Tender Leaves of Daniellia Oliveri

Proximate Parameters Concentration (%)	
Moisture (%WW)	78.67±2.31
Ash (%DW)	4.67±0.29
Crude lipid (% DW)	2.67±0.29
Crude protein (%DW)	7.23 ± 0.13
Crude fibre (%DW)	2.33 ±0.29
Carbohydrate (%DW)	4.43 ± 2.59
Energy value (Kcal)	70.67 ±12.45

The data are mean value ± standard deviation of triplicate results.
DW = Dry Weight, WW = Wet Weight
The proximate composition of the D. oliveri is presented in Table 3.1. 78.67 % was reported for moisture content, which is slightly higher than that reported for 59.55 % Myrianthusarboreus leaves (Atabo., 2017) and O. gratissimum leaves contained 75.73 % (Oluwole et al., 2019), but lower than 87.67 % of Amaranthusviridis tender leaves reported by Umar et al., (2011). Food moisture content is used for the assessment of stability and receptiveness to microbial contamination (Uraih and Izuagbe, 1990).
The result obtained for ash content is comparable to previous studies (Oluwole et al., 2019; Iheanacho and Ubebani 2009). It is of great significance in food as it represents the mineral components (Edema and Okiemen, 2000). The crude protein content of D. oliveri tender leaves obtained was lower than the protein content of various leafy vegetables from other studies (Onwordi et al., 2009; Asaolu., 2012, Fagbohun et al., 2011).
The obtained value of crude fibre content value (2.33%) was low compared to the values reported for Myrianthus arboreus leaves (13.15%) by Atabo et al., (2017). This likely suggests that the leaves may aid digestion as some fiber has been reported to help prevent constipation, gastrointestinal upset, hermorrhoids, diabetes and breast cancer (Ishida et al., 2000; Abifarin et al., 2021).
Carbohydrate represents an important group of organic compounds that occur naturally which are necessary for the protection of life and provides raw materials for many industries (Ebun-Oluwa and Alade, 2007). The carbohydrate content of D. oliveri (4.43%) is well comparable to O. gratissimum (6.63%) reported by Oluwole et al., (2019) and (1.22%) reported by Asaolu et al., (2012).
Table 3.1 presented 2.67% for crude lipid of the sample which was lower than the 5.27% reported for tender leaves of Amaranthus viridis (Umar et al., 2011). Low lipid is the trait considered for suggested leafy vegetables to fight obesity (Umar et al., 2011). The calorific value of D. oliveri tender leaves was lower than the 271.04 Kcal of the leaves of Heteromorpha arborescens (Spreng.) reported by Abifarin et al., (2021). Abifarin et al., (2021) reported that the high carbohydrate content resulted to high energy content, suggesting that it may be a better dietary energy source, contrary to the results obtained in this study.

Table 3.2: Mineral Composition of Tender Leaves of D. Oliveri (Mg/100 G Dry Weight)

Element	Concentration (mg/kg)
Ca	1.60 ± 0.05
Mg	0.62 ± 0.06
Na	70.83 ± 1.44
K	3766.67 ± 57.74
P	3.14 ± 0.01

Fe	1.1083 ± 0.00010
Zn	0.1502 ± 0.00020
Pb	0.2352 ± 0.00015
Cr	0.2275 ± 0.00026
Cu	0.2545 ± 0.00016

The data are mean value ± standard deviation of triplicate results.

There are essential minerals for building and maintaining the body, such as calcium, magnesium, sodium, potassium, phosphorus, iron, zinc, etc., (Appel, L. J 1999). They help support and improve muscle, heart and brain functions, also help to maintain and produce of teeth and strong bones (Bello et al., 2008).

The mean value of calcium concentration in the tender leaves of D. oliveri (1.60mg/kg) as shown in Table 3.2. The calcium content in the leaves was higher than that reported in Heteromorpha arborescens (Spreng.) leaves by Abifarin et al., (2021). It supports the growth and maintenance of bones, teeth and muscles (Dinicolantonio et al., 2018). Calcium intake is generally recommended for children and expectant women (Duran et al., 2008).

Magnesium makes breathing easier for asthmatics by playing a key part in muscle relaxation all along the airway to the lungs. It plays an important role in most reactions related to phosphate transfer; believe that it is essential for nucleic acid and intestinal absorption while its deficiency leads to severe diarrhea and migraines in humans (Harun et al., 2015).High levels magnesium is predictable as it is a component of leaf chlorophyll (Umar et al., 2011). The value is comparable to several green vegetables (Hassan et al., 2004). Sodium is engaged in the control of acid–base balance, normal cell function, and transport of metabolites, transmission of nerves impulse and maintaining blood pressure (Insel et al., 2011). Potassium is essential for sustaining normal cell function, regular muscle contraction, and blood pressure regulation (Abifarin et al., 2021).

In addition, iron is an essential element in the diets of pregnant women, nursing mothers, babies who experience seizures, and the aged to avoid anaemia and other related diseases (Insel et al., 2011). Zinc is an important trace element for the synthesis of protein and nucleic acid and involves in normal body development and essential for rapid growth (Jéquier, and Constant 2010). Copper is needed for multiple enzymatic reactions with performance of organs in the body, synthesis of collagen, production of energy, and the development of hemoglobin (Ladan et al., 1996; Melaku, 2005).

However, the mineral compositions examined in this study were present in significant quantities, with the exception of the potassium content, which was quite high. Mineral composition result investigated in this study showed that the tender leaves of D. oliveri can function as essential minerals.

Chromium is an important trace element that increases insulin activity, thereby affecting carbohydrate, fat and protein metabolism (Ndidi et al., 2014). The chromium level in in D. oliveri is 0.2275 mg/kg, which is low compared to the 1.53 reported in the tender leaves of Amaranthusviridis (Umar et al., 2011). The concentration of lead obtained was presents in considerable amount. However, high consumption of this element has a negative impact on human health.

Table 3.3: Levels of Some Anti-Nutritive Factors in Tender Leaves of D. Oliveri

Anti-nutrients (mg/kg)	Concentration (mg/kg)
Phytate	6.7592 ± 0.4225
Oxalate	0.0023 ± 0.0005
Tannins	430.80 ± 0.30
Cyanides	122.73 ± 1.52
Saponins	1.20± 0.20

Each value represents mean ± standard deviation of three replicate determinations. n = 3

Anti-nutrients can have adverse effects by decreasing protein digestibility and bioavailability of mineral. Low levels of phytate, oxalate, and saponins were examined with reasonably high level of tannins and cyanides as shown in Table 3.3. The mineral assay results obtained compared well to previous results by Atabo et al., (2017). Tannins are complex water-soluble phenolic compounds; and besides their bitterness, which gives them some nutritional appeal, their main nutritional importance obtained from their capacity to complex with and precipitate proteins (Umar et al., 2011).

High levels of cyanide intake can linked to a serious health problem, spastic paraparetis known as Konzo. A neurological condition known as Tropical Ataxic Neuropathy (TAN) has also been connected to the intake of high level of cyanide in the cassava–based diet (Okaka et al., 2006). Nevertheless, the presence of reasonable level of tannins and cyanides should not create a problem if processed properly, as processing reduces the anti-nutrients level to acceptable levels (Oluyemi et al., 2006; Saupi et al., 2009).

4. Conclusion

This work revealed that the fresh tender leaves of Daniellia oliveri contain a significant amount of carbohydrate, ash, moisture, crude fibre, crude protein, crude lipid and minerals. The leaves also contain significant amounts of low anti-nutritional contents such as oxalate, phytate, saponin, below established toxic levels. And the high level of cyanide and tannins make it a good source of antioxidant in food and can be reduced with right preparation method. The leaves of the plant can serve as an alternative source of energy.

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