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Evaluation of the Phytochemical and Nutritional Profiles of *Cnidoscolus chayamansa* (Mc Vaugh) Leaf Collected in Jos, North Central, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author RJK designed the study and performed the statistical analysis. Author MKJ wrote the protocol. Author VPD wrote the first draft of the manuscript. Author DHE managed the analyses. Author CEM managed the literature of the study. Author CNO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Plants could either be ornamental, medicinal, as well as nutritional, hence there has been a high level of reliance on plants as a whole by both man and animals for survival.
Aim of the Study: This study aimed to evaluate the Phytochemical contents and Nutritional Profiles of *Cnidoscolus chayamansa* Leaf Collected in Jos, North Central, Nigeria.
Study Duration: This study was conducted on 30th June, 2019 at the Department of Biochemistry, Faculty of Basic Medical Sciences, University of Jos, Nigeria.
Methodology: The proximate and phytochemical compositions were investigated in accordance with standard procedures. Mineral concentrations were determined by using flame photometer, atomic absorption spectrophotometer, calorimetry. Crude protein content was determined by Kjeldahl method and amino acid profile were analyzed using Technicon sequential Multi-Sample Amino Acid Analyzer (TSM).
Results: The preliminary qualitative phytochemical screening revealed the presence of alkaloid, flavonoids, tanins, saponins, terpenes and steroids, balsam and phenol with the absence of cardiac glycosides, and resin. The proximate analysis showed high carbohydrate (27.48±0.02), crude fibre

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(25.18±0.02) and protein (18.63±0.01), moderate concentration of moisture content (12.62±0.00) and ashes content (11.68±0.01), low concentration of crude lipid (4.40±0.01). The minerals detected were calcium, magnesium, potassium, sodium, iron, manganese, cobalt, sulphur, aluminium, zinc, molybdenum, and Phosphorus. Seventeen amino acids were analysed; nine essential amino acids namely; Leucine, isoleucine, phenylalanine, trptophane, valine, threonine, arginine, methionine and histidine and Eight non-essential amino acids namely; proline, tyrosine, cysteine, alanine, glutamate, gycine, serine and aspartic. Glutamic and leucine acids were found in higher concentration as 10.14± 0.016 and 8.99± 0.000 respectively.

Conclusion: This investigation shows that *Cnidoscolus chayamansa* leaf from Jos, Nigeria contains high medicinal and nutritional compositions which could be exploited for the treatment of diseases as well as nutritional supplements.

Keywords: Amino acid; minerals; Cnidoscolus chayamansa; phytochemicals.

1. INTRODUCTION

Vegetables are those herbaceous plants whose part or parts are eaten as supporting food or main dishes and they may be aromatic, bitter or tasteless [1].

The utilization of leafy vegetable is part of Africa's cultural heritage and they play important roles in the customs, traditions and food culture of the African household.

Nigeria is endowed with a variety of traditional vegetables and different types are consumed by the various ethnic groups for different reasons. The nutrient content of different types of vegetables varies considerably and they are not major sources of carbohydrates compared to the starchy foods which form the bulk of food eaten, but contain vitamins, essential amino acids, as well as minerals and antioxidants [2]. Vegetables are the cheapest and most available sources of important proteins, vitamins, minerals and essential amino acids [3]. Vegetables are included in meals mainly for their nutritional value; however, some are reserved for the sick and convalescence because of their medicinal properties. plants have certain traceable distinctiveness found in them like the unique chemicals they synthesize. In Africa, many studies have indicated that a vast number of indigenous wild plants play a significant role in the diet of the populace [4]. Vegetables are the cheapest and most available sources of important nutrients, supplying the body with minerals salts, vitamins and certain hormone precursors, protein, energy and essential amino acids [5]. These make the different vegetables of high importance. In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by starchy staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acids [6]. These vegetables vary considerable in their nutrient composition and are good sources of vitamins, essential amino acids, proteins as well as minerals and antioxidants which are usually in short supply in the diet [7].

Cnidoscolus chayamansa otherwise known as Tread Softly, Cabbage Star, most commonly referred to as Chaya, or spinach tree, is a tropical shrub. The plant has several medicinal usages. It is used as treatment for various illnesses such as alcoholism, diabetes, insomnia, gout, scorpion stings, skin disorders, and venereal diseases and for its ability to strengthen fingernails, darken greying hair, and improving brain function and memory [8] When cooked, the young leaves and shoots of tree spinach are consumed as vegetable as it is rich in protein, calcium, iron, carotene, riboflavin, niacin, and ascorbic acid. It should be noted however that leaves should be cooked thoroughly to remove its high hydrocyanic acid content. It can be grown from woody stem cuttings, softwood cuttings, or semi-hardwood cutting [9]. This study evaluates the phytochemical content and nutritional profile (proximate, amino acids and minerals composition of *Cnidoscolus chayamansa* collected from Jos, North Central Nigeria.

2. MATERIALS AND METHODS

2.1 Chemical and Reagents

All chemicals were of analytical grades and prepared in glass apparatus using distilled water.

2.2 Plant Material

The Fresh leaves of *Cnidoscolus chayamansa* were collected from a residential area in hill

station Jos north L.G.A, Plateau state,North Central, Nigerian and deposited in a clean polyethene bag after been washed with clean water. Plant was authenticated at the Department of Plant Science and Biotechnology, University of Jos.

2.2.1 Plant identification and authentication

The plant, *Cnidoscolus chayamansa* was identified and authenticated by O.E Agyeno from the Department of Plant Science and Biotechnology, University of Jos, Nigeria.

2.3 Phytochemical Screening (Qualitative)

The presence of alkaloids, flavonoids, tannins, terpenes, steroids, phenolics, cardiac glycosides, resins, balsam and saponins were determined by the methods described [10].

2.4 Proximate Analysis

The moisture content was determined by drying at 105Â°C in an oven, until a constant weight was reached. For total ash determination, the plant samples were weighed and converted to dry ash in a muffle furnace at 450 and at 550Â°C for incineration. The Crude fat content was determined by extraction with hexane, using a Soxhlet apparatus. All these determinations were carried out according to AOAC [11]. Kjeldahl method was used for crude protein determination. Carbohydrate content was determined by calculating the difference between the sum of all the proximate compositions from 100%. Energy values were obtained by multiplying the carbohydrate, protein and fat by the Atwater conversion factors of 17, 17 and 37, respectively [12].

2.5 Mineral Analysis

Mineral analyses were carried out according [13]. Elemental analyses were carried out using an atomic absorption spectrophotometer and a flame photometer to determine calcium, sodium, potassium and magnesium content. Aluminium, iron and phosphorus were determined calorimetrically. The concentration of each element in the sample was calculated on a dry matter basis.

2.6 Determination of Amino Acid Profile

The Amino Acid profile in the known sample was determined using methods described by [14].

2.7 Statistical Analysis

The data were expressed as Mean ± Standard Error of Mean. Statistical analysis was performed using analysis of variance (ANOVA) and Duncan multiple range test at 5% level of confidence ($p<0.05$).

3. RESULTS

The results below showed the phytochemical screening, proximate analysis, mineral composition and amino acids analysis of *Cnidoscolus chayamansa.*

Table 1. Phytochemical analysis of *Cnidoscolus chayamansa*

Test	*Cnidoscolus chayamansa*
Alkaloid	+
Flavonoids	+
Tanins	+
Saponins	+
Terpenes and steroids	+
Cardiac glycosides	-
Balsam	+
Phenol	+
Resin	-

Table 2. Proximate composition of *Cnidoscolus chayamansa*

Proximate analysis	*Cnidoscolus chayamansa* Percentage composition (%)
Ash content	11.68±0.01
Crude lipid	4.40±0.01
Moisture	12.62±0.00
Crude fibre	25.18±0.02
Crude Protein	18.63±0.01
Carbohydrate	27.48±0.02

Tabulated values are expressed as Mean ± SD

Table 3. Table showing essential amino acids

Plant extracts (g/100g protein)	
Amino acid	***Cnidoscolus chayamansa***
Leucine	8.99+ 0.000
Lysine	7.37+ 0.008
Isoleucine	5.04+ 0.008
Phenylalanine	5.59+ 0.008
Tryptophan	0.55+ 0.003
Valine	5.79+ 0.016
Threonine	5.11+ 0.008
Arginine	7.05+ 0.008
Histidine	2.24+ 0.008
Methionine	1.82+0.016

Table 4. Non essential amino acids of plant extracts

Plant extracts (g/100 g protein)	
Amino acids	***Cnidoscolus chayamansa***
Proline	3.15+ 0.016
Tyrosine	5.16+ 0.016
Cystine	0.97+ 0.008
Alanine	3.19+ 0.008
Glutamate	10.14+ 0.016
Glycine	3.80+ 0.016
Serine	3.29+ 0.008
Aspartic	7.50+ 0.008

Table 5. Mineral analysis of *Cnidoscolus chayamansa*

Cnidoscolus chayamansa	**Element**
Macro Element	**(%)**
Potassium	2.41±0.05
Calcium	6.67±0.05
Sodium	0.018±0.001
Magnesium	0.866±0.001
Phosphurus	0.37±0.01
Sulphur	0.38±0.01
Aluminium	0.05±0.00
Micro Element:	**mg/kg**
Zinc	102.5±0.5
Manganese	63±0.01
Iron	0.063±0.01
Molybdenum	3.02±0.01
Cobalt	0.28±0.01
Copper	29.97±0.01
Lead	6.63±0.005

4. DISCUSSION

Phytochemical constituents are responsible for medicinal activity of plant species. The preliminary qualitative phytochemical screening of the leaf of *Cnidoscolus chayamansa* revealed the presence of alkaloid, flavonoids, tanins, saponins, terpenes and steroids, balsam and phenol with the absence of cardiac glycosides, and resin Phenols, which are in agreement with those obtained by Peixoto et al. [15] Generally, the evaluation of chemical components of plants provides a vital information about discovery of new drugs and clue compounds for other applications [16].

The presence of alkaloids, flavonoids, tannins and saonins in *Cnidoscolus chayamansa* leaves is a clear indication that the plant, can be exploited in pharmaceuticals for the treatment of many disease conditions. The presence of flavonoids makes the plant a potential cancer therapy because flavonoids are well known for the enormous ability to combat cancer.

The presence of flavonoids is in agreement with those reported by [17].

Saponin serves as natural antibiotics, which help the body to fight infections and microbial actions. Its presence makes *Cnidoscolus chayamansa a* potential antibiotics drug.

Saponins protect against hyperglycaemia, hypercholesterolaemia, hypertension [18] have antibiotic properties and anti-inflammatory property and aid healing [19]. Saponins natural tendency to ward off microbes makes them an effective therapy for fungal and yeast infections. Cardiac glycosides was not detected, this is in contrast with those reported by [20]

The potential of a particular food or plant is determined primarily by its nutrient composition. The nutritional evaluation of *Cnidoscolus chayamans* revealed the presence of proximate such as carbohydrate, protein, crude fat, moisture, ash and crude fiber. The results of the nutrient composition revealed that the carbohydrate content was the highest, while crude fat was the least.

The high presence of carbohydrate, crude fiber and moisture content are clear indication that it's nutritional essence [21]. Ash content of a plant based food is the function of the mineral elements present. Its presence shows that *Cnidoscolus chayamansa* mineral elements. Other important proximate available includes crude fat and crude protein which are in appreciable quantity. Their presence goes further to expose the nutritional benefit of the leaf.

The mineral evaluation revealed the presence of calcium, magnesium, potassium, sodium, iron, manganese, cobalt, sulphur, aluminium, zinc, molybdenum, and Phosphorus The result of the analysis showed that the calcium content was the highest follow by potassium. The presence of sodium and potassium to such extent shows that the plant can be used in the management and treatment of diseases associated with the central nervous systems and also in the prevention of CNS associated disease condition [22]. This is because Potassium and sodium ions are known activators of energy potentials across nerve membrane. Calcium (Ca) is an important factor in fibrin formation which forms fibrinogen and subsequently fibrin and collagen. Fibrin which is a clotting factor responsible for homeostasis

together with calcium ions may serve as replenishment in diarrheic conditions, maintenance of normal nervous function and gut peristalsis.

Iron plays a vital part in blood function and this may explains the traditional use of this plant as blood booster or blood tonic.

Zinc is an essential component for enzymatic functions of the body and without zinc, the body will quickly lose overall function and results in a number of health concerns, including an inability to heal wounds, store insulin, fight off disease, develop proper growth patterns, as well as defend against a variety of skin infection [23]. According to this study, *Cnidoscolus chayamansa* leaves are rich sources of minerals, which are involve in diverse metabolic functions. For example sodium is for osmotic balance, magnesium and potassium for muscle contraction, calcium and phosphorus are involved in bone and teeth development and iron is essential for haemoglobin formation [24]. High concentration of minerals makes the leaf an excellent antioxidants.

Seventeen amino acids were analysed; nine essential amino acids namely; Leucine, isoleucine, phenylalanine, trptophane, valine, threonine, arginine, methionine and histidine and Eight non-essential amino acids namely; proline, tyrosine, cysteine, alanine, glutamate, glycine, serine and aspartic. Glutamic and leucine acids were found in higher concentration. phenylalanine like other aromatic amino acids have been suggested to have anti-sickling potentials [25] Arginine is a semi-essential amino acid that serves as a substrate for protein synthesis and is the precursor to nitric oxide (NO), Polyamines, Proline, Glutamate and Creatinine etc. Arginine supplementation has been shown to decrease pain sores in children with Sickle Cell Disease [26].

However the amino acid composition has clearly shown the presence of most essential amino acids thus, making *Cnidoscolus chayamansa* a potential panacea for kwashikwor and other related protein-deficiency diseases.

5. CONCLUSION

The present study shows the presence of phytochemicals, amino acids, minerals and nutrients in *Cnidoscolus chayamansa* .leaves which may therefore justify both its nutritional and ethnomedicinal benefits to human health. The study further revealed low level of toxicant, glycosides and high levels of flavonoid, tannin, alkaloid. The leaves also showed a high level of moisture and carbohydrate. Leaves of *Cnidoscolus chayamansa* seem to have good nutritive and suitable mineral element value necessary to maintain good health.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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