



Proximate Composition, Antinutrient Content and Antimicrobial Properties of *Cnidoscopus aconitifolius* Leaves

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Authors' contributions

This work was carried out in collaboration between both authors. Author JAL designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author GEJ managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Fresh leaves of *Cnidoscopus aconitifolius* were harvested from area gardens around Mayne Avenue in Calabar. Proximate composition, anti-nutrient content, vitamins content and antimicrobial activity of the extract were determined. The antimicrobial activity using the aqueous extract was also determined. The results of the proximate composition revealed the presence of moisture 86.40%, ash 6.50%, protein 4.38%, fat 1.20%, fibre 2.39% and carbohydrate 85.36%. The antinutrient components detected are within the acceptable limits with phytic acid 60.44mg/100g followed by total oxalate 40.30mg/g and therefore will not cause any adverse health problems. Toxic amino acid and chlorogenic acid were not detected in the plant extract. The vitamin contents range from 0.10mg/100g to 143.20mg/100g. The highest value was found in vitamin A and the least in niacin. The antimicrobial activities of the extract of this plant against the pathogenic test organisms showed zones of inhibition ranging from 20.5 mm for *Salmonella typhi* to 26 mm for *Streptococcus pyogenes* at 10 µg/ml. The highest zones of inhibition observed with

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the standard antibiotics were gentamycin 19mm at 10 µg/ml against *E. coli*, ofloxacin 21mm at 5 µg/ml against *K. pneumoniae* and methicillin 16mm at 10 µg/ml against *S. pyogenes*, *K. pneumonia* and *E. coli*.

Keywords: Antioxidant; antimicrobial; proximate composition; inhibition; antinutrient; *Cnidoscolus aconitifolius*.

1. INTRODUCTION

Rural and urban populations in some parts of West Africa use certain plant species for therapeutic and dietary purposes. *Cnidoscolus aconitifolius* belonging to the Euphorbiaceae family [1] is cultivated and is used by people with scarce economic resources. This family includes *Cnidoscolus aconitifolius*. *C. aconitifolius*, known as tree spinach (English), *efo iyana ipaja*, or *efo Jerusalem* (Yoruba) is commonly found in the Western part of Nigeria. This vegetable is planted and consumed by indigenes of Southern Nigeria. The volume of consumption of this plant is more in the west and midwestern states of Nigeria as compared to other parts.

Despite the widespread use of this plant across the states, the scientific literature is yet to fully investigate the traditional uses and nutritional values of these species. However, some reports describe the nutritive values of *C. aconitifolius* [2]. *C. aconitifolius* was found to be mainly valued as a food source; nonetheless, it was and continues to be an important medicinal plant [3]. The importance of this vegetable to human nutrition and wellness is still not fully harnessed and given its due place. It is still one of nature's underutilised herbs in this part of the world. However, the simple fact that it is commonly known as "hospital too far" is quite gratifying and is at the same time this is an indication of its healing potentials in the community.

It is a widely distributed annual plant, ranging from temperate to tropical zones, and has a long history of use as both a medicinal and an edible plant [4]. It has certain antibacterial properties, and many patients have benefited from using this plant to manage their hypertensive health challenges [5]. It has also been used as diuretic, circulation and lactation stimulants, and has also been recommended for diabetes, obesity, acne, kidney stones and eye problems [6]. It supports spermatogenesis (formation of sperm cells in the testes).

Research has shown that *C. aconitifolius* is rich in natural antioxidant [2], which scavenges free

radicals. Many chronic diseases and causes of food spoilage are linked to pro-oxidants. Antioxidant components are therefore useful in food preservation and drug formulations [7]. Synthetic antioxidants like butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) are suspected to be tumorigenic [8]. Therefore, there is a need to search for potential antioxidant compounds, especially from herbs, that can replace their synthetic counterparts. An expanding body of evidence from epidemiological and laboratory studies have demonstrated that some edible plants as a whole or their identified compounds with antioxidant properties have substantial protective effects against free radicals associated diseases [9].

In view of the wide uses of this plant, this study aimed at evaluating the proximate composition and its efficacy against some pathogenic bacteria with a view to exploiting its activities for improving human health.

2. MATERIALS AND METHODS

2.1 Collection and Preparation of the Leaves of the Hospital Too Far

Fresh leaves of *C. aconitifolius* were collected from Mayne Avenue in Calabar South Area Council of Cross River State of Nigeria. The samples were immediately transported to the University of Calabar where they were botanically identified in the Department of Plant and Ecological Studies, University of Calabar, Nigeria. In the laboratory, the samples were washed with sterile water and air dried under controlled conditions to avoid too many chemical changes occurring. The dried leaves were ground and the resulting powdered samples used for further analysis.

2.2 Proximate Analysis

The determination and evaluation of carbohydrate content, moisture content, ash content, crude fibre, proteins and crude fat were determined by the methods reported by the

Association of official Analytical Chemists [10], while nitrogen content was determined by the microkjedahl method of Pearson [11], and the percentage nitrogen was converted to crude protein by multiplying with 6.25.

2.3 Anti-nutrient Analysis

The anti-nutrient levels in the leaves such as soluble oxalate, total oxalate, phytic acid and HCN were determined by using the standard methods of AOAC [10] and Ravindran et al. [12].

2.4 Vitamins Analysis

High Performance Liquid Chromatographic system (Shi- madzu-UFLC Prominence), equipped with an autosampler (Model-SIL 20AC HT) and UV-Visible detector (Model-SPD 20A) was used for the analysis. The data were recorded using LC-solutions software. The HPLC method was employed in the determination of vitamins A, B1, B2, B9, C, D, E and K contents.

2.5 Test Organisms

The test organisms used for this research study included: *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus* and *Streptococcus pyogenes*. They were previously isolated, identified and stored in the Department of Microbiology, University of Calabar, Nigeria.

2.6 Antimicrobial Test

Disc diffusion method proposed by Bauer et al. [13] was followed for the susceptibility test. About 3-5 colonies of the test organism were selected using a sterile inoculating loop and suspended in saline after which the inoculum was adjusted to a turbidity equivalent to a 0.5 mm McFarland standard (corresponds to approximately 1.5×10^8 CFU/ml). The suspension was then vortexed to make sure it was well-mixed. This was inoculated unto plates containing freshly prepared Muller Hinton Agar (MHA). The sterile filter paper was cut into discs and the discs soaked in the extract of *Cnidoscopus aconitifolius*. Using a sterile pair of forceps the discs were carefully picked and placed on the inoculated media plates and then pressed down firmly to ensure a firm, level contact with the agar. The plates were inverted and incubated in ambient air at 35°C for 16-18 hours. After incubation, the clear zone around each disc was measured. This procedure was carried out on all bacterial isolates.

3. RESULTS AND DISCUSSION

The potential of a particular food is determined primarily by its nutrient composition. The results of the nutritional evaluation of *Cnidoscopus aconitifolius* are presented in Table 1. The results of the antinutrient and vitamin contents are presented in Tables 2 and 3. The value of a food product is dependent on the content of its nutrients and vitamins. The antimicrobial properties of this plant were indicated by the inhibition zones surrounding the discs (Table 4).

Table 1. Proximate composition of *Cnidoscopus aconitifolius* (g/100g Dry Weight)

Parameters	Moisture	Ash	Protein	Fat	Fibre	Carbohydrate
Mean±SD	86.40±0.1	6.50±0.02	4.38±0.02	1.20±0.1	2.39±0.01	85.36±0.02

Table 2. Levels of anti-nutrients contents in *Cnidoscopus aconitifolius*

Anti nutrient component	Quantity (mg/100g Dry weight)
HCN	4.32±0.02
Toxic amino acid	ND
Total oxalate	45.30±0.1
Soluble oxalate	18.43±0.02
Tannins	0.21±0.02
Saponins	1.20±0.1
Phytic acid	60.44±0.1
Chlorogenic acid	ND

Results mean of 3 determinations

ND ----- Not Detected

Table 3. Determination of vitamins in *Cnidoscopus aconitifolius* (µg/100 g)

No. of analysis	Vitamin A	Total vitamin C	Soluble vitamin C	Thiamin	Niacin	Riboflavin
	143.20±0.02	54.70±0.01	24.75±0.01	0.14±0.02	0.10±0.01	0.22±0.02

Results mean of 3 determinations

Table 4. Mean diameter of zone of inhibition (mm) of aqueous extract of *Cnidoscopus aconitifolius*

Isolates	Aqueous extract 5 µg/ml	Aqueous extract 10 µg/ml	Gentamycin 10 µg	Ofloxacin 5 µg	Methicillin 10 µg
<i>S. aureus</i>	13±0.2	23±0.3	17	19	14
<i>S. pyogenes</i>	16±0.1	26±0.2	18	20	16
<i>P. aeruginosa</i>	13±0.1	21±0.2	18	18	15
<i>K. pneumoniae</i>	15±0.2	21±0.3	16	21	16
<i>S. typhi</i>	16±0.2	18.5±0.2	17	19	15
<i>E. coli</i>	16±0.1	25.5±0.1	19	18	16

The results revealed the presence of carbohydrate content (85.36%) which was the highest while fat was the least (1.20). Other nutrients present were crude protein, ash, crude fibre and moisture. The high presence of carbohydrate, moisture, and protein are a clear indication that *Cnidoscopus aconitifolius* is of high nutritional value. The ash content of a plant based food is the function of the mineral elements [14]. Its presence shows that *Cnidoscopus aconitifolius* possesses mineral elements. The moisture content is high (86.40%) compared to that recorded by Adanlawo and Elekofehinti [14]. This value is also higher than that of *Moringa oleifera* [15], *Telfairia occidentalis* [16]. This could be dependent on the location and season of sampling. This research was carried out during the raining season which must have contributed to the high moisture content. The protein content (4.34%) is low and does not correspond to the value obtained by Adanlawo and Elekofehinti [14], where a high protein content of 18.73% was observed. This could have been due to the different geographical locations. The presence of protein in *Cnidoscopus aconitifolius* makes it a rich source of food. The carbohydrate (85.36%) content was found to be higher when compared with the value obtained for *Moringa oleifera* [15], *Cnidoscopus aconitifolius* [14] and also the values recorded by Adanlawo and Akanji [17] for *Solanum anguivi* and *Garcinia kola* [18]. The proximate values obtained in this study are comparable with those reported by Egbon et al. [19] except carbohydrate and moisture contents which are higher. Also, the moisture, crude protein and fibre contents of *Cnidoscopus aconitifolius* in this

study compares favourably with that obtained by Agbaire and Emoyan [20].

The relatively high carbohydrate and protein content of *C. aconitifolius* make it a ready source of energy via glycolysis, beta-oxidation and amino acid oxidation reactions respectively. Amino acids from protein will also serve as precursors for repair and replacement for worn-out tissues via protein synthesis [14].

The anti-nutrient contents as shown in Table 2 have higher values but within acceptable levels than those obtained by Adanlawo and Elekofehinti [14]. The levels present in *Cnidoscopus aconitifolius* are safe for consumption by man and animal [21,22].

It is revealed that vitamin A content (143.20mg/100g) was maximum while Niacin was minimum (0.10mg/100g) in the present study as depicted in Table 3. The high content of Vitamin A is a clear indication that *Cnidoscopus aconitifolius* can serve as an antioxidant. Vitamin A is a potent antioxidant that facilitates the transport and uptake of non-heme iron at the mucosa, the reduction of folic acid intermediates and the synthesis of cortisol. The vitamin A content of *Cnidoscopus aconitifolius* is important for normal vision, gene expression, growth and immune function by its maintenance of epithelial cell function [23].

4. CONCLUSION

The antimicrobial property of *Cnidoscopus aconitifolius* was assessed and showed

considerable zones of inhibition against all the test organisms used than the standard antibiotics. At 10µg/ml of the aqueous extract, the zones of inhibition are higher in compared to the standards. This shows that *Cnidoscopus aconitifolius* can be used in the treatment of diseases caused by these organisms. This study also highlighted the significance of this plant due to the presence of vital vitamins, proteins, carbohydrates, fibre, low fat, ash, low anti-nutrients and its ability to destroy some of these pathogenic bacteria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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