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RESEARCH ARTICLE

A COMPARATIVE ANALYSIS OF NUTRITIONAL AND CHEMICAL COMPOSITION OF SEVEN LEAVES USED AS FOLK MEDICINE IN SOUTH EASTERN NIGERIA

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ABSTRACT

Background:Healthcare burden of nations across the globe are on a steady rise, governments and individuals are seeking solutions, which are efficient and affordable and evidence shows that leaves have something to offer.
Aims: A comparative analysis of the nutritional and chemical composition of seven leaves used to manage diseases in south eastern Nigeria were analyzed. The findings will help to encourage right choices and easy access of consensus evidence to healthcare professionals and decision makers.
Study design: Systematic Review.
Methodology: A systematic review and theory is of community approach to intervention services was adopted. Peer reviewed evidence that the compositions of the leaves were collated and analyzed. Search engines were Google, Google scholar, Firefoxand Yahoo.
Results: The leaves had rich macro and micronutrients. Evidence of some of the leaves showed they have disease control potency though not comparable to modern medicine, being highly dose-dependent. Highest concentration of carbohydrates occurred in *Carica papaya* with 73.50% while *Plukenetia conophora* has the lowest, 20.94%. *Tetrapleura tetraptera* showed the highest protein content, 19.75% with *Chrysophyllum albidum* having the least, 7.45%. Highest crude fat, 24.00% occurred in *Anacardium occidentale*, the least occurred in *Tetrapleura tetraptera*, 0.52%. Fibre concentration was highest in *Plukenetia conophora*, 14.94%, *Anacardium Occidentale*, 3.40% came last. A disproportionate level of ash occurred in *Annona muricata*, 14.96%, *Carica papaya* had lowest score; 1.92%. The largest amount of nitrogen occurred in *Anacardium occidentale*, 54.98. Outcome can be beneficial to users.
Conclusion: The leaves are rich in nutrients, which have capacities to manage diseases.

INTRODUCTION

Healthcare costs are rising across the global communities including the rich countries inclusive, (4, 5, 6, 65, 73). Search for alternative ways to restore health and cut down costs appear to be the world's order presently. Medicinal leaves used in South Eastern Nigeria provide hope for a healthy alternative. Also, there is a worldwide increase in the demand for alternative medicines because it is efficacious and affordable. The World Health Organization reported that 80% of the poor populations among the developing countries can barely afford healthcare costs. Often healthcare costs come from personal purses and serious side or adverse effects of some modern medicines contribute to the barriers. Clinical evidence has revealed that plant medicines if appropriately administered are affordable and side effects are next to nothing (4, 5, 6). In this systematic review, the authors sought to determine the nutritional and chemical composition of *Magnifera indica, Plukenetia conophora, Carica papaya and Chrysophyllum albidum*. The major objective was to determine the nutritional and chemical compositional ranking of the leaves to prompt right choices to suit various needs of persons with different health conditions. Clinical evidence has suggested that the nutritional and chemical compositions have nutraceutical and pharmacological properties, which explains why the leaves are capable of treating diseases and justification of its use in South Eastern Nigeria as native medicine. Additionally, while some health conditions need super strong potent agents to control, some require medium or mild treatments. Through this research, the quantities of nutrients and chemical composition of the investigated leaves were determined and comparatively synthesized for educational purpose and appropriate use. Findings will be beneficial to the public, health practitioners, researchers, farmers, manufacturers and policy decision makers.

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METHODOLOGY

The method of the study was systematic review. In this study the nutritional and chemical composition of leaves used as native medicines for controlling various diseases in South Eastern Nigeria were determined and a comparative analysis of the nutritional and chemical composition of the leaves was performed. The leaves include those of Anacardium occidentale, Annona muricata, Mangifera indica, Plukenetia conophora, Carica papayaand Chrysophyllum albidum. Search engines were, Google scholar, Google, google scholar, Firefox, Bing and Yahoo. Search words were, "Anacardium occidentale, Annona muricata, Mangifera indica, Plukenetia conophora, Carica papayaand Chrysophyllum albidum. Also, specific nutrient example, "calcium composition of specific plant" example, Vitamin B1 composition of Annona muricata " The theoretical backgrounds of this research are Community approach to intervention services and native medicine theories. Only peer reviewed articles available for free read online were selected and included in the data used for the analysis. Articles not peer reviewed and not available online for free read were excluded. The results of nutritional and chemical composition of the leaves examined were synthesized comparatively.

RESULTS

It was fascinating to learn about the rich concentrations of macro and micro nutrients compositions of the leaves investigated. Clinical evidence has implicated some of the nutrients as having nutraceutical and pharmaceutical properties and as a result, its use in South Eastern Nigeria as native medicine for treating diseases is justifiable. The results were synthesized and presented in four subheadings. The headings are:

Chemical Composition of Leaves of Annona *muricata, Mangifera indica, Plukenetia conophora, Carica papaya*, *Chrysophyllum albidum and Tetrapleura tetraptera*.

The compositions of the macronutrient, minerals, trace elementsand micronutrient vitamins were analysed. The details of the comparatively analyzed and synthesized nutrient and chemical compositions were presented on three tables (Tables 1- 3).

Synthesis of the Macronutrients of the Seven Leaves: There was high concentration of macronutrients in the leaves. *Carica papaya* showed the highest amount of moisture, 82.00% followed by *Chrysophyllum albidum*, 47.82%, next was *Plukenetia conophora*, 29.00%, then *Mangifera indica*, 20.10%, *Annona muricata*, 16.58% and *Anacardium occidentale* with the lowest level of 14.00%.

The highest concentration of carbohydrates occurred in Carica papaya, 73.50%, next was *Tetrapleura tetraptera*, 68.81%, then, *Annona muricata*, 65.56%, *Mangifera indica*, 60.61%, *Chrysophillum albidum*, 36.82%, *Anacardium occidentale*, 23.94%and *Plukenetia conophora*, with the lowest score of 20.94%. The least protein content occurred in *Chrysophyllum albidum*, 7.45%, *Carica papaya* was slightly higher, 9.05%, next was *Anacardium occidentale*, 13.95%, followed by *Annona muricata*, 15.74%, while *Mangifera indica* and *Plukenetiacophonora* had high scores of 16. 25% and 16.62% respectively. *Tetrapleura tetraptera* with 19.75% scored highest.

Anacardium occidentale, showed the highest concentration of fat, 24.00% the rest of the leaves showed low levels of fat namely, *Tetrapleura tetraptera, Annona Muricata, Carica papaya, Chrysophyllum albidum, Mangifera indicaand Plukenatia conophora* that scored 0.52%, 2.98%, 3.15%, 3,42%, 4.30% and 5.63% in that order.

Among the leaves, the largest amount of fibre was found in *Plukenetia conophora*, 14.94% , followed by *Carica papaya*, 12.38%, then *Tetrapleura tetraptera*, 11.38% and Mangifera indica, 10.60%. *Annona muricata*, had 7.24% while *Chrysophyllum albiduma* and *Anacardium occidentale* had 3.42% and 3.40% respectively.

A large amount of ash occurred in *Annona Muricata*, 14.96%, followed closely by P*lukenetia conophora*, 12.89%, then*Mangifera indica*, 8.24%, *Tetrapleura tetraptera*, 3.92%, *Anacardium occidentale*, 3.70%, while lowest concentrations occurred in *Chrysophyllum albidum* and *Carica papaya* with scores of 1.92% and 2.18% respectively. Nitrogen was reported in *Anacardium occidentale*, 54.98and nearly equal amount in *Annona muricata*, 2.52 and *Mangifera indica,* 2.50. Nitrogen was not reported in the other four leaves.

Table 1. Chemical Composition of Leaves of *Annona muricata, Magnifera indica, Plukenatia conophora, Carica papaya, Chrysophyllum albidum* and *Tetrapleura tetraptera*

Nutrients	Magnifera Indica %	Anacardium Occidentale %	Annona muricata %	Carica papaya %	Plukenatia conophora	Chrysophyllum albidum	Tetrapleura tetraputera
Macronutrients	Air dried	Air dried	Air dried		mg/kg	mg/100 g	mg/100g
Moisture	20.10	14.00	16.58	82.00	29.00	47.82	21.13
Carbohydrates	60.61	23.94	65.56	73.50	20.94	36.82	68.81
Crude Protein	16.25	13.95	15.74	9.05	16.62	7.45	19.75
Crude fat	4.30	24.00	2.98	3.15	5.63	3.42	0.52
Crude fibre	10.60	3.40	7.24	12.38	14.94	3.42	11.38
Ash	8.24	3.70	14.96	1.92	12.89	2.18	3.92
Nitrogen	2.60	54.98	2.52	NR	NR	NR	NR

*+ve: Present
NR: Not reported

(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 29, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 81).

Synthesis of Mineral Composition of the Seven Leaves

Macro minerals Synthesis

Micronutrient minerals also called macro minerals isolated from the examined leaves were quite high. The highest level of calcium (C) occurred in *Plukenetia conophora*, 1870.00 mg/100 g, next was *Annona muricata*, 1118.30 mg/100 g, followed by *Carica papaya*, 1086.00 mg/100 g, then *Chrysophyllum albidum*, 64.33 mg/100 g, *Tetrapleura tetraptera* 6.16 mg/100 g, *Mangifera indica*, 3.82 mg/100g and *Anacardium occidentale* scored lowest, 0.68 mg/100 g.

Potassium (K): Largest amount was found in *Plukenetia conophora*, 1598.70 mg/100 g, followed by *Carica papaya*, 534.00 mg/100 g, then, *Chrysophyllum albidum*, 411.23 mg/100 g, *Tetrapleura tetraptera*, 250.73 mg/100 g, Annona muricata, 36.31mg/100 g and low concentrations occurred in *Mangifera indica*, 0.83 mg/100 g and *Anacardium occidentale*, 0.42 mg/100 g.

Sodium (Na)was disproportionately high in *Plukenetia conophora*, 798.00 mg/100 g, then, *Tetrapleura tetraptera*, 663.73 mg/100 g, next was *Annona muricata*, 69.49 mg/100 g,*Carica papaya*, 30.42 mg/100 g. *Chrysophyllum albidum,* 17.62 mg/100g, *Anacardium occidentale* had 16.50 mg/100 g and *Mangifera indica* with the lowest scored 0.38 mg/100 g,

Highest quantity of Magnesium (Mg) occurred in *Annona muricata*, 961.00 mg/100 g, next was *Plukenatia conophora* with 176.63 mg/100g, then, *Chrysophylyum albidum*, 45.78 mg/100 g, *Carica papaya,* 33.33 mg/100 g, *Tetrapleura tetraptera*, 19.11 mg/100 g and low quantities, 0.91 and 0.204mg/100 g occurred in *Magnifera indica* and *Anacardium occidentale respectively.*

Phosphorus (P): The amount of phosphorus found in *Carica papaya* was highest, 1971.17 mg/100 g, next was *Plukenatia conophora*, 14.00 mg/100 g, low quantity occurred in *Chrysophiloum albidum,* 1.56 mg/100 gand very low levels, 0.78, 0.46 and 0.31 mg/100 g were found in *Magnifera indica*, *Anacardium occidentale*and *Annona muricata*, respectively.

Microminerals (Trace elements) Synthesis

Iron (Fe): Iron was present in disproportionate quantity in *Plukenetia conophora*, 461.00 mg/100 g, next was *Annona muricata*, 13.95 mg/100 g, then, *Carica papaya*, 5.90 mg/100 g, *Chrysophyllum albidum,* 3.33 mg/100 g, with *Plukenetia conophora*, following closely with a score of 3.26 mg/100 g. Low levels were found in *Anacardium occidentale*, 0.50 mg/100 g and *Mangifera indica*, 0.002 mg/100 g.

Manganese (Mn): manganese was present in *Carica papaya* but it was not specified, *Mangifera indica* showed the smallest amount of manganese, 0.003 mg/100 g, *Anacardium occidentale was slightly higher scoring* 0.014 mg/100 g, *Tetrapleura tetraptera*, 0.03 mg/100 g was a bit higher, and yet, a low quantity was found in *Chrysophyllum albidum,* 0.17 mg/100 g, *Plukenetia conophora*, 47.95 mg/100 g, was higher and the biggest amount, 8.25 mg/100 g was located in *Annona muricata*.

Zinc (Zn): Biggest quantity of zinc, 8.34 mg/100vg was found in *Annona muricata,* followed closely by *Mangifera indica*, 7.88 mg/100 g, then, *Plukenatia conophora*, 6.12 mg/100 g, next was *Chrysophyllum albidum* 1.87 mg/100 g, *Tetrapleura tetraptera*, 0.45 mg/100 gand the least score, 0.01mg/100 g occurred in *Anacardium occidentale*.

Copper (Cu): Copper was highest in very high in *Annona muricata*, 14.25 mg/100 g, next was *Mangifera indica*, 8.68 mg/100 g, it was moderate in *Anacardium occidentale*, 1.15 mg/100 g, *Chrysophyllum albidum,* 0.48 mg/100 gand *Tetrapleura tetraptera*, 0.29 mg/100 g. Copper was not reported in *Carica papaya*.

Nickel (N): Nickel occurred in appreciable quantity in *Plukenetia conophora*, 3.40 mg/100 g. Nickel was not reported in the rest of the leaves.

Chromium (Cr): Chromium was not reported in four leaves. It was reported in three leaves only namely, *Carica papaya*, 31.10 mg/100 g, which is very high, next was *Annona muricata*, 3.75 mg/100 gand moderate level showed in *Plukenetia conophora*, 0.31 mg/100 g.

Cadmium (Cd): Was too high in *Annona muricata*, 5.49 mg/100 g, moderately high in *Mangifera indica*, 1.50 mg/100 gand low level, 0.50 mg/100 g in *Plukenetia conophora.* Cadmium was not reported in the rest of the leaves. Just like Sulphur (S), 0.37 mg/100 g, Boron (B) were found only in *Mangifera indica,* 0.002 mg/100 g. It was not found in the rest.

Nitrogen (N): Occurred in three of the leaves namely, *Anacardium occidentale*, 54.98 mg/100 g, which was very high, *Mangifera indica*, 2.60 mg/100 gand *Annona muricata*, 2.52 mg/100 g. Lead (Pb) was only reported in *Tetrapleura tetraptera*, 1.71 mg/100 g. It was not reported in the rest of the leaves.

Table 2.Micronutrient Mineral Compositions of leaves of *Anacardium occidentale, Picralima nitida, Annona muricata, Magnifera indica, Plukenatia conophora, Carica papaya, Chrysophyllum albidum* and *Tetrapleura tetraptera*.]

Nutrients	Magnifera Indica %	Anacardium Occidentale %	Annona muricata %	Carica papaya %	Plukenatia conophora	Chrysophililum albidum	Tetrapleura tetraputera
Micro-nutrients							
Minerals	mg/100g	mg/100 g	mg/100 g	mg/100 g	mg/100 g	mg/100 g	mg/100 g
Calcium (Ca)	3.82	0.68	1118.30	1086.53	1870.00	64.33	6.16
Potassium (K)	0.83	0.42	36.31	534.00	1593.70	411.23	250.73
Sodium (Na)	0.38	16.50	69.49	30.42	798.00	17.62	663.73
Magnesium (Mg)	0.91	0.204	961.90	33.33	176.63	45.78	19.11
Phosphorus (P) mg/100g	0.78	0.46	0.31	1971.17	14.00	1.56	NR
Iron (fe)	0.002	0.05	13.95	5.90	461.00	3.33	3.26
Maganese (Mn)	0.003	0.014	8.25	+ve	7.95	0.17	0.03
Zinc (Zn)	7.88	0.01	8.34	+ve	6.12	1.87	0.45
Copper (Cu)	8.68	1.15	14.25	NR	0.86	0.48	0.29
Chromium (Cr)	NR	NR	3.75	31.10	0.31	Nr	NR
Cadmium (Cd)	1.50	NR	5.49	NR	0.50	NR	NR
Boron (B)	0.002	NR	NR	NR	NR	NR	NR
Sulphur (S)	0.37	NR	NR	NR	NR	NR	NR
Nitrogen (N)	2.60	54.98	2.52	NR	NR	NR	NR
Nickel (Ni)	NR	NR	NR	NR	3.40	NR	NR

*+ve: Present
NR: Not reported
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 29, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66).

Micronutrient Vitamins Synthesis

It was mentioned from the beginning that research on some medicinal plant products is not as sufficient as modern medicine. Also noticed was that though some authors did some studies on some plants products, many studies available freely online did not perform studies on all the nutrients that they investigated on. For example some performed studies on vitamins and mineral composition; however, only a few of the minerals or vitamins were investigated and not all. This made data mining for this study a bit of a challenge. More studies may be necessary to perform a comprehensive mineral and vitamin composition of medicinal plant products such as the leaves. Water-soluble vitamins namely vitamin C and B group vitamins as well as fat-soluble vitamins essentially, vitamin A, Eand K were present in most of the leaves.

Vitamin C: The leaves are very rich in vitamin *Carica papaya* ranked top with a score of 68.59 mg/100 g, followed by *Annona muricata*, 66.00 mg/100 g, next was *Chrysophyllum albidum,* 43.54 mg/100 g. *Tetrapleura tetraptera* scored 41.00 mg/100 g, *Anacardium occidentale*, 34.20 mg/100 g, *Mangifera indica*, 27.70 mg/100 g and *Plukenetia conophora*, had the lowest score of 16.90 mg/100 g**.**

Vitamin A: Vitamin A occurred in five leaves, it was not reported in two leaves. It was disproportionately high in *Annona Muricata*, 5375.09 ug/100 g, very high in *Mangifera indica*, 765.00 ug/100 g, *Chrysophyllum albidum,* ranked third, 89.00 ug/100 g, next was *Carica papaya*, 47.00 ug/100 gand *Tetrapleura tetraptera*, ranked last with a score of 0.70 ug/100 g. Beta carotene was reported in four plants only, the highest quantity occurred in *Carica papaya*, 303.55 ug/100 g, next was *Annona muricata*, 43.25 ug/100 g then, *Anacardium occidentale*, 21.60 ug/100 g, lastly, *Tetrapleura tetraputera*, 1.40 ug/100 g.

Vitamin E: Vitamin E was reported in all the leaves except *Chrysophyllum albidum.* The lowest quantity was found in *Carica papaya*, 0.42 ug/100 g, *Mangifera indica* was higher, 1.12 ug/100 g, *Tetrapleura tetraputera*, was yet, higher, 1.40 mg/100 g, *Plukenetia conophora*, 2.67 ug/g followed closely, then, *Anacardium occidentale*, 5.80 ug/100 gand *Annona muricata* ranked top with a score of, 6.68 ug/100 g. Vitamin E was not reported in *Chrysophyllum albidum.*

Vitamin K: Vitamin K was not reported in *Plukenetia conophora* and *Chrysophyllum albidum.* It occurred in the rest of the leaves. It is present in Anacardium *occidentale*and *Annona muricata*; however, the quantities were not specified. The least amount 2.60 ug/100 g, occurred in *Carica papaya*, *Mangifera indica*was a bit higher, 4.20 ug/100 gand a very high quantity was found in *Chrysophyllum albidum*, 35.36 ug/100 g.

Vitamin B: Vitamin B occurred in all the leaves. Vitamin B1 occurred highest in *Chrysophyllum albidum*, 18.68 mg/100 g, next was *Anacardium occidentale*, 15.50 mg/100 g, followed by *Tetrapleura tetraptera*, 5.00 mg/100 g, then *Mangifera indica*, 0.48 mg/100 g, next was *Plukenetia conophora*, 0.29 mg/100 g, *Carica papaya*, 0.24 mg/100 g, and *Annona muricata* scored the least, 0.11 mg/100 g.

Riboflavin (B2), Niacin (B3) B5 and B6: Vitamins B2 and B3 were not reported in *Chrysophyllum albidum.* B2 occurred highest in *Tetrapleura tetraptera*, 3.00 mg/100 g, followed closely by *Anacardium occidentale*, 2.90 mg/100 g, then *Plukenetia conophora*, 0.34 mg/100 g, next 0.21 mg/100 gand *Annona muricataand Carica papaya* showed equal score of 0.05 mg/100 g each. Niacin (B3), the highest amount of B3 occurred in *Tetrapleura tetraptera*, 10.00 mg/100 g, next was, *Anacardium occidentale*, 1.28 and small quantities occurred in *Plukenetia conophora*, *Anacardium occidentale, Carica papaya*and *Mangifera indica,* which scored 0.12, 0.23, 0.36and 0.60 mg/100 g, respectively. Unspecified quantity of pantothenic acid (B5) was indicated in *Mangifera indica* only. B5 was not reported in the rest of the leaves. Pyridoxine (B6) occurred only in two leaves namely, *Chrysophyllum albidumandMangifera indica*. Amount in M*angifera indica* was not specified. The quantity in *Chrysophyllum albidum,* was 3.26.mg/100 g. Pyridoxine (B6) was not reported in the rest of the leaves. Folate (B9) was present in two leaves only. High amount, 14.00 ug/100 g in *Mangifera indica*and moderate amount in *Chrysophyllum albidum*2.02 ug/100 g. It was not reported in the other leaves.

Cyanocobalamin (B12): Vitamin B12 was not reported in three leaves namely, *Mangifera indica*, Anaca*rdium occidentale* and *Tetrapleura tetraptera.* It occurred in four leaves namely, Annona muricata, quantity was not specified, *Carica papaya*, *Plukenetia conophora*and *Chrysophyllum albidum,* which scored 0.28, 0.23 and 0.05 ug/100 g in that order. Choline was present in *Mangifera indica* and *Carica papaya* only. It was not reported in other leaves studied. Lycopene was disproportionately high in *Carica papaya*, 1928.00 ug/100 g. It was not reported in the rest of the leaves. Lutein, 89.00 ug/100 g was reported in *Carica papaya* only.

Table 3. Micronutrient Vitamin Compositions of Leaves of *Anacardium occidentale, Annana muricata, Magnifera indica, Plukenatia conophora, Carica papaya*, *Chrysophillum albidum* and *Tetrapleura tetraptera*

Nutrients	Magnifera Indica %	Anacardium Occidentale %	Annona muricata%	Carica papaya %	Plukenatia conophora	Chrysophililum albidum	Tetrapleura tetraputera
Nutrients	Magnifera indica	Anacardium occidentale	Annona muricata	Carica papaya	Plukenatia conophora	Chrysophililum albidum	Tetrapleura tetraputera
Micronutrient	mg/100 g	mg/100 g	mg/100 g	mg/100 g	mg/100 g	mg/100 g	mg/100 g
Vitamins							
Vitamin C mg/100 g	27.70	34.20	66.60	68.59	16.28	43.54	41.00
Vitamin A ug/100 g	765.00	NR	5375.09	47.00	NR	89.00	0.70
Beta-carotene (mg/g)	21.60	NR	43.25	303.55	NR	NR	1.40
Vitamin E (4 vitamers (ug/100 g)	1.12	5.80	6.68	0.42	2.67	NR	1.30
Vitamin k (phylloquinone)) (ug/100 g	4.2	+ve	+ve	2.60	NR	35.36	NR
Vitamin B1 (Thiamin)	0.48	15.50	0.11	199.31	0.29	18.68	5.00
B2 (riboflavin)	0.21	2.90	0.05	295.63	0.34	NR	3.00
B3 (Niacin) mg/100 g	0.60	0.23	1.28	0.36	0.12	NR	10.00
B5 (Pantothenic acid)	+ve	NR	NR	NR	NR	NR	NR
B6 (Pyridoxine) ug/100 g	+ve	NR	NR	NR	NR	3.26	NR
B9 (Folate) (ug/100 g)	14.00	NR	NR	NR	NR	2.02	NR
B12 (Cyanocobolamine) ug/100 g	NR	NR	+ve	0.28	0.23	0.05	NR
Choline	+ve	NR	NR	+ve	NR	NR	NR
Lycopene	NR	NR	NR	1928.00 ug	NR	NR	NR
Lutein + Zeaxanthin	NR	NR	NR	89.00 ug	NR	NR	NR

*+ve: Present
NR: Not reported
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 29, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70).

DISCUSSION

There were appreciable varying quantities of macro and micro nutrient compositions of the leaves investigated. The ranking now paves way for easy choice based upon needs. Moderately high ash and low fat, carbohydratesand protein as well as very high concentration of fibre content makes the leaves healthy food for metabolic syndrome diseases effective control namely, coronary heart diseases, obesity, cancer and diabetes. High concentration of fibre that spanned from, 3.42% to 14.94%, offers further beneficial value for diabetes control and sugar tolerance, as well as ease of constipation, peristalsis function and bowel movement (14, 70).

Minerals: While disproportionate composition of some of the minerals in some leaves informs about appropriate nutritional choices, it is also a suggestion of its beneficial importance for nutraceutical and pharmacological industries. Some minerals are essential for various metabolic functions in animals and biological activities of plants. Although some have highmedicinal values, some can be toxic to the body when present in excess concentration and that is one of the goals of this study to rankand educate to promote right choices and appropriate use. For example, calcium is essential in the following metabolic functions such as, absorption of vitamin B and lipase -fat digestive enzyme activation, in building bone mass and bone mineralization to prevent rickets in children and osteoporosisand osteomalacia in adult, it reduces blood pressureand it is involved in the production of neurotransmitter called acetylcholine (26, 75, 76).

Calcium is ranking first among minerals found in the bodyand its metabolism involves other nutrients namely, phosphorus, protein and vitamin D. It is essential for teeth and bone formation and maintenance. At optimum concentration calcium reduces the risk of bone fracture and prevents rickets in children, osteoporosisand diabetesand deficiency will increase the risk of fracture, resulting in rickets in children, osteoporosis in adults and diabetes in all ages. Also, absence of lactose digesting enzyme called lactase occurs as a result of low calcium consumption for a long time (26, 74, 75, 76). Potassium (K) and Sodium (Na) affect cardiac function through the regulation of body fluid and acid base balance. Phosphorus and calcium work together to promote healthy teeth and bone formation and maintenance (5, 71). Zinc is involved in many metabolic functions and it is a large component of many enzymes, namely, ribonucleic polymerases, alkaline phosphatase, carbonic anhydraseand alcohol dehydrogenase. Zinc is essential for male and female fertility and nerve functions, namely, sex organs such as ovaries for females and testes for male as well as white and red blood cell formation. Low and lack of zinc cause coronary illnesses and fetus deformation (26, 28, 67, 75, 76). Chromium normalizes blood sugar through insulin regulation because it is an insulin cofactorand it is involved in sugar metabolization. Manganese is involved in the digestion of protein and it is a component of some enzymes namely, superoxide dismutaseand pyruvate carboxylase. Excess of chromium causes hyperglycemia (high blood sugar) and stomach problems. It enhances the function of insulin at moderate level, but at high level, its inhalationand occupational exposure is carcinogenic (26, 74, 75, 76).

Iron is a component of hemoglobin and is essential in the formation and oxygenation of red blood cells. Iron boosts body immunity and energy production. Low and lack of deficiency of iron cause anemia. And copper is an essential catalyst that aids the body to absorb iron, copper deficiency causes anemia and osteoporosis (26, 74, 75, 76). Cobalt, though an essential constituent of cobalamin (B12), it performs both harmful and beneficial effects to the body. Inhibition of iodine absorption by thyroid is a harmful function of cobalt. It enhances methionine metabolismand aiding enzyme functions namely, homocysteine methyltransferase. It is hard to absorb cobalt from the digestive system. At high concentration it raises the production of red blood cells in healthy people (5, 26, 74, 75, 76). Cobalamin (B12) is involved in all cell metabolism that requires DNA production and control, as well as in energy and fatty acid synthesis. B12 is involved in white and red blood cells production, nervous functions of myelin basic protein synthesis, RNA and DNA replication as well as in the formation of mood-affecting substance called S-adenosyl-L-methionine (SAM). Deficiency of cobalt results incardiomyopathy, congestive cardiac failure, thyroid enlargement, polycythemiaand pericardial effusion. It can also result in digestive disorder, fatigue, low level of B12and neuromuscular (neurone and muscle) problems (5, 26, 74, 75, 76).

Vitamins: All the leaves are rich in vitamin C. All except two were rich in vitamin A and beta caroteneand all but one leaf contains appreciable amount of vitamin E. Vitamins A, Cand E are powerful antioxidants, which protect the body from harmful effect of free radicals that cause cell oxidation in the body that triggers metabolic syndrome diseases. Antioxidants reinforce the immune system to protect the body against diseases. Additionally, vitamin A is essential for healthy eyes as well as growth and reproductive processes. Vitamin E is essential for reproduction for male and females (5, 71, 72).

B group of vitamins are necessary for the utilization of nutrients that give energy to the body such as fat, carbohydrates and protein. Also, B group vitamins are used for RNA and DNA formation and for body cell multiplication. They are essential for building blocks, health and well being of the body, for digestion and nutrient absorption. B group vitamins are involved in many metabolic functions in the body, catabolic functions during food digestion for energy release, for anabolic functions to produce metabolites such as enzymes for digestive purposes. Additionally, B vitamins are involved in neuronal transmission. B vitamins are water soluble and cannot not be stored inside the body. Deficiency of B vitamins cause neurological disorder and negative impact on the function that it performs in the body (5, 71, 72).

CONCLUSION

The leaves studied indicated high quantities of macronutrients at varying levels that can satisfy the nutritional needs of animals and human beings, making way for choices based upon suitability. High amounts of micronutrients minerals in almost all the leaves suggest that the nutrients are nutritionally beneficial as well as having nutraceutical and pharmacological capabilities and evidence has implicated the nutrients as having capacities for health restoration. Some micronutrient vitamins are not reported in some of the leaves, but the vitamins reported in some of the leaves were suggested by evidence to possess a capacity to perform various essential functions to the bodyand restore health to the body. The general public, researchers, public health, health practitioners, farmers, manufacturersand policy decision makers are to benefit from the findings.

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COMPETING INTERESTS

Author declared that no competing interests exist.

AUTHORS 'CONTRIBUTIONS

Author* Author designed the study, performed the analysis, wrote the protocoland wrote the first draft of the manuscript. Author managed the analyses of the study and managed the literature searches. Author read and approved the final manuscript. Author 2, participated in the review of the manuscript. Author 2 participated in the analyses of the study and participated in the literature searches.Authors read and approved the final manuscript.

CONSENT (WHERE EVER APPLICABLE)

This is a systematic review, written consent was not applicable.

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

This is a systematic review, ethical approval is not applicable. This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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