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RESEARCH ARTICLE

A COMPARATIVE ANALYSIS OF PHYTOCHEMICAL COMPOSITION OF EIGHT LEAVES USED AS NATIVE MEDICINE IN AFRICA

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ABSTRACT

Background: Healthcare burden of nations across the globe are on a steady rise, governments and individuals seek for effective and affordable solutions. Evidence revealed that leaves have food and medicinal potentials. ***Aims:*** A comparative analysis of the phytochemical composition of eight leaves used to control diseases in Africa. To encourage right choices and easy access of consensus evidence to healthcare professionals and decision makers. Promote exploration of nutritional and economic values of the leaves. ***Study design:*** Systematic Review: ***Methodology:*** The theories are a community approach to intervention services and native medicine, methods are a systematic review. Peer reviewed evidence that the phytochemical compositions of the leaves were collated and analyzed. Search engines were Google, Google scholar, Firefox. ***Results:*** Evidence suggests that the leaves are rich in phytochemical compounds, which have diseases controlling properties, modern medicine have more evidence. Highest quantity of alkaloids 567.17 mg/100 g occurred in *Tetrapleura tetraptera*, the lowestin *Plukenetia conophora*, 2.67 mg/kg. *Tetrapleura tetraptera* was also on the lead for flavonoids, with a score of 672.66 mg/100 g and *Hunteria umbellata* scored the least, 78.27 mg/kg. For tannins, *Chrysophyllum albidum*, came first, scoring 135.55 mg/100 g and *Plukenetia conophora* was lowest, 0.56/kg. Terpenoids were lowest, 4.60% in *Mangifera indica*, and *Tetrapleura tetraptera*, 118.73 mg/100 g highest. The lowest level of saponins, 0.028 mg/100 g occurred in *Chrysophyllum albidum*, and the highest, 253.30 mg/100 g occurred in *Tetrapleura tetraptera*. The highest phenols, 424.89mg/100 g, occurred in *Carica papaya* and A*nnon muricata*, scored the least, 4.38%, Outcome can be beneficial to users. ***Conclusion:*** The leaves are rich in phytochemical compounds with capacities to control diseases.

INTRODUCTION

The global communities are in serious search for alternative ways to restore health and cut down costs because of the ever rising cost of healthcare (4, 5, 6, 65, 73). Medicinal leaves used in Africa offer hope for a healthy alternative. Also, 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 medicines contribute to the barriers in community access to healthcare. Clinical evidence has revealed that plant medicines, if appropriately administered, are not only affordable and safe, side effects are next to nothing (4, 5, 6). In this systematic review, the author sought to determine the phytochemical composition of eight popular leaves used as traditional medicine for treating disease in Africa namely, *Anacardium occidentale*, *Annona muricata, Mangifera indica, Hunteria, umbellata, Plukenetia conophora, Carica papaya, and Chrysophyllum albidum.* The objective is to determine the phytochemical 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 phytochemical compositions have strong pharmacological properties, which explains why the leaves are capable of treating diseases in Africa. Additionally, while some health conditions need super strong potent agents to control, some require medium or mild treatments. Furthermore, the leaves are presently wasted as mere foliage, which can now be channelled into all important healthcare and economic use. Through this research, the quantities of the phytochemical composition of the investigated leaves were determined and comparatively synthesized for educational purposes and right choices of use. Findings will be beneficial to the public, health practitioners,researchers, farmers, manufacturers and policy decision makers.

METHODOLOGY

The method of the study is systematic review. In this study the phytochemical composition of leaves used as native medicines for controlling various diseases in Africa were determined and a comparative analysis of the phytochemical composition of the leaves was performed.

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The leaves are from Anacardium occidentale, Annona muricata, *Mangifera indica, Plukenetia conophora, Carica papaya,* and *Chrysophyllum albidum*. Search engines were Google scholar, Google, Yahoo, Firefox, and Bing. Search words were, "*Anacardium occidentale*, *Annona muricata*, *Mangifera indica, Plukenetia conophora, Carica papaya,* and Chrysophyllum *albidum*. phytochemical composition. Also, specific phytochemical compound example, "Phenol composition of specific plant" example, Saponin composition of *Annona muricata* " The theoretical background of this research is 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 phytochemical composition of the leaves examined were analyzed and comparatively synthesized.

RESULTS

High concentration of phytochemical compounds found in the leaves was impressive, and clinical evidence suggested that the bioactive compounds possess pharmaceutical properties, which have a capacity to treat microbial and metabolic syndrome diseases. And most fascinating is that clinical studies suggest the phytochemical compounds as having safe potent agents that control chronic diseases including the ones that are yet to find cure or effective treatment with modern medicine. This study now has grounds to mention that the use of the leaves in South Africa as native medicine for treating diseases is justifiable. Findings are an incremental contribution to the existing literature. The results were presented in table 1 and comparatively synthesized. The discussion of the results was done under the discussion heading.

Table 1. Phytochemical composition of *Anacardium occidentale, Hunteria umbellata, Annano muricata, Magnifera indica, Plukenatia conophora, Carica papaya, Chrysophillum Albidum* and *Tetrapleura tetraputera* Leaves

Phytochemical Compounds	Magnifera Indica	Anacardium Occidentale	Annona muricata	Carica papaya	Plukenatia conophora	Hunteria Umbellata	Chrysophililum Albidum	Tetrapleura Tetraputer a
Phytochemical compounds	**%**	**mg/g**	**%**	**mg/100 g**	**mg/kg**	**mg/g**	**mg/100 g**	**mg/100 g**
Alkaloids	7.10	65.50	1.20	156.91	2.67	76.76	513.48	567.17
Flavonoids	16.90	58.50	9.67	333.14	78.27	24.59	112.60	672.66
Tannins	11.30	110.20	0.18	31.05	0.56	65.32	**135.55**	10.38
Terpenoids	4.60	+ve	+ve	NR	8.68	NR	+ve	118.73
Saponins	7.80	85.00	3.50	89.81	1.080	85.00	0.028	253.30
Steroids	3.10	+ve	NR	0.23%	14.21	+ve	+ve	6.86
Anthraquinones	+ve	NR	NR	+ve	0.130	+ve	NR	+ve
Glycosides	21.70	+ve	+ve	+ve	13.93	+ve	+ve	2.41
Cardiac Glycoside	+ve	NR	+ve	+ve	NR	+ve	+ve	95.00
Antioxida nt	+ve	+ve	50.88	90.01	+ve	+ve	+ve	64.60
Reducing sugar	+ve	+ve	48.33	+ve	NR	+ve	+ve	416.02
Phenols	33.75	184.36	4.38	424.89	8.02	120.24	222.56	16.66
Phenolic compounds mg EAG g-1	+ve	2.32	15.50	424.89	+ve	+ve	28.38	823.07
Polyphenols mg/100 ml	+ve	+ve	66.77	NR	+ve	NR	NR	4.50
Phenolic acids mgQEg	+ve	+ve	209.52	+ve	110.71	+ve	+ve	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,

Phytochemical Compounds Present in the Leaves: Evidence revealed that phytochemical compounds are richly present in all the leaves. The amount present varies from each leaf.

Alkaloids: Alkaloids were present in all and the highest amount, 567.17 mg/g was found in *Tetrapleura tetraptera*, followed by C*hrysophyllum albidum*, 513.48 mg/100 g *Carica papaya* 156.91 mg/100 g, *Annona muricata*, 65.50%, *Anacardium occidentale* 65.50 mg/g,next*Mangifera indica*, 7.10 %, then, Hunteria umbellata, 76.76, mg/100 g, and lowest score, 2.67 mg/100 goccurred in *Plukenetia conophora*.

Flavonoids: Flavonoids were found in all the leaves.The Largest amount was found in *Tetrapleura tetraptera*, 672.66 mg/100 g, *Carica papaya*, 333.14 mg/kg, *Chrysophyllum album*, 112.60 mg/1000 g, next was *Anacardium occidentale*, 58.50 mg/100 g, then *Hunteria umbellata*, 24.59 mg/g, *Mangifera indica*, 16.90% next was *Annona muricata*, 9.67%, *Annona muricata*, 9.67%, And*Plukenetia conophora*, with the lowest score of 78.27 mg/kg.

Tannins: Tannins were found in all the leaves at high quantity and the highest quantity was found in *Chrysophyllum albidum*, 135mg/100 g,then *Anacardium occidentale*, 110.20 mg/100 g, next *Hunteria umbellata*, 65.32 mg/g followed by *Carica papaya*, 31.05 mg/100 g, *Mangifera indica*, 11.30%, *Tetrapleura tetraptera*, 10.38 mg/100 g, *Annona muricata*, 0.18%, and *Plukenetia conophora*, with a least score of 0.56 mg/kg.

Terpenoids: Terpenoids were present in all but was not reported on two leaves namely, Carica papaya and Hunteria umbellata. The highest amount of Terpenoids occurred in Tetrapleura tetraptera, 118,73 mg/100 g, then, Annona muricata, 4.60 %, next was Plukenatia conophora, 8..68 mg/kg. Specific amounts found in Chrysophiloum Albidum, Anacardium Occidentale , and Annona muricata were not reported.

Saponins: Saponins were found in all the leaves. A disproportionate amount occurred in *Tetrapleura tetraptera*, 253.30 mg/100 g, followed by *Carica papaya* was highest, 89.81 mg/100 g. Equal amount, 85.00/g, occurred in *Anacardium occidentale*, and *Hunteria umbellata*, next was *Mangifera indica*, 7.80%, then, *Annona muricata*, 3.50%, *Chrysophyllum albidum*, 0.028 mg/100 g, and *Plukenetia conophora* with a lowest score of 1.08 mg/kg.

Steroids: Steroids were isolated from all the leaves except one, *Annona muricata*. The lowest concentration occurred in *Plukenetia conophora*, 14.21 mg/100 g, then, Carica papaya a bit higher, 0.23%, next was *Mangifera indica,* 3.10%, and the highest concentration occurred in *Tetrapleura tetraptera* was a bit higher, 6.86 mg/100 g. Specific quantities of steroids found in *Anacardium occidentale*, *Hunteria umbellata* and *Chrysophyllum albidum* were not indicated.

Anthraquinones: Anthraquinone was present in some leaves and not present in some. The amount that occurred in *Plukenetia conophora* was 0.13 mg/kg. Specific concentrations in *Mangifera indica*, *Carica papaya*, and *Tetrapleura tetraptera* were not mentioned. It was not reported in *Anacardium occidentale, Chrysophyllum albidum,* and *Annona muricata*.

Glycosides: Glycosides were isolated from all the leaves. Biggest quantity 21.70% was found in *Mangifera indica*, next was *Tetrapleura tetraptera*, 2.41 mg/100 g, then, *Plukenetia conophora*, 13.93 mg/kg. Specific quantities found in the rest of the leaves were not mentioned.

Cardiac Glycoside: Was not reportedin *Plukenetia conophora* and*nacardium occidentale.*It was not found in *Annona muricata*. It was disproportionately high in *Tetrapleura tetraptera*, 95.00 mg/100 g. Amounts present in the rest of the leaves were not specified.

Antioxidant: Antioxidants occurred in all the leaves. The lowest amount was located in *Annona Muricata*, 50.88% then, *Tetrapleura tetraptera*, 64.60 mg/100 g and *Carica papaya*, 90.01 mg/100 g with the largest amount. Concentrations found in the rest of the leaves were not specified.

Reducing Sugar: Reducing sugar was not reported in *Plukenetia conophora*, and it was found in the rest of the leaves. The least amount occurred in *Annona muricata*, 48.33% and the highest in*Tetrapleura tetraptera*, 416.02 mg/100 g. There was no specific mention of the amount present the rest of the leaves.

Phenols: Phenols were isolated from the leaves at high concentrations. The least amount, 8.02 mg/kg, was found in *Plukenetia conophora, Annona muricata* was a bit higher, 4.38%, next was *Tetrapleura tetraptera* was, 16.66 mg/100 g, then *Mangifera indica*, 33.75%, *Hunteria umbellata*, 120.24 mg/100 g, Anacardium occidentale, 184.36 mg/g*Chrysophyllum albidum*, 222.56 mg/100 g, and*Carica papaya*with largest quantity, 424.89 mg/100 g.

Phenolic compounds: Phenolic compounds were present in all the leaves, and specific amounts present in three leaves namely, *Mangifera indica, Plukenetia conophora, and Hunteria umbellata*were not specified. The largest quantity was found in *Tetrapleura tetraptera,* 823.07 mg/100 g, then, *Carica papaya*, 424.89 mg/100 g, *Annonamuricata* 15.50%, *Chrysophyllum albidum*, 28.38 mg/100 g, equivalent of mg EAG g-1 The lowest score 2.32 mg/100 g was found in *Anacardium occidentale*.

Polyphenols: Polyphenols were not reported in *Hunteria umbellata, Chrysophyllum albidum,* and *Carica papaya* only. Amounts present in *Mangifera indica, Anacardium occidentale,* and *Plukenetia conophora* were not specified, the least amount, 4.50 mg/100 g occurred in *Tetrapleura tetraptera*, and the highest quantity was found in *Annona Muricata*, 66.77 mg/100 g.

Phenolic acids: Phenolic acids were found in all the leaves except *Tetrapleura tetraptera.Amounts present in Mangifera indica, Anacardium occidentale, Carica papaya, Hunteria umbellata,* and *Chrysophyllum albidum*, were not specified. Least amount occurred in *Plukenetia conophora*, 110.71 mg/kg and the highest amount, 209.52 mg/100 g was isolated from *Annona muricata*.

DISCUSSION

Alkaloids: Alkaloids are phytochemical compounds that have strong potency and capabilities for being used as effective drugs for treating the world's most dreaded disease called cancer. In vivo and in vitro Clinical evidence has shown that alkaloids have powerful anti-cancer functions and anti cancer proliferation properties. Alkaloids of plant origin have high potentials for use in the manufacture of cancer drugs in the future. It is very antagonistic against cell growth and proliferation. It causes cancer cells apoptosis. Examples ofalkaloids that are potent against cancer are, Berberine, Tetrandrine, Martin, sanguinarine, piperine, and evodiamine (77, 78, 80, 81, 82, 83).

Phenolic compounds: Ellagic acids, sodium gallate, protacatechuric acid, methyl gallate, phenolic acids: examples of phenolic acids are, garlic acid, caffeine acid and trans-ferulic acids (77, 78, 79, 80). Phenolic compounds: Phenols and phenolic compounds are bioactive compounds or groups of molecules that possess strong anti-cancer or carcinogenic capabilities. It attacks cancer cells at various points of its strongholds of harmful actions to not only interrupt the damage process but also causes cell apoptosis, cell cycle disruption and cause autophagy (77, 78, 80). It prevents cancer cell initiation, progression and proliferation. Phenols essentially quercetin and garlic acids have the potency to control cancer on its own or in combination with medications (77, 78, 80). Saponins: saponins reduce the production of harmful nitric oxide in the body, prompt autophagic death of cancer cells. Saponins also weaken the strength of the cytoskeleton and disassemble it. Saponins cause cytotoxic action by causing cancer cell apoptosis, and cell death that is not caused by apoptosis stimulation. Examples of saponins that have anti-carcinogenic properties are, diosgenin, oleandrin, dioscin, Polyphilin D, gensenoside, Saikosaponin A and D, and Tinosaponin. It has Chem-preventive effect on cancer cells and it has anti-tumour properties as well as anti-inflammatory function (77, 78, 80, 81, 82, 83, 84). Mangiferine:While Mangifera indica leaf extract significantly controlled diabetes *in vitro* in clinical study, Mangiferin content of the Mangifera indica leaves was indicated as the most active ingredient for inhibition of alpha glucosidase (77, 78).

Methyl gallate and garlic acid: Are acids found in most of the leaves. These acids are potent agents against tumour and cancer and it is dose response, the less the concentration the lower the inhibition rate and the higher the concentration, the more the inhibition rate; 10 ug/ml showed 31% inhibition and 50 ug/ml revealed 73% inhibition. These acids are a powerful antioxidant, which prevents spasm, inflammation, microbial activities, and it is anti-atherogenic. (77, 78, 80). Its antioxidant activities prevent and neutralizes oxidative stress, inhabit the production of reactive oxygen species (ROS), and scavenge free radicals that cause cell oxidative damage and DNA breakage, which produce peroxides that cause cell oxidation (77, 78, 80).

Antioxidants: All leaves showed high antioxidant capacities, which prevents spasm, inflammation, microbial activities, and are anti-atherogenic. (77, 78, 80). Anti-oxidation prevents cell oxidation and neutralizes the effects of oxidative stress. Antioxidants inhibit the production of reactive oxygen species (ROS), and scavenge free radicals that cause oxidative damage to cell and DNA and form peroxides that cause cell oxidation (77, 78, 80, 81).

Quercetin: was found in the leaves. Evidence showed that quercetin is effective for prostate, breast, and colon cancers, it inhibits cell proliferation, cause cell apoptosis, and cell recycling and migration. It has strong effect in cancer cell death (77, 78, 80, 81).

Kaempferol: Kaempferol inhibited the growth of leukaemia cells and caused the death or apoptosis of Leukaemia cells and enhanced medicine cells function. (77, 78, 80, 81).

Myricetin: Myriscetin caused a suppression of esophageal cancer cells survival and its proliferation, caused esophageal cell apoptosis and lowered the growth rate of tumour in mice (77, 78, 80, 81).

Rutin: Just like quercetin, Rutin raised anti-cancer function and performed chemotherapeutic function, reduced adenosine triphosphate function and enhanced cytotoxicity caused by cyclophosphamide and methotrexate. It arrested cancer cell cycle and prompted cancer cell death (77, 78, 80, 81).

Flavonoids: Examples of flavonoids are quercetin, isoquercitrin, Kaempherol, and myricetin (77, 78, 79, 80). One of the major obstacles to cancer treatment is that cancer cells are not sensitive (resistant) to chemotherapy and radiotherapy treatments. Clinical evidence has revealed that plants rich in flavonoids or flavonoids from plants have the capability to sensitize cancer cells to respond to chemotherapy and radiotherapy treatments to enhance cancer treatment. The leaves investigated in these study posses high concentration of
flavonoids and flavonoids can be found in food sources namely, blue, black and raspberries, citrus, banana, onions including spring onions, leek, fenugreek, sea buckthorn, and African spices (77, 78, 80, 81). Also, isoflavonoids, insoles, sulforaphane, isoflavones, and isothiocyanate are good for food preservation, which can be useful in healthy food processing and preservation.

Terpenoids: Also called isoprenoids occur in the form of sterols, sesquiterpenes, diterpenes, triterpene and squalene. Terpenoids are plant bioactive agents that are potent against viruses, microbes, parasites, and fungi. It also has anti-inflammation, anti-hyperglycemic, antiplasmodial, chemo-preventive, analgesic, and memory enhancing properties. Terpenoids give flavour, pigment, taste, astringent, fragrance to plants. It is also volatile (essential oil) and can be used as solvent. It occurs in plants and animals. Living organisms use it for protection against predators and stress. It is a potent agent against dementia, it has anti-dementia properties for memory enhancement. It prevents cholinesterase to enhance cholinergic function. Other common sources of terpenes are citrus, tea tree, cannabis, lemongrass, thyme, citral and sage.

Steroids: Steroids are a type of cholesterol or hormone produced naturally by adrenal gland in the body, which helps the cells, tissues, and organs to perform its functions. It can also be manufactured as a medicine called cortisol for treating diseases. It is also called corticosteroids and it is not the same thing as anabolic steroids. It is an organic compound which performs biological functions in human cells. It exist in the membrane, alters fluid level in the membrane and transmits molecular signals. Steroids are anti-inflammatory, it surpasses the immune system from making compounds that trigger inflammation. Steroids are good for arthritis, and asthma when consumed at optimum level, it also has many adverse effects when in high concentration in the body. Some use steroids for strength, pain, and performance-enhancement. Steroids are effective agents for treating rheumatoid arthritis, autoimmune disorders, for example lupus, multiple sclerosis, asthma, eczema and rashes. All the leaves suggested presence ofsteroids at different concentrations, meaning that the leaves could be a natural source of steroids and can be used in the pharmaceutical industry to produce medical steroids.

This will convert the leaves wasted as mere foliage for healing and economic purposes.

CONCLUSION

The leaves studied in this investigation are usually wasted as mere foliage and yet, they are rich in phytochemical compounds namely, alkaloids, flavonoids, saponins, tannins, phenols, polyphenols, terpenoids, antioxidants, and glycosides in various concentrations, which have pharmacological properties and clinical evidence has linked the compounds with healing capabilities for controlling metabolic syndrome diseases namely, obesity, inflammation, high cholesterol, triglycerides, immunomodulatory, cancer, tumour, diabetes, hypertension and cardiovascular diseases. Also, evidence suggested that thephytochemical compounds have communicable disease capabilities such as, antimicrobial, anti-viral, anti parasitic, antifungal, antiallergic and antipyretic functions. The general public, researchers, public health, health practitioners, farmers, manufacturers, investors and policy decision makers can benefit from the findings. From this study it is clear that the leaves, which are usually wasted as mere foliage can now be channelled into healing, pharmaceutical and economic fortune.

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AUTHORS 'CONTRIBUTIONS

Author designed the study, performed the analysis, wrote the protocol, and 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.

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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