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RESEARCH ARTICLE

A COMPARATIVE ANALYSIS OF PHYTOCHEMICAL COMPOSITION OF SEVEN SEEDS USED TO TREAT DISEASES IN EASTERN NIGERIA

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ABSTRACT

Background: Healthcare burden is rising steadily globally across nations. Individuals and governments are in search of effective and affordable solutions. Evidence has shown that some seeds with food values also have medicinal potentials. **Aims:** A comparative analysis of the phytochemical composition of eight seeds used to control diseases in Eastern Nigeria. To support suitable choices and easy access of clinical evidence to busy healthcare professionals and decision makers. And to promote exploration of nutritional and economic values of the seeds. **Methodology:** The theories are community approach to intervention services and native medicine, method is a systematic review. Peer reviewed evidence that the phytochemical compositions of the seeds were collated and analyzed. Search engines were Google, Google scholar, Firefox. **Results:** Although evidence suggests that the seeds are rich in phytochemical compounds, which have disease controlling properties, modern medicine has more evidence. Highest quantity of alkaloids 14.62% occurred in *Chrysophyllum albidum*, lowest occurred in *Mangifera indica*, 0.01 mg/100 g. *Chrysophyllum albidum*, was also on the lead for flavonoids, with a score of 11.20% and *Hunteria umbellata* scored the least, 0.30 mg/kg. And for saponin, the highest level occurred in *Chrysophyllum albidum*, 21.14% and *Mangifera indica*, scored lowest, 0.04 mg/100 g; while *Chrysophyllum albidum*, was top 23.32% for tannins and *Hunteria umbellata* came last, 0.20 mg/kg. Terpenoids were lowest, 1.24% in *Chrysophyllum albidum*. and lowest in *Hunteria umbellata* was 1.33 mg/100 g. Highest phenols, 164.78% occurred in *Anacardium occidentale* and the least in *Chrysophyllum albidum*, 0.48%. Outcome can be beneficial to users. **Conclusion:** The seeds are rich in phytochemical compounds in varying amounts, which have nutritional and pharmacological values.

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). Plant seeds used in Eastern Nigeria for native medicine possess the potential for a healthy alternative. Also, there is a worldwide increase in the demand for alternative medicines because it is efficacious, affordable and safe to use. The World Health Organization reported that 80% of the poor populations in developing countries cannot afford healthcare costs. Often healthcare costs come from personal purses and serious side or adverse effects of some medicines contribute to the barriers. Clinical evidence has revealed that plant medicines if appropriately administered is affordable and it is safe to use (4, 5, 6). In this systematic review, the authors sought to determine the phytochemical composition of seven seeds popularly used for treating diseases as traditional medicine in Eastern Nigeria. The seeds are from, *Tetrapleura tetraptera*, *Anacardium occidentale*, *Carica papaya*, *Annona muricata*, *Mangifera indica*, *Chrysophyllum albidum* and *Hunteria umbellata*. The objective is to determine the phytochemical compositional ranking of the seeds to promote healthy choices based upon suitability to meet various needs of persons with different health conditions. Clinical researches suggest that the phytochemical compositions of the seeds have strong pharmacological properties, which explains why the leaves are capable of treating diseases in Eastern Nigeria. Additionally, while some health conditions require highly potent agents to treat, some require medium or mild treatments. Additionally, some of the seeds are presently not utilized as food or medicine, but rather wasted as garbage, and through this study, it is our hope to end the waste of these valuable seeds and channel them into highly valuable healthcare and economic purpose. Through this research, the quantities of the phytochemical composition of the investigated leaves were determined and comparatively synthesized for educational purposes and to promote 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 a systematic review. In this investigation, the phytochemical compositions of seven seeds used as native medicines for controlling various diseases in Eastern Nigeria were determined and a comparative analysis of the

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phytochemical composition of the seeds was performed. Plants bearing the investigated seeds were, *Tetrapleura tetraptera*, *Anacardium occidentale*, *Annona muricata*, *Mangifera indica*, *Carica papaya*, *Chrysophyllum albidum* and *Hunteria umbellata*. Search engines were Google scholar, Google, Yahoo, Firefox and Bing. Search words were, "Anacardium occidentale, Annona muricata, Mangifera indica, 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 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 for free read online were excluded. The results of phytochemical composition of the seeds were examined, analyzed and comparatively synthesized.

RESULTS

Clinical evidence suggests that the level of phytochemical compounds in the seeds was quite high and that the bioactive compounds possess pharmaceutical properties, which have a capacity to control diseases. The phytochemical compounds are safe potent agents for treating chronic diseases including the diseases that are yet to find cure or effective treatment with modern medicine. Such as cancer and diabetes. Thus, on account of the findings of this study and evidence from clinical studies, seeds from medicinal plants, which are used in Eastern Nigeria for controlling diseases are justifiable. Findings are incremental contributions to the existing literature. The results were presented in table 1 and synthesized comparatively. A comparative synthesis of the result discussion was done under the discussion heading.

Table 1. Phytochemical composition of *Anacardium occidentale*, *Hunteria umbellata*, *Annona muricata*, *Mangifera indica*, *Carica papaya*, *Chrysophyllum albidum* and *Tetrapleura tetraptera* Seeds.

Phytochemical compounds	Mangifera indica (mg/100)	Anacardium Occidentale (mg100g)	Annona muricata (mg100g)	Carica papaya (mg/100 g)	Hunteria Umbellata (mg/kg)	Chrysophililum Albidum (%)	Tetrapleura Tetraptera (%)
Alkaloids	0.01	2.80	3.09	7.25	20.80	14.62	0.52
Flavonoids	3.30	3.47	5.33	3.66	0.30	11.20	0.91
Saponins	0.04	12.00 %	8.41	+ve	12.80	21.14	0.51
Tannins ug/100 g	1.03	184.97	5.70	10.60	0.20	23.32	0.23
Terpenoids	+ve	+ve	+ve	1.33	+ve	1.24	+ve
Steroids % Sterols	5.92	+ve	+ve	0.49	+ve	+ve	NR+ve
Phenols ug/100 g	+ve	164.78	2.26	30.32	8.10	0.48	0.34
Reducing sugar	0.55	2.00%	1.70%	+ve	+ve	+ve	+ve
Athraquinones	+ve	+ve	NR	21.50	8.40	+ve	NR
Glycosides	+ve	+ve	49.51	9.17	3.60	+ve	NR
Antioxidant	+ve	+ve	+ve	+ve	+ve	+ve	+ve

*+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, 39, 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).

Phytochemical Compounds in the Leaves: Evidence suggested that there is a high concentration of phytochemical compounds in the seeds studied and the quantity varies from each seed.

Alkaloids:The results showed that all the seeds contain alkaloids. The highest quantity, 14.62% occurred in *Chrysophyllum albidum*, next was *Carica papaya*, 7.25 mg/100 g, followed by *Annona muricata*, 3.09 mg/100 g, *Anacardium occidentale* and *Hunteria umbellata* that came bracket, with 2.80 mg/100 g, each, *Tetrapleura tetraptera*, 0.52%, then *Mangifera indica* showed the lowest score of 0.01 mg/100 g.

Flavonoids:Flavonoids occurred in all the seeds, the Largest amount was found in *Chrysophyllum albidum*, 11.20%, then *Annona muricata*, 5.33 mg/100 g, followed by *Carica papaya*, 3.66 mg/100 g, next *Anacardium occidentale*, 3.47 mg/100 g, *Mangifera indica*, 3.30 mg/100 g, *Tetrapleura tetraptera*, 0.91% and *Hunteria umbellata* with the least score of 0.30 mg/kg.

Saponins:All the seeds contain Saponins. A least concentration, 0.04 mg/100 g occurred in *Mangifera indica*, the concentration in *Tetrapleura tetraptera* 0.51% was a bit higher, next was *Hunteria umbellata*, 12.80 mg/kg, then *Annona muricata*, 8.41 mg/100

g.Anacardium occidentale, was second to the highest score of 12.00%, while *Chrysophyllum albidum*, made the highest score of 21.14% and the amount in *Carica papaya* was not specified.

Tannins:Tannins were found in all the seeds from small to high concentrations and the highest quantity was found in *Chrysophyllum albidum*, 23.32%, next was *Carica papaya*, 10.60 mg/100 g, then *Annona muricata*, 5.70 mg/100 g, *Tetrapleura tetraptera*, 0.23%, *Anacardium occidentale*, 184.97 ug/100 g, *Mangifera indica*, 1.03 mg/100 g and *Hunteria umbellata* with the least score of 0.20 mg/kg.

Terpenoids:Terpenoids were present in all; however, the amounts in five seeds were not specified. The lowest concentration 1.24% was found in *Chrysophyllum albidum* and the highest score, 1.33 mg/100 g occurred in *Carica papaya*.

Steroids:Steroids were isolated from all the seeds except in *Tetrapleura tetraptera*. However, the specific amounts were not reported except for *Carica papaya* that made a least score of 0.49 mg/100 g and *Mangifera indica* that made the highest score of 5.92 mg/100 g. Also, although steroids found in *Tetrapleura tetraptera*, it is worthy of mentioning that sterol was present in *Tetrapleura tetraptera*.

Phenols:All the seeds constitute phenols, specific quantities present in each leaf were mentioned but not in *Mangifera indica*. The least amount, 0.34% occurred in *Tetrapleura tetraptera*, next was with low score is *Chrysophyllum albidum* 0.48% was found in *Hunteria umbellata* was 8.10 mg/kg, *Annona muricata*, 2.26 mg/100 g, and *Anacardium occidentale* with the highest score of 164.78 ug/100 g.

Reducing Sugar:Reducing sugar was in all the seeds; however, the amount was only specified in three seeds namely, *Mangifera indica*, with the lowest score of 0.55 mg/100 g, *Annona muricata*, 1.77% and *Anacardium occidentale* with a highest score of 2.00%. Examples of reducing sugars are, mannose, galactose, glucose and arabinose.

Anthraquinones:Anthraquinones were present in all the seeds except two, namely, *Annona muricata* and *Tetrapleura tetraptera*. Amount of anthraquinone found in three seeds namely, *Mangifera indica*, *Anacardium occidentale* and *Chrysophyllum albidum* were not stated. *Carica papaya*, was top of the scores, 21.50 mg/100 g and *Hunteria umbellata* was next to it with a lowest score of 8.40 mg/kg.

Glycosides:Glycosides was not reported in *Tetrapleura tetraptera*, but was present in the rest. The least concentration occurred in *Hunteria umbellata*, 3.60 mg/kg, moderate level occurred in *Carica papaya*, 9.17 mg/100 g and highest amount, 49.51 mg/100 g occurred in *Annona muricata*.

Antioxidant:Antioxidant was present in all the seeds but the amount was not specified.

DISCUSSION

Alkaloids: As the disease burden of the global communities rises, essentially, chronic disease and nations including rich and poor are in desperate search for effective, safe and affordable leeway to overcome the burden. Plant-based products over the past decade have continuously offered hope. The seeds examined in this study reveal a rich concentration of alkaloids.

Alkaloids are phytochemical compounds with strong potency against the world's most dreaded disease called cancer. In vivo and in vitro Clinical evidence has shown that alkaloids have long-sought-for 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. Alkaloids are highly antagonistic to cancer cells growth and proliferation. Alkaloids prompt cancer cells apoptosis. The alkaloids with high potency against cancer are Berberine, tetrandrine, martin, sanguinarine, piperine and evodiamine (77, 78, 80, 81, 82, 83).

Flavonoids: 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 flavonoids from plants have the capability to sensitize cancer cells to respond to chemotherapy and radiotherapy treatments to enhance cancer treatment. Examples of flavonoids are quercetin, isoquercitrin, kaempferol and myricetin (77, 78, 79, 80). The seeds examined in these study possess a rich amount of flavonoids. Flavonoids can be found in food sources namely, blue berries, black berries and raspberries. It is also found in rich concentration in citrus, bananas, 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. Exploration of flavonoids in food processing and preservation can replace the use of harmful chemicals in food processing and preservation, which will have a major direct control in chronic diseases explosion, caused by the consumption of food processed with harmful chemicals. The exploration of the potentials offered by the phytochemical compounds is worthwhile. seeds stands a chance for a significant social change world wide.

Saponins: Saponins perform functions in the body that are similar to anti oxidation functions. It reduces the production of harmful nitric oxide in the body. Some authors stated that Saponins cause inflammation and damage the intestine; however, there is no evidence to support these claims, because more evidence suggested that saponins are body shepherds and plant naturally use saponins to protect it from predators and infections; in similar way it protects the body from infections and diseases (96). Saponins can protect the body from infection and diseases by reducing blood cholesterol, blood sugar and the risks of cancer and increasing

food fibre concentration. Saponins also possess powerful anti-inflammatory functions, essentially it prevents gut inflammation (96). Saponins prompt autophagic death of cancer cells. Saponins also cause weakness of the strength of the cytoskeleton and disassembles 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, ginsenoside, Saikosaponin A and D and Tinosaponin.

It has Chemo-preventive effect on cancer cells and it has anti-tumour properties as well as anti-inflammatory function. Inflammation is a way the body responds to harmful stimuli caused by autoimmune diseases, disease infections, cell irritations and cell damage (77, 78, 80, 81, 82, 83, 84, 97). Saponins are good for healthy teeth and bones, prevent platelet aggregation, lower cholesterol, it prevents dental caries and prevent hypercalciuria- high calcium level in the urine. Saponins are found mostly in vegetables, edible legumes and generally in herbs (97). From the on-going discussion, we can see that an exploration of potentials oil these seeds will not only bring about the most desired health benefits; but will also generate other multiple effects on the economy by way of increase in productivity as a result of healthy populations, diversification in farming, investment, trade and increase in employment rate.

Anacardium occidentale seed oil has aphrodisiac properties, it increases male sexual behaviours namely, libido, intromission and mount frequencies, drive and vigour, genital sniffs and penile licks. It also caused reduction in the mount latency (length of time taken to mount), Saponin is largely present in the seed, which increases androgen and natural endogenous testosterone and this action is caused by rise in luteinizing hormones (LH) secreted by the pituitary gland to control the amount of testosterone produced by male (76, 77, 78, 79, 80).

Tannins:Tannins also called tannic acid or tannoids are water-soluble polyphenols that occur naturally in plants. Tannins are astringent in nature, plants use it to protect from predators and it gives plants pungent or unpleasant tastes. It is used for healthy food preservation. Tannins are bioactive molecules that usually bind to protein and precipitate it. Tannins are anti-carcinogenic, it retards cancer growth and mutagen, it protects the body cell from oxidative damage, prevents lipid peroxidation and superoxide radical formation. It is also important to mention that some authors suggested that oesophageal cancer was linked with the excessive consumption of plants rich in tannins; however, more authors suggested that indigence of oesophageal cancer linked with tannins were not caused by Tannins but rather caused by compounds associated with tannins (95). Tannins can be beneficial to the pharmaceutical industry for production of medicines for treating metabolic syndrome diseases and in the food industry for healthy food preservation.

Steroids:Steroids are a type of cholesterol or hormone, which is produced naturally by adrenal gland to help the body cells, tissues and organs to perform daily functions. Additionally steroids can be produced artificial as a drug known as cortisol to control diseases. Steroids are also called corticosteroids, which are not the same thing as anabolic steroids. It is an organic compound, which performs biological functions in human cells. It exists in the membrane, alters fluid level in the membrane and transmits molecular signals. Steroids prevent inflammation, suppresses the immune system from making compounds that trigger inflammation. When present in the body at optimum level, it is good for arthritis and asthma. Conversely, it also has many adverse effects when in high concentration in the body. Some people 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. The seeds studied in this research contain steroids at different quantities, meaning that the seeds can be natural sources of steroids and can be used in the pharmaceutical industry to produce medical steroids. Exploring the potentials of the seeds may mean putting to an end the wastes of some of the seeds and channelling them into healing and economic uses.

Phenolic compounds:Phenolic compounds occur in several forms namely, ellagic acids, sodium gallate, protocatechuic acid, methyl gallate and phenolic acids. Phenolic acids can come in the form of 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 have powerful anti-cancer or carcinogenic properties. Phenolic compounds attack cancer cells at various points, where it exerts most harmful action to interrupt the cancer damaging processes to the body and cause cancer cell apoptosis. Phenols also cause cancer cell cycle disruption and autophagy- starvation of cancer cells to death (77, 78, 80). Phenols prevent cancer cell initiation, progression and proliferation. Phenols particularly the quercetin and garlic acids have the potency to treat cancer diseases alone or it can achieve that in combination with other medications (77, 78, 80).

The polyphenol composition of *Mangifera indica* seeds include, tannins, garlic acids, xanthone, catechins, quercetin, kaempferol, caffeic acid, mangiferin and mangoxanthone. These and other phytochemical properties listed above, as well as vitamin, A, C and E offer *Mangifera indica* seed medicinal and pharmacological capacities of protecting the body from radiological damage, cell oxidation, inflammation, tumour, diabetes, allergy, bone resorption, parasite and microbial attacks or infections. It also has immunomodulatory, lipolytic capacities (76, 77, 78, 79, 80).

Antioxidants:The seeds have antioxidant properties. Antioxidant property prevents spasm, inflammation, microbial activities, as well as atherogenic prevention (77, 78, 80). Anti-oxidation prevents cell oxidation and neutralizes the effects of oxidative stress. Antioxidants prevent the production of reactive oxygen species (ROS) and scavenge free radicals. Free radicals cause cell oxidation, which are harmful to the cell and DNA. Antioxidants break the formation of reactive oxygen species and peroxide formation (77, 78, 80, 81).

CONCLUSION

Other than *Anacardium occidentale* and *Tetrapleura tetraptera*, which are consumed as food, the rest of the seeds are wasted as garbage. And for a reason that the seeds have both nutritional and pharmacological values, exploring the pharmaceutical as well as the nutritional potentials of the seeds will generate public health and economic benefits. The seeds possess phytochemical compounds in varying good quantities namely, alkaloids, flavonoids, saponins, tannins, phenols, polyphenols, terpenoids, antioxidants and glycosides. Clinical evidence connects compounds with healing capabilities for metabolic syndrome diseases namely, obesity, inflammation, high cholesterol, triglycerides, immunomodulation, cancer, tumour, diabetes, hypertension and cardiovascular diseases. Evidence also suggested that the phytochemical compounds are capable of treating communicable disease namely, microbial, viral, parasitic, fungal, allergic, diseases, while possessing antipyretic functions. The general public, researchers, public health, health practitioners, farmers, manufacturers, investors and policy decision makers are to profit from the results. Thus, the seeds essentially, the wasted seeds can be put to healthcare, nutritional and economic use.

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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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