FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 7 No. 6, December, 2023, pp 338 - 341
DOI: https://doi.org/10.33003/fjs-2023-0706-2140

COMPARATIVE PHYTOCHEMISTRY AND ANTI- FUNGAL INFECTION STUDIES WITH ECONOMIC TREES *Vachellia nilotica* and *Senegalia ataxacantha* DISTRIBUTED WITHIN KATSINA STATE

***Umar Shittu, Umma Sada and Nura Surajo**

Department of Biology, Isa Kaita College of Education Dutsin-ma Katsina State, Nigeria

*Corresponding authors' email: shittuumarkk@gmail.com Phone: +23408065578102

ABSTRACT

The Vachellia nilotica and Senegalia ataxacantha are native to various African nations. This investigation aimed to compare the phytochemistry with anti-fungal infection studies of these economic trees distributed within the Katsina state of Nigeria. The survey was done with some selected local government areas across the three senatorial zones in the state. Shoot parts samples of two different tree plant species were collected and then were separately processed into powdered form and phytochemistry was performed. Phytochemical screening of these plants indicated the presence of numerous bioactive compounds which include flavonoids, steroids, alkaloids, glycosides, saponins, and tannins in the shoot parts of the plant species. Betamethasone dipropionate, Neomycin, Ketoconazole, and Clobetasol propionate were the major compositions of any antifungal therapy and were sourced from the chemical organic compounds. It could be of great interest for the Katsina State Government to consider these plant species as a good source of valuable raw materials for pharmaceutical industries to manage the plants and generate revenue.

Keywords: *Vachellia nilotica, Senegalia ataxacantha,* phytochemistry, Katsina state

INTRODUCTION

The perennial vascular tree *Vachellia nilotica*, sometimes known as *Acacia nilotica*, is native to various African nations and was later brought to the Indian Ocean and to nations in the Middle East. *V. nilotica* is a fast-growing evergreen tree with a broad and rounded crown. Its height can range from around 2.5 meters in soil with poor growing circumstances to 14 meters or more in soil with favorable growing conditions (Anyam *et al.,* 2021). The plant can endure high P^H, drought, and harsh temperature conditions while continuing to thrive for a very long time. This type of plant has been discovered to have a symbiotic interaction with soil organisms like bacteria. The bacteria are typically attached to the plant's aerial parts and fix atmospheric nitrogen for the plant to use and for other nearby plant species. For the local population, it is recognized as one of the most significant multipurpose dry land species. The young shoot parts of the plant are used as vegetables, and in countries is used as an ingredient in various food dishes, the plant can be medicinally to treat many infections. In the Northern part of Nigeria, the plant's native name is *Bagaruwa* in the Hausa language, and can traditionally be processed in different parts of the plant mixed with some food supplements to treat health-related problems including dysentery, stomach ulcers, and piles (*Dyer, 2014)*. It can also be used as chemical products, food, drink, wood for cooking, and living environmental management.

The flame thorn, or Senegalia ataxacantha, is a native African plant species. A ubiquitous tree in subtropical Africa, the flaming thorn grows from Senegal in the west to northeastern Sudan, from where it extends to the southern parts of the continent. The plant is typically restricted to water courses and ravines in drier land locations, but it can also be found as a typical bush constituent in arid regions near streams but in an area with higher rainfall because the plant does have good fairly drought-resisting properties. This plant is regarded as the common constituent of the bush, that is why it favors the forest margins (Kyalangalilwa *et al.,* 2013). *S. ataxacantha* in their normal habit usually possess a multi-stem system in which the stems are generally quite thin with single hooked thorns grown on young stems, possess alternate long leaves with bipinnate, it has large shrub with shoots scramble using their recurved prickles and slightly rounded crown with dark green foliage composed of very small pinnules, also flowers occur as clusters of cream-coloured terminal spikes which are fragrant and bloom during spring and summer, the plant fruits produced is attractive with the distinct and straight flat dehiscent long pod. This species of plant has variable habits and can be distinguished from other acacias by it is physical features of non-spinescent stipules and spicate inflorescences. The stems of wood can be used to provide a good weaving material and produce good quality baskets, plant roots were used for making long-stemmed smoking pipes. This plant tree can be planted to demarcate an area with provide an efficient and hardy border, also used traditionally as medicine to cure health-related problems like constipation, ulcer, and stomach pain, it protect infants from the practice of magic for evil purposes.

The pharmacological and phytochemical activities studies of S. ataxacantha provide certitude to the traditional medicinal applications of the species against different diseases and medically the species have been confirmed as anti-inflammatory, antibacterial, antifungal, antioxidant, and anti-diabetic (Alfred, 2018). Studies of comprehensive chemical characterization and biological evaluation of *V. nilotica* and *S. ataxacantha* identified the plant species as good sources of enzyme inhibitors, antimicrobials, antiproliferative, and antioxidant agents (Dimitrina *et al.,* 2021). However, because of the need to utilize plant valuable materials for economic purposes that is why this investigation aimed to compare the phytochemistry with anti-fungal infection studies of the economic trees *V. nilotica* and *S. ataxacantha* distributed within Katsina state of Nigeria.

Aim of the study be included here

MATERIALS AND METHODS

The survey was done about the economic trees *V. nilotica* and *S. ataxacantha* with some selected local government areas across the three senatorial zones in Katsina state of Nigeria. Samples of stems and leaves from two different tree plant species were collected and then put under shadow until the samples were completely dried. Therefore, the samples were separately processed into powdered form for phytochemistry.

About 150g powder for each sample was processed and ethanol were used for the laboratory activities, fan drops of Meyers reagent were added to two-centimeter cubes ($2cm^3$) of the extract for each sample to test the presence of alkaloids or not. Two-centimeter cubes ($2cm^3$) of the filtrates were treated with three (3) drops of 5% ferric chloride solution for each sample in order to test the presence of tannins. The presence of safonins was tested for each sample with five-centimeter cubes ($5cm^3$) of the filtrates were vigorously shaken with distilled water and stood for some minutes. Five-centimeter cubes ($5cm^3$) of the extracts for each sample were dissolved in two-milliliter (2ml) of chloroform and two-milliliter (2ml) of sulfuric acid were carefully added to the solution to test steroids. Then three-milliliter (3ml) were used for each sample filtrate and dissolved in (1ml) of 10% sodium hydroxide (NaOH) to observe the presence of flavonoids. Glycoside was tested for each plant sample using (2.5ml) of 5% sulfuric acid (H_2SOH) added to five-centimeter cubes ($5cm^3$) of the extract in a test tube for each sample separately, these mixtures were heated in boiling water for about (15) minutes, then cooled and neutralized with 10% of NaOH followed by adding of five-milliliter (5ml) of Fehling solution and the mixtures were also boiled for about (15) minutes in the boiling water for this observation. Comparisons were carried out based on the chemical compositions contained in different antifungal pharmaceutical products with the chemical constituents identified from two different shoot parts of the economic plant tree species.

RESULT AND DISCUSSION

Phytochemistry studies exposed the presence of alkaloids, saponins, cardiac glycosides, tannins, and flavonoids in the shoot parts of *V. nilotica* (Mrityunjoy *et al.,* 2016). The carbohydrates and anthraquinone were detected in ethanol extract studies revealed that *V. nilotica* possess sterols and tannins; no alkaloids, saponins, or glycosides. Leaves of *V. nilotica* contain tannins, alkaloids, and sterols but no glycosides, saponins, resins, or flavonoids were detected (Okoro *et al.,* 2014).

Table 1: Chemical constituents from the extract shoot parts of *V. nilotica* and *S. ataxacantha*

Chemical Constituents/ extracts	Leave of *V. nilotica*	Stem of *V. nilotica*	Leave of *S. ataxacanth.*	Stem of *S. ataxacanth.*
Alkaloids	+	+	+	_
Flavonoids	_	+	+	_
Glycosides	_	+	_	+
Saponins	+	+	+	_
Steroids	+	+	+	+
Tannins	+	-	-	-

The naturally organic chemical compounds presence in the shoot parts of *V. nilotica* in table 1 indicated that the plant is reach with these valuable chemical constituents. Phytochemical analysis of ethanol and petroleum ether extracts of the stem bark of *V. nilotica* exposed that the plant contains terpenoids, tannins, alkaloids, saponins, and glycosides (Deshpande, 2013).

Alkaloids and Saponins were only presence in both leave and stem extracts of *V. nilotica* when compared with other naturally organic chemical constituents found in the plant shoot parts. Alkaloids are generated by various higher plant organisms of about 10 to 25% of those organisms contain alkaloids. This organic chemical constituent is among the most important and best-known secondary metabolites, it generally mediates ecological interactions, which may produce a selective advantage for the plant organism by increasing its life survivability (Manske, 2014). Saponins, also referred to as triterpene glycosides, are bitter-tasting organic chemicals that are typically toxic to aquatic life. They are derived from plants and have a foamy appearance when agitated in water. However, they have also been isolated from marine life, including sea cucumbers and soapwort plants, whose roots were once used to make soap (*Tsuno et al.,* 2018). The Sapindaceae family of botanical plants contains saponins as well. This organic substance acts as an anti-feedant, shielding the plant organisms from fungi and bacteria. Plant saponins derived from spinach and oats may lessen plant palatability in livestock diets and improve nutrient absorption to aid in animal digestion, or they may even include toxicity that might be fatal to animals. some quantities of saponins in insects are harmful to insects and other cold-blooded creatures (*Cotrim et al.,* 2023).

S. ataxacantha was found to have steroids only present in both major shoot parts from the chemical constituents. The leaves part of the plant was observed to have a higher content present of chemical constituents when compared with the stem part. *S. ataxacantha* is an important medicinal plant species used in tropical Africa against different human infectious diseases because Phytochemical screening of the plant indicated the presence of numerous bioactive compounds which include flavonoids, alkaloids, glycosides, saponins, and tannins (Compean *et al.,* 2014). The presence of specific secondary metabolites in the S. ataxacantha plant extracts has been identified (Amoussa et al., 2016). These findings are vital information towards progressing the studies of the ethnopharmacologically relevant medicinal value of the plants in order to contribute to curing infectious diseases.

The majority of medicinal plants produce a wide variety of secondary metabolites, or components and chemicals. This is a product of a plant's defense mechanism or long-term evolution, which means that all of these things are done to help the plant adapt to its biological and ecological surroundings (Lozano *et al.,* 2021). The connection that these secondary metabolites provide between different plant species and their natural environments is crucial, and the chemical components that are present in plants can be classified into various classes according to the unique metabolic functions that they perform.

Comparison in table 1 revealed the presence of valuable chemical constituents especially from the stem extracts of *V. nilotica and* leave extracts of *S. ataxacantha.* When these two different plant valuable shoot parts were utilized together, it can be enormous important in making various traditional medicines and can also be considered as an excellent raw materials for making different pharmaceutical products to treat many infectious diseases (*Marks et al., 2019)*. In tropical Africa, these two distinct plants' essential shoot portions are used as a vital herbal remedy for sores and wounds, stomach

issues, malaria, pneumonia, dental cavities and toothache, headaches, backaches, and abscesses (Alfred, 2018). Alkaloids, anthracene derivatives, carbohydrates, coumarins, flavonoids, lignan, naphtoquinone, polyphenols, reducing sugars, saponins, steroids, tannins, terpenoids, and triterpenoids are among the chemical components of these two different plant species.

Betamethasone dipropionate, Neomycin, Ketoconazole, and Clobetasol propionate were the major compositions of any antifungal therapy and were sourced from the chemical organic compounds (BNF, 2018). The chemical constituents extracted from shoot parts of *V. nilotica* and *S. ataxacantha* are the secondary metabolites used to synthesize effective products for antifungal therapy (Moreno *et al.,* 2014). Betamethasone and Neomycin can combine together as strong steroids and form a antifungal powerful formula that helps to target inflammation, itching, and irritation caused by health conditions such as dermatitis and eczema to protect and heal the skin against infections (WHO, 2019).

Ketoconazole is an imidazole derivative that is synthesized from imidazole, a chemical molecule found in many natural products, including alkaloids. Important biological building components like histidine and the related hormone histamine contain this ring of alkaloids (Elks, 2014). Numerous medications, including certain antifungals, the antibiotics in the nitroimidazole class, and the sedative midazolam, have an imidazole ring. For fungal infections of the skin and mucous membranes, such as ringworm, athlete's foot, candidiasis, jock itch, and tinea versicolor, ketoconazole is typically administered (*KMP, 2019)*. Topical ketoconazole is also used to treat seborrheic dermatitis and dandruff in various parts of the body. It is possible that topical ketoconazole works in these situations by reducing the amount of the fungus Malassezia furfur on the skin (Young *et al.,* 2013). Ketoconazole works against a wide range of fungi that cause diseases in humans, including Histoplasma, Candida, Coccidioides, Blastomyces, chromomycosis, and paracoccidioidomycosis. The azole antifungal drug that was initially administered orally was ketoconazole. However, due to ketoconazole's higher toxicity, lower absorption, and more constrained spectrum of activity, alternative azole antifungal medications, such as itraconazole, have essentially supplanted ketoconazole as a first-line systemic antifungal drug.

Lichen sclerosis, psoriasis, eczema, and herpes labialis are among the skin disorders that can be treated with clobetasol propionate. It is also used for other auto-immune diseases, such as lichen planus, alopecia areata, and mycosis fungoides, a T-cell skin lymphoma (Gbetoh *et al.,* 2016). As a first-line treatment, it treats both acute and chronic GVHD of the skin.

CONCLUSION

The *Vachellia nilotica* and *Senegalia ataxacantha* are medicinal plant species used extensively in traditional medicine and pharmaceutical industries to treat various infectious diseases. This study revealed the presence of valuable chemical constituents, especially from the stem extracts of *V. nilotica* and leave extracts of *S. ataxacantha* considered excellent raw materials for making different pharmaceutical products to treat fungal infectious diseases. It could be of great interest for the Katsina State Government to consider these plant species as a good source of valuable raw materials for pharmaceutical industries to manage the plants and generate revenue. However, further investigation is needed in this field of studies to explore other potential medical benefits of these different plant species.

ACKNOWLEDGEMENT

This research work is supported by TETFund through Institutional Based Research (IBR) hereby gratefully acknowledged.

REFERENCES

Alfred Maroy (2018). Review of Ethnopharmacology and phytochemistry of Acacia ataxacantha. *Tropical Journal of Pharmaceutical Research* November 2018; 17 (11): 2301-2308 ISSN: 1596-5996 (print); 1596-9827 (electronic) © Pharmacotherapy Group, Faculty of Pharmacy, University of Benin, Benin City, 300001 Nigeria. http://www.tjpr.org http://dx.doi.org/10.4314/tjpr.v17i11.2

Amoussa, A. M. O., Lagnika, L., Bourjot, M., Vonthron-Senecheau, C., & Sanni, A. (2016). Triterpenoids from Acacia ataxacantha DC: Antimicrobial and antioxidant activities. *BMC Complementary and Alternative Medicine*, *16*(1). https://doi.org/10.1186/s12906-016-1266-y

Anyam, John V.; Daikwo, Priscilla E.; Ungogo, Marzuq A.; Nweze, Nwakaego E.; Igoli, Ngozichukwuka P.; Gray, Alexander I.; De Koning, Harry P.; Igoli, John O. (2021). "*Two New Antiprotozoal Diterpenes From the Roots of* Acacia nilotica"". Frontiers in Chemistry. ***9****: 624741. doi:10.3389/fchem.2021.624741. PMC 8097170. P MID 33968894*

British national formulary : BNF (2018) 76 (76 ed.).PharmaceuticalPress.2018. p. 1198. ISBN 9780857113382.

Compean KL, Ynalvez RA. (2014). Antimicrobial Activity of Plant Secondary Metabolites: A Review. Research J Med Plant. 2014; 5: 204-2013.

Cotrim, Gustavo dos Santos; Silva, Deivid Metzker da; Graça, José Perez da; Oliveira Junior, Adilson de; Castro, Cesar de; Zocolo, Guilherme Julião; Lannes, Lucíola Santos; Hoffmann-Campo, Clara Beatriz (2023). "Glycine max (L.) Merr. (Soybean) metabolome responses to potassium availability". Phytochemistry. ***205****: 113472.* doi:10.1016/j.phytochem.2022.113472. ISSN 0031-9422. PMID 36270412. S2CID 253027906

Deshpande SN. (2013). Preliminary Phytochemical Analysis and in vitro investigation of antibacterial activity of Acacia nilotica against clinical isolates, *Journal of Pharmacognosy and Phytochemistry* 2013, 1 (5), 23-27

Dimitrina Zheleva-Dimitrova Kouadio Ibrahime Sinan , OuattaraKatinan Etienne Gunes Ak JugreetB. Sharmeen Gokhan Dervisoglu , FethiAhmet Ozdemir Mohamad Fawzi Mahomoodally (2021). *Comprehensive chemical characterization and biological evaluation of two Acacia species: A. nilotica and A. ataxacantha.* Food and Chemical Toxicology Volume 156, October 2021, https://www.sciencedirect.com/science/article/abs/pii/S0278691521004798. https://doi.org/10.1016/j.fct.2021.112446

Dyer C. (2014). "New names for the African Acacia species in Vachellia and Senegalia". Southern Forests: A Journal of Forest Science. ***76*** *(4): iii. doi:10.2989/20702620.2014.980090.*

Elks J (2014). *The Dictionary of Drugs: Chemical Data: Chemical Data, Structures and Bibliographies*. Springer. pp. 720–. ISBN 978-1-4757-2085-3.

Gbetoh MH, Amyot M (2016). "Mercury, hydroquinone and clobetasol propionate in skin lightening products in West Africa and Canada". *Environmental Research*. **150**: 403–410. Bibcode:2016ER....150..403G. doi:10.1016/j.envres.2016.06.030. hdl:1866/19006. PMID 27372064

Ketoconazole Monograph for Professionals.*KMP (2019). Drugs.com. American Society of Health-System Pharmacists*. Retrieved 23 March 2019.

KYALANGALILWA, B., BOATWRIGHT, J.S., DARU, B.H., MAURIN, O. & BANK, M. (2013). Phylogenetic position and revised classification of *Acacia* s.l. (Fabaceae: Mimosoideae) in Africa, including new combinations in *Vachellia* and *Senegalia*. *Botanical Journal of the Linnean Society* 172(4): 500–523. DOI: 10.1111/boj.12047

Lozano, Hector Benjamin (2021). "Investigation of the Antimicrobial Activity and Secondary Metabolites of Leaf Extracts from Vachellia Rigidula, Vachellia Farnesiana, Senegalia Berlandiery, and Senegalia Gregii" (2021). Theses and Dissertations. 148. https://rio.tamiu.edu/etds/148

Manske, R. H. F. (12 May 2014). *The Alkaloids: Chemistry and Physiology, Volume 8*. Vol. 8. Saint Louis: Elsevier. pp. 683–695. ISBN 9781483222004. OCLC 1090491824

*Marks DH, Prasad S, De Souza B, Burns LJ, Senna MM (2019). "Topical Antiandrogen Therapies for Androgenetic Alopecia and Acne Vulgaris". Am J Clin Dermatol. **21** (2): 245–254. doi:10.1007/s40257-019-00493-z. PMID 31832993. S2CID 209331373*

Moreno G, Corbalán J, Peñaloza B, Pantoja T (2014). "Topical corticosteroids for treating phimosis in boys". *The Cochrane Database of Systematic Reviews*. **9** (9): CD008973. doi:10.1002/14651858.CD008973.pub2. PMID 25180668.

Mrityunjoy Das, Md. Sohanur Rahman, Md. Maniruzzaman and Md. Belal Uddin (2016). Evaluation of phytochemical, in vitro antibacterial and cytotoxic properties of ethanol extract of Acacia nilotica (L) leaves. *Indo American Journal of Pharmaceutical Sciences*, 2016, 3 (12), 1492-1497.

Okoro, S. O., Kawo, A. H. and Arzai, A. H., (2014). Phytochemical Screening, Antibacterial and Toxicological Activities of Acacia Nilotica Extracts, *Bayero Journal of Pure and Applied Sciences*, 2014, 7 (1), 105-115

*Tsuno, Yuhei; Fujimatsu, Teruhisa; Endo, Keiji; Sugiyama, Akifumi; Yazaki, Kazufumi (2018). "Soyasaponins: A New Class of Root Exudates in Soybean (Glycine max)". Plant & Cell Physiology. **59** (2): 366–375.* doi:10.1093/pcp/pcx192. ISSN 1471-9053. PMID 29216402.

Young BK, Brodell RT, Cooper KD (2013). "Therapeutic Shampoos". In Wolverton SE (ed.). *Comprehensive Dermatologic Therapy* (3rd ed.). Philadelphia: Saunders. pp. 562–569. ISBN 978-1-4377-2003-7.

World Health Organization *(2019). World Health Organization model list of essential medicines: 21st list 2019. Geneva: World Health Organization.* hdl:10665/325771. *WHO/MVP/EMP/IAU/2019.06. License: CC BY-NC-SA 3.0 IGO*

Zabre, Geneviève; Kaboré, Adama; Bayala, Balé; Katiki, Luciana M.; Costa-Júnior, Lívio Martins; Tamboura, Hamidou H.; Belem, Adrien M.G.; Abdalla, Adibe L.; Niderkorn, Vincent; Hoste, Hervé; Louvandini, Helder (2017). "Comparison of the in vitro anthelmintic effects of *Acacia nilotica* and *Acacia raddiana*". *Parasite*. **24**: 44. doi:10.1051/parasite/2017044. PMC 5703060. PMID 29173278