

**Medicinal Plants Research in Nigeria: An Output Analysis**

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ABSTRACT

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Global renewed interest in medicinal plants, the place of Nigeria with a sizeable population of researchers and an accompanying biological and cultural diversity to instigate a wide range of plant's applications as medicine, motivated the present study to evaluate the volume, spread, and progression in scholarly publications on medicinal plants, with top countries in perspective. The study accessed publications (2009 – 2018) by DIMENSIONS® internet platform links with over 124 million documents and Citation Data in various subject areas. A total hit of 33, 071 retrieved medicinal plant publications of Nigerian affiliation were analyzed with decreased annual percentage output of 15.22% in 2009 to 10.06% in 2017, and 12.37% in 2018. The 10 top journal outlets, subject areas and productive authors of Nigerian affiliations accounted for 9.94%, 32.95%, and a 1.58% share of total medicinal plant publication output. Country-wise, the productivity profile shares of the analyzed ten countries varied widely, from -3% to 64% for the period between 2009-2013 and 2014-2018 and positional change among the countries oscillated over the study period. The observed trend buttresses the need to challenge the present state of medicinal plant publication output, particularly in Nigeria, for rigorous research productivity and commensurate funding.

Keywords: Medicinal plant, Nigeria, Scientometric, Dimensions

Introduction

The progress in addressing medical needs and ailment burden is still relatively low in developing and developed countries despite the considerable wealth of information and medical advances. Recently efforts have been increasingly made to use plants as alternative medicine.^{2,3} Plant therapeutic potential dates back to over 5000 years with evidence of its use in disease treatment and revitalization of body systems.⁴ Majority of today's pharmaceutical pursuits have shown rejuvenated interest in studying plants as a rich source of secondary metabolites such as alkaloids, flavonoids, terpenoids and saponins.⁵⁻⁷ In searching for novel bioactive compounds, pharmaceutical and allied industries explore plants' therapeutic properties to discover and develop drugs and standardized phytotherapeutic agents with proven quality, efficacy, and safety.⁸ The increasing demand for novel compounds has led to exploring more plants as better and safer materials. The World Health Organization reports that about 80% of the global population uses medicinal plants to treat diseases,^{9,10} with African countries having higher rates.¹¹ Plants with at least one or more parts employed for therapeutic purposes or sources of precursors of useful drug synthesis are called medicinal plants.^{12,13}

As a state-of-the-art quantitative metric system, the scientometric analysis evaluates a particular research field by engaging statistics as a suitable option for quantitative evaluation of scholarly research at varying levels.^{14,15} To identify and analyze patterns of growth in scholarly publications in medicinal plant, objective knowledge on recent publication output in the area of medicinal plant is imperative.

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Therefore, this study aims to comparatively analyze the country-wise productivity profile of ten (10) countries with significantly higher scholarly outputs and the contributions of researchers of Nigerian affiliations in medicinal plant research, over ten years (2009 to 2018) duration. The objective is to evaluate the volume, growth and research progression of scholarly publications of Nigerian affiliations in medicinal plants field, with top countries in perspective.

Materials and Methods*Data source*

The study collated publication data of authors of Nigerian affiliations and identified the productivity profile of the top ten (10) countries in the field of medicinal plant research. The study's retrieved data from Research for Australia (ERA) 2015, Norwegian register level 1, 2, 0, Directory of Open Access Journals (DOAJ) and PubMed database using DIMENSIONS®. This database houses approximately 161 million publications.

Search strategy

The search is up until November (2nd -28th), 2018. Search contents for the analysis are; journal articles, book chapters, proceedings, preprints, and monographs. The search targets publications on Nigerian affiliation authors and the top ten (10) countries (China, India, Japan, United States, South Africa, Germany, Brazil, Iran, Malaysia, and South Korea) from the DIMENSIONS® database. The search for the present study covered ten years from 2009 to 2018. The study period is further stratified into three (3) categories: 2009-13, 2014-16 and 2014-18 to chronologically situate the publication output trend across the entire period (2009-2018) through the subcategories.

The search terms employed for data retrieval are as shown in Table 1. The search terms are subsequently refined using analytical functions to evaluate research output, source wise output, major subject areas, researchers and access type with Nigeria affiliation. This search strategy terms (table 1.) is applied to search and evaluate the top ten (10) productive countries' primary data by replacing Nigeria simultaneously.

Table 1: Search Strategy Terms

#	Searches*
No 1	2009 or 2010 or 2011 or 2012 or 2013 or 2014 or 2015 or 2016 or 2017 or 2018
No 2	Medicinal Plant and Nigeria
No 3	No 1 AND No 2
No 4	No 3 LIMITS: Publication Type = journal articles, book chapters, proceedings, preprints and monographs; Language = All languages; Year = 2009 to 2018

Results and Discussion

Comparative country-wise productivity profile of top ten (10) countries

Country-wise, the productivity profile shares of the ten countries varied widely (Figure 1), from -3% to 64% for the period between 2009-2013 and 2014-2018. Expectedly, a significantly higher volume of publications was generated for all the countries in recent years (2014 - 2018) than in earlier years (2009 – 2013), except for Germany (-3%) and South Korea (5%). However, South Korea (53%), Brazil (38%), Germany (28%), United States (27%) and Japan (15%) generated a significantly higher volume of publication share within the mid-years (2014 - 2016) than the first quinquennial (2009 -2013). In contrast, Iran (-50%) and Malaysia (-37%) recorded a significantly lower publication share volume. China, India and South Africa (1-8%) recorded similar volume of publication share in the first period (2009-2013) and the succeeding three (3) years (2014-2016), suggesting that the amount of publication for the period of years (2014 -2016) were as much as the amount of Scholarly paper for earlier years (2009 - 2013). The trend of increasing publications with years was consistent for all the countries except for South Korea and Germany. The dropping trend observed for South Korea (5%) and Germany (-3%) may reflect the attention shift away from folk's medicine research and medicinal plants often connected with infectious diseases toward noncommunicable diseases in these countries.^{16, 17}

Conversely, Iran (64%) and Malaysia (49%) recorded a significant reversal growth in the publication from a low in the earlier year (2009 - 2013) to a high in the latter years (2014-2018) than any other country. The surge in publications for both countries is not unconnected to the increased boost in economic and research towards herbal products development for the international market in the countries in recent times, in the bid to compete with countries like China and India, the two largest countries of Asia in natural resources and populace.^{18, 19}

While countries like Iran and Malaysia experienced a surge in publication and significant difference in output between the 1st and 2nd periods, countries like the United States of America, Germany, Brazil, and South Korea recorded a lull in publication growth for the same period.

Country-Wise productivity ranking for the top ten (10) countries

Positional change among the countries oscillated over the study period (Figure 2). Between the earlier and mid-period, several countries changed positions in the volume of publications generated, countries like; China (3rd to 1st), India (4th to 2nd), Iran (10th to 7th), and Malaysia (9th to 8th) improved in the ranking. Conversely, countries like; Japan (2nd to 4th), United States of America (1st to 3rd), Brazil (7th to 9th), and South Korea (8th to 10th) dropped in ranking. However, some countries like; China (1st), India (2nd), South Africa (5th), Germany (6th), Iran (7th), and South Korea (10th) retained their mid-period ranking in the latter period. Countries like; United States of America (3rd - 4th) and Malaysia (8th -9th), dropped in ranking, while a few like; Brazil (9th -8th) and Japan (4th -3rd) improved in the hierarchy. Over the three sub-periods, China, India, Iran, South Korea attained improved positions in the mid-period and retained the same in

the latter period. Brazil, Japan, and Malaysia recorded inconsistent growth across the three sub-periods. Germany and South Africa recorded sluggish growth and remained unchanged in position across the sub-periods. The United States of America showed a bearish growth with time losing its 1st position to a 4th place ranking. While the improved positions recorded for the five countries may point to increase attention to medicinal plants research, herbal products development efforts in the countries, the sluggish or bearish growth trend observed for the last three countries may point to a change in attention away from folk medicine research or a climax of such research efforts in these countries. The improvement in reporting safety, interactions, and efficacy against mere reporting of herbal products' folk uses may be the link to the increase in publication output and concentration generated for the five countries can be linked. This increase is coupled with the increasing engagements with pharmaco-experts leading to increased publishing of herbal-base works in journals dedicated to biomedical, pharmacological and even synthetic drugs.²⁰⁻²²

Research volume, growth and progression of Nigerian affiliations

The research output trend on the medicinal plants at the national level over time depicts in Figure 3. The research output cumulated to 33,071 publications in ten (10) years. The annual percentage output decreased from 15.22% in 2009 to 12.37% in 2018. The most productive year in the ten years was in 2014 (16%), and the least was 2010 (3.76%), with a 16% rise in publication output observed for 2014. The results express an inconsistent trend with the publication outputs on medicinal plants. This result may reflect the scientific environment researchers in the country have to deal with, which include pitfalls like inconsistent policies, ineffective data management, inconsistency in educational programs, inadequate and inconsistent funding of research, and scholarly publication. This output contrasts with developing and emerging economies such as Malaysia and Iran, with defined national research projections and fundings.²²⁻²⁴

Document -wise output in the field of medicinal plant

The types of papers indexed to authors of Nigerian affiliation were mainly journal articles (52.03%), book chapters (42.66%), monographs, (5.05%), proceedings (0.2%), and preprints (0.05%) (Figure 4). The predominant position of a journal article may suggest a growing rate of evidence-based studies on medicinal plants.

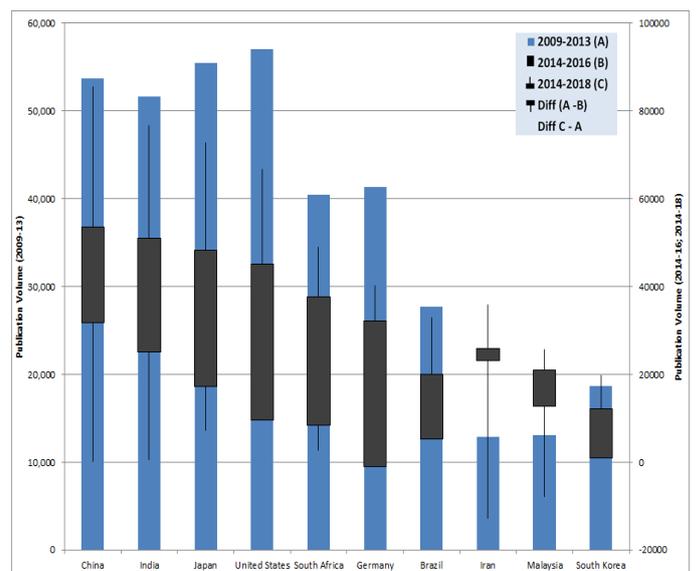


Figure 1: Comparative Publication Output for 10 top Countries on Medicinal Plant for ten years period, through the sub-periods: ranging from 2009-13, 2014-16 and 2014-18

Source titles in the field of medicinal plant

The analyses indicate the top (10) source titles are analyses where most Nigerian affiliation authors published and the document-wise publications output (Figure 5). The 10 top journal outlets reported papers ranging from 153 to 956 documents on medicinal plant research; accounting for 9.94% (3288 papers) of total medicinal plant publication output during 2009-2018. These figures reveal the growing rate of evidence-based studies on medicinal plants.²⁵ The journal; Tobacco Induced Diseases accounted for 29.08% of the 3288 recorded, Tropical Journal of Pharmaceutical Research (16.73%) and Journal of Ethnopharmacology (16.00%). Asian Pacific Journal of Tropical Biomedicine recorded the least volume of 4.65%. The retrieved top (10) source titles show that a sizeable proportion of the publications were through interdisciplinary outlets and core subject outlets such as complementary, alternative and ethnopharmacology. Similarly, the journal spread cut across local to regional and global outlets.

Subject areas spread for medicinal plant research output

The top ten (10) subject areas accounted for 10898 records representing 32.95% share of the total number of 33, 071 published (Figure 6). The subject areas distribution cut across core subject areas for medicinal plant research, botanists and other plants related fields such as plant biology. Expectedly, clinical, pharmaceutical and pharmacological sciences; also recorded a considerable number of publications; an indication that journals for primarily synthetic compounds and clinical trial outcomes are increasingly accommodating researches on the medicinal plant.²⁶⁻²⁹ The degree of acceptability and most probable scope of medicinal plants investigations have broadened to the environmental and ecological sciences as environmental purifiers and decontaminators,³⁰ in phytoremediation for heavy metals³¹ or all together for ecological mapping for various habitats.³¹⁻³³ Similarly, medicinal plants research and data now constitute a sizeable amount of the contents of databases related to cell biology, molecular biology,³⁴⁻³⁷ bioinformatics and system biology,³⁸⁻⁴⁰ and in Microbiology, where medicinal plants have been investigated extensively for antimicrobial properties⁴¹ or the interactions of medicinal plants with the microbiome of various microhabitats.⁴²⁻⁴⁵

Topmost productive researchers

The top ten most productive Nigerian affiliations authors collectively contributed 523 publications on medicinal plants, constituting a 1.58% share of the total output for the study period (2009 - 18). The most productive authors contributed 140 to 34 publications (Figure 7). Each author's total publication count in each sub-period and the relative citation rate (RCR) is further analyzed. The author-publication volume trend did not necessarily align with citation. Generally, authors increasingly generated a more significant number of publications in the latter years (2014 - 2018) than in the earlier years (2009 - 2013) except for three authors (COE, CSN, and SIO). The majority of the publications recorded for the authors; COE and CSN were generated within the earlier years, with lesser publication output in the later years. Conversely, the majority of the publications recorded for SIO were developed in the latter years. Six authors (GO, AOA1, TOA, SIO, SAA, AOA2) recorded increased citation rates (RCR) than other top authors captured for the study period. However, SIO recorded higher citation than any other, although with a considerably lesser number of total publications than the other five. Higher impact outlets in a relevant subject to a broader audience or even a slimmer audience, among others may be the link to increased citation.

Scholarly access type

The findings of the study clearly show that the ratio of total open access (28%) to subscription (closed) access (45%) is significantly lower (Figure 8). The significantly skewed percentage to subscription outlets is reflective of the prevailing dispositions of authors in the

region as it is common with authors in the global south where payment of Article Processing Charge (APCs), the gold model for open access publishing is the least preferred by such authors. Authors in such regions often prefer a subscription model that publishes free for authors but requires users' subscription paywalls. Similarly, the trend is understandably so, as the open access route of publication only recently began to receive acceptance considerably among researchers in the global south. Though open access (OA) is gaining a lot of ground, a researcher in the global south still prefers the subscription route primarily due to inadequate funding.⁴⁶ Most OA outlets are also of gold OA model; authors in the region preferably target source subscription-based journals.⁴⁷⁻⁴⁸

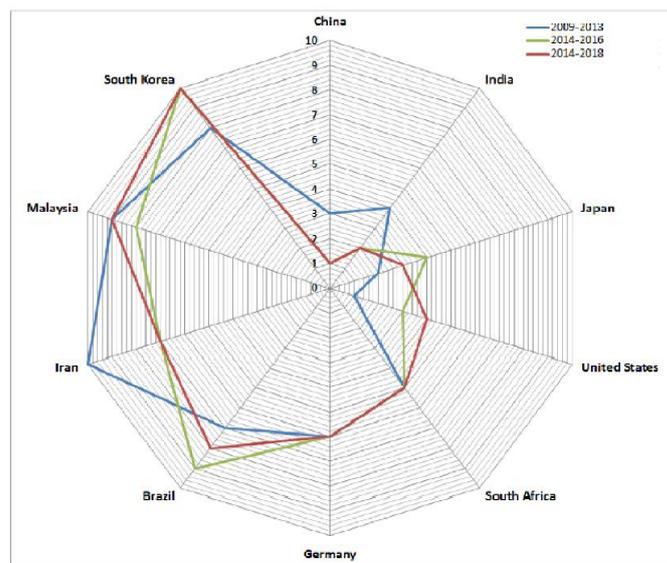


Figure 2: Ranking and Positional Change between the ten (10) productive countries for the study sub-periods: 2009-13; 2014-16; 2014-18.

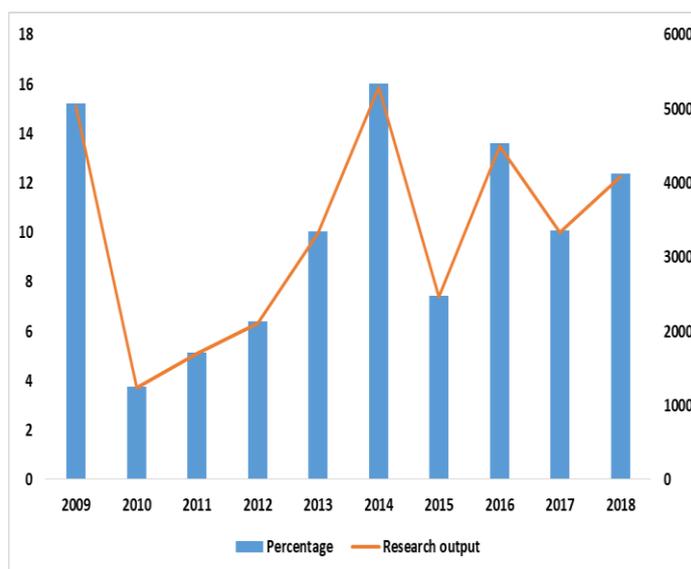


Figure 3: Volume and Trend of Medicinal Plant Research Output of Nigerian Affiliations

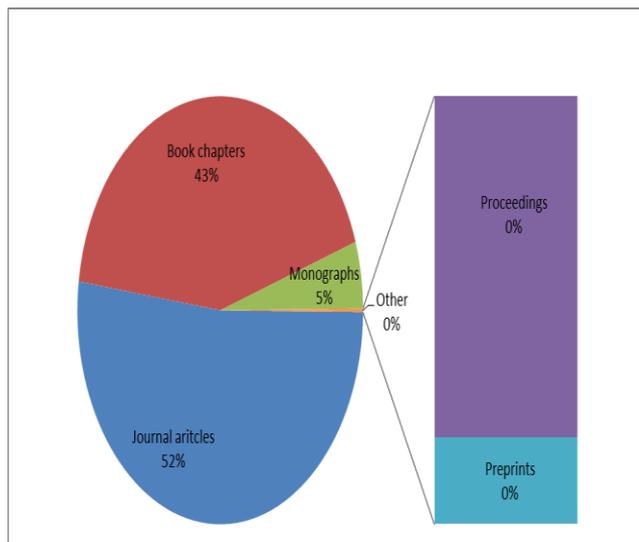


Figure 4: Document -wise output of authors of Nigerian – affiliation

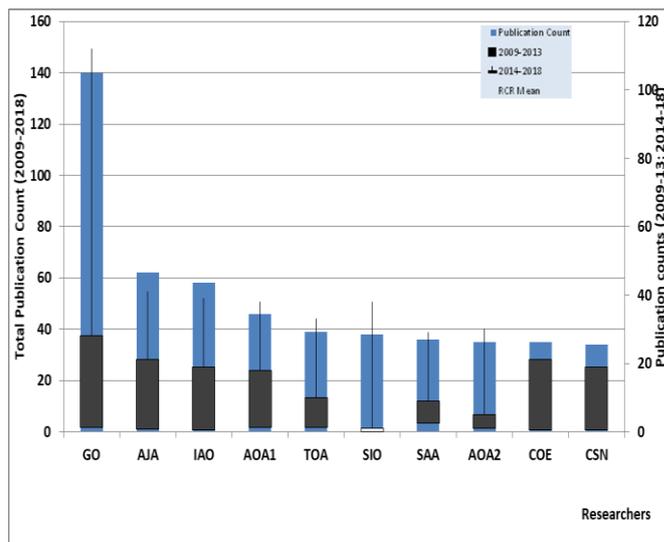


Figure 7: Topmost Contributors' Publication output: Total, earlier years (2009-13) and later years (2014-2018) counts with Relative Citation Rate (RCR) mean for each researcher in 10 years (2009-18).

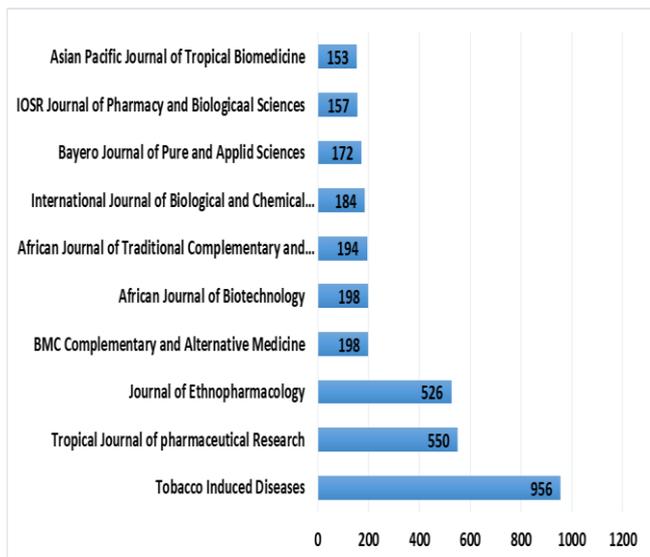


Figure 5: Top ten (10) source title of Nigerian Medicinal Plant Publications (2009 - 18)

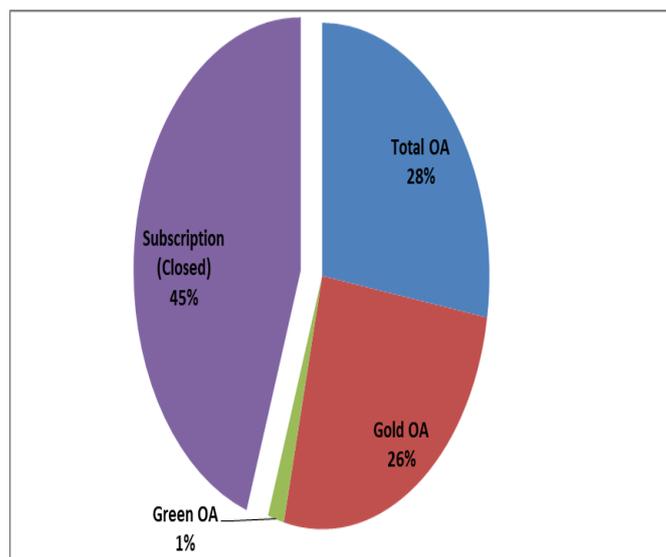


Figure 8: Accessibility profile of medicinal plant scholarly publications analyzed for the study, with a more significant percentage (53%) of scholarly journal by Nigeria –affiliated authors on medicinal plants accessible only through closed (subscription-based) access.

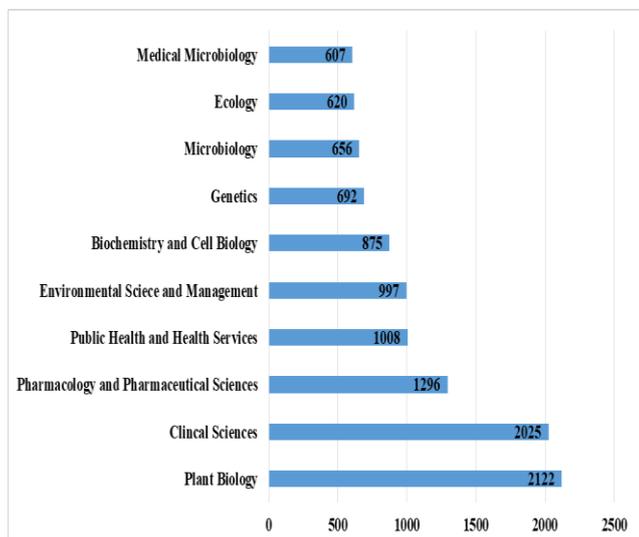


Figure 6: Top ten (10) subject areas of medicinal plant publications of Nigerian affiliation

Conclusion

The retrieved scholarly publications data on medicinal plants from ten top countries and Nigeria provides information on researchers' contribution in the medicinal plant field over ten years, 2009-2018. The top productive researchers in medicinal plant research dominate in publication volume and some other researchers dominate in citation. The analyzed results reflect an inconsistent trend in the medicinal plant publication output of Nigerian affiliation, possibly due to certain pitfalls connected with the environment. However, diverse opportunities exist to tap and improve this field by harnessing the abundant potentials inherent in the various aspects of medicinal plant research. To this end, intensive research productivity, multiple affiliation/collaborations across boundaries, increased open research

accessibility, multicultural research ambience/envirom is required to improve the output levels significantly. The analytics in this study will serve for further assistance to medicinal plant researchers, information officers, librarians, policymakers, and analysts in recognizing relevant data gaps, that would enable the development of sustainable contextual strategies for medicinal plant research in Nigeria.

Conflict of interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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