

Prostate Cancer: Causes and Medicinal Plants Used in Africa for Twenty Years (2001-2021)

Oludare Oladipo Agboola^{1,4}, Samuel Bawa Ijimbili^{1,*}, Gift Onyinyechukwu Ofuasia², Joseph Anejo-Okopi³, Jasini Alexander Wahedi¹, Joshua Oluwole Olowoyo^{4,5}

Oludare Oladipo Agboola^{1,4}, Samuel Bawa Ijimbili^{1,*}, Gift Onyinyechukwu Ofuasia², Joseph Anejo-Okopi³, Jasini Alexander Wahedi¹, Joshua Oluwole Olowoyo^{4,5}

¹Department of Biological Sciences, Federal University of Health Sciences Otuokpo, Benue State, NIGERIA.

²National Biotechnology Development Agency, Calabar, NIGERIA.

³Department of Microbiology, Federal University of Health Sciences Otuokpo, Benue State, NIGERIA.

⁴Department of Biology and Environmental Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa.

⁵Department of Health Sciences, Florida Gulf Coast University, Fort Myers, USA

Correspondence

Samuel Bawa Ijimbili

Department of Biological Sciences, Federal University of Health Sciences Otuokpo, Benue State, NIGERIA.

E-mail: samuel.ijimbili@fuhsso.edu.ng

History

- Submission Date: 08-08-2022;
- Review completed: 16-09-2022;
- Accepted Date: 29-09-2022.

DOI : 10.5530/pj.2022.14.174

Article Available online

<http://www.phcogj.com/v14/i6>

Copyright

© 2022 Phcogj.Com. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International license.

ABSTRACT

Prostate cancer is one of deadliest cancers in the universe especially in Africa. A lot of work has been done on the treatment and control of breast cancer, colon/colorectal cancer, skin cancer, etc. Only a few works on prostate cancer has been published in literature. The conventional method of treatment used is almost not affordable by many cancer patients due to high cost of drugs and therapy. Also, the cumulative side effects arising from the treatment is enormous to patients. Hence, there is need to exploit local herbs that contain active anticancer ingredients that are readily available and affordable with little or no side effects. The present review was carried out to evaluate published works on medicinal plant species used for treatment and control of prostate cancer in Africa for twenty years (2001-2021). A total number of 48 plant species with 40 families were retrieved from database using ScienceDirect, Google scholar, Web of Science, Springerlink, Scopus, PubMed, and BioMed. All the plant species were reported to possess cytotoxic activity against prostate cancer cell lines *in vitro* and *in vivo*. The most cited plant species according to literature sources are *Hypoxis hemerocallidea*, *Plumbago zeylanica*, *Gongronema latifolium* and *Mangifera indica*. Plant families that were used more in treating prostate cancer were Apocynaceae, Fabaceae, Asteraceae, Cucurbitaceae, Bignoniaceae, Lamiaceae. We conclude that more research be carried out on the medicinal plants' usage on the treatment of prostate cancer and further bio-prospecting drugs from the enlisted plants should explored by the pharmaceuticals in Africa.

Key words: Cure, Death, Ethnobotany, Families, Phytomedicine, Tumour.

INTRODUCTION

Medically, cancer was first mentioned historically in early 1600BC at the centre (Edwin Smith papyrus) where the oldest description of disease existed.¹ Cancer synonymously called tumor had its origin from two Greek words: "Karkinos and Karkinoma" by a Hippocratic physician. Not until 1980s, when groundbreaking evidences on carcinogenicity came into limelight, there was no major findings on the cause of the growth of the malignant cells (tumour) in the body.

Cancer is a severe metabolic syndrome and is one of the prominent causes of death irrespective of the advancements in its diagnosis now, management and prevention processes.^{2,3} According to a report of the World Health Organization,⁴ cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020 with breast cancer, lung cancer, colon and rectum, prostate, skin and stomach reported death cases to be 2.26 million, 2.21 million, 1.93 million, 1.41 million, 1.20 million and 1.09 million respectively⁵ Meanwhile,⁵ reported nearly about 8.2 million deaths and 14.1 million new cases of cancer and it has been estimated that by 2032, this number would have increased by 70%.⁶⁻⁸ Thus, there is bound to be increase in the reported cases of cancer globally and possibly, cancer may remain as the leading cause of death worldwide.⁹

The major cause of cancer remains a mystery to so many physicians and patients suffering from cancer. However, certain factors could possibly have led to the transformation of normal cells

into tumour cells that lead to growth of malignant tissues.⁴ The cause of these changes are interaction of genetic factors and environmental factors majorly physical carcinogens: ultra violet and ionizing radiation, chemical carcinogens: asbestos, alcohol, components of tobacco smoke, aflatoxin and arsenic in drinking water and biological carcinogens most especially viral infections. Cancer is also caused by external factors like infectious organisms, tobacco use, internal factors like immune conditions, genetic mutations, or hormonal imbalance. Mutation causes cancer which alters the molecular mechanism of genes for controlling the normal cell growth. Of concern is the report of¹⁰ on 13% of cancers diagnosed in 2018 globally which were associated to biological carcinogens such as bacterium; *Helicobacter pylori* and virus like human papillomavirus (HPV), hepatitis B virus, hepatitis C virus, and Epstein-Barr virus. Infections with virus such as HIV increased the risk of developing cervical cancer progressively while Hepatitis B, C and some types of HPV also increase the risk for liver and cervical cancer respectively.

The mortality as a result of cancer, can be reduced if detected and treated early either by early diagnosis and screening. Every cancer type requires an appropriate regimen for effective treatment which relies on correct diagnosis though major cure of cancer demands a particular strategy such as chemotherapy, surgery, immunotherapy, vaccinations, photodynamic therapy, radiotherapy, stem cell transformation etc. No doubt, these treatments are effective and can increase the lifespan of cancer patient to some extent. Besides that, it has various unbearable side effects such as toxicity and non-specificity.¹¹

Cite this article: Agboola OO, Ijimbili SB, Ofuasia GO, Anejo-Okopi J, Wahedi JA, Olowoyo JO. Prostate Cancer: Causes and Medicinal Plants Used in Africa for Twenty Years (2001-2021). Pharmacogn J. 2022;14(6): 822-828.

Table 1: Plants used to treat prostate cancer, their scientific names, families, common names, parts and references.

S/No	Scientific Name	Family	Common Name	Part	Reference
1	<i>Panax ginseng</i>	Araliaceae	Root Ginseng	Root	17
2	<i>Arum palaestinum</i>	Araceae	Black calla	Root-leaf	18
3	<i>Melissa officinalis</i>	Lamiaceae	Lemon balm	Leaves	19
4	<i>Ganoderma lucidum</i>	Ganodermataceae	Whole plant	Ganoderma	20
5	<i>Psidium guajava</i>	Myrtaceae	Lemon guava	Leaves	21
6	<i>Artemisia</i>	Asteraceae	Wormwood	Aerial part and root	22
7	<i>Prunus africana</i> (Hook.f.) Kalkman (<i>Pygeum africanum</i>)	Rosaceae	African cherry, pygeum, iron wood, red stinkwood, African plum, African prune, and bitter almond	Leaves, bark	23
8	<i>Pseudocedrela kotschy</i>	Meliaceae	Dry zone cedar, hard cedar-mahogany	Leaves and stem	24
9	<i>Asparagus africanus</i> Lam.	Asparagaceae	Bush asparagus, wild asparagus, African asparagus	Roots, leaves,	25
10	<i>Bulbinella floribunda</i> (Thunb.)	Asphodelaceae	Bulbine, bulbinella, burn jelly plant, cat's tail, snake flower	Roots	26
11	<i>Kigelia africana</i> (Lam.) Benth.	Bignoniaceae	Sausage tree, worsboom	Fruits, leaves, bark	27
12	<i>Hypoxis hemerocallidea</i> Fisch,	Hypoxidaceae	Star lily, magic muthi, yellow star	Corms	28,29
13	<i>Aloe ferox</i> Mill	Liliaceae	Barbados aloe, bitter aloe, first aid plant, medicinal aloe	Leaves	30
14	<i>Catharanthus roseus</i> (L.)	Apocynaceae.	Bright eyes, cape periwinkle, graveyard plant, old maid, pink periwinkle, rose periwinkle	Leaves, stem	31
15	<i>Ximenia caffra</i> Sond.	ximeniaceae	Munhengeri, mutsvanzva	Roots, fruits, seeds	32
16	<i>Aloe volkensii</i> Engl.	Aloaceae	Aloes	Leaves	26
17	<i>Opuntia</i> sp	Cactaceae	Opium poppy, breadseed poppy	Leaves	33
18	<i>Steganotaenia araliacea</i> Hochst	Apiaceae	Musvodzambudzi	Bark, young leaves	32
19	<i>Euclea natalensis</i> A.DC.	Ebenaceae	Nataloguari, natal ebony	Bark	34
20	<i>Moringa oleifera</i> Lam.	Moringaceae	horseradish tree	Leaves, root, bark	35
22	<i>Capsicum frutescens</i> L.	Solanaceae	Tabasco Pepper, Cayenne pepper	Fruit	34
23	<i>Byophyllum pinnatum</i> (Lam).	Crassulaceae	Cathedral bells	Leaves	36
24	<i>Burkea africana</i> Hook.	Fabaceae	Mukarati, umnondo	Roots, stem bark	37
25	<i>Alstonia congensis</i> Engl.	Apocynaceae	Stool wood, chinese wood, emien	Leaves	38
26	<i>Chenopodium ambrosioides</i> L.	Chenopodiaceae	Sweet pidweed	Leaves	39
27	<i>Pseudolachnostylis maprouneifolia</i> Pax.	Phyllanthaceae	Mutsonzwa, mukura	Leaves	32
28	<i>Nymphaea lotus</i> L.	Nymphaeaceae	Water lotus, tigeter lotus, Egyptian white waterlily	Leaves	40
29	<i>Petiveria alliacea</i> L	Phytolaccaceae	Guinea hen weed	Root	41
30	<i>Sutherlandia frutescens</i> L.	Fabaceae	Cancer bush	Shoots	32
31	<i>Xylopia aethiopica</i> (Dunnal) A.Rich.	Annonaceae	Spice tree, African pepper, Ethiopian pepper, guinea pepper	Seed	38
32	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Wild worth leadwort, Ceylon plumbago, startwaterbossie	Root	42,43
33	<i>Duranta erecta</i> L.	Verbeceae	Golden Dew-Drop, Lilac-flowered Golden Dewdrop, Pigeon Berry, Sky Flower, Brazilian Sky Flower, Kachang Puteh, Forget-Me-Not	Leaves, roots, bark, Fruits	32
34	<i>Gongronema latifolium</i> Benth.	Apocynaceae	Utazi, arokeke, bush buck, tafel boom	Leaves	44,45
	<i>Hibiscus sabdariffa</i> L.	Malvaceae	Roselle	Calyces	32
35	<i>Musa sapientum</i> L.	Musaceae	French plantain/banana, desert banana	Tuber	46
36	<i>Kigelia africana</i> Lam. Benth.	Bignoniaceae	Mubveve	Fruits, leaves, bark	37
37	<i>Ocimum basilicum</i>	Lamiaceae	Sweet basil	Leaves	47
38	<i>Vernonia amygdalina</i> Delile	Asteraceae	Congo bololo, bitter leaf	Leaves	48
39	<i>Momordica charantia</i> L	Cucurbitaceae	Cucubits	Leaves	49
40	<i>Heliotropium indicum</i> L.	Boraginaceae	Indian turnsole, indian heliotrope	Leaves	50
41	<i>Naucllea latifolia</i> Sm.	Rubiaceae	Guinea peach	Seed	51
42	<i>Momordica cabraei</i> (Cogn.) C.Jeffrey.	Cucurbitaceae	Ahara,dawodu, burkill	Leaves	52
43	<i>Euphorbia hirta</i> L	Euphorbiaceae	Garden spurge	Stem	53
44	<i>Mangifera indica</i> L.	Anacardiaceae	Mango	Bark	54
45	<i>Cannabis sativa</i> L.	Cannabaceae	Mbanje	Leaves, whole plant	32
46	<i>Heteromorpha trifoliata</i> Wendl.	Apiaceae	Mhingano, imfenkulu	Leaves, bark, roots	37
47	<i>Raphia mambillensis</i>				55
48	<i>Vernonia guineensis</i> Benth.	Asteraceae	Mgbu, Kwet		55

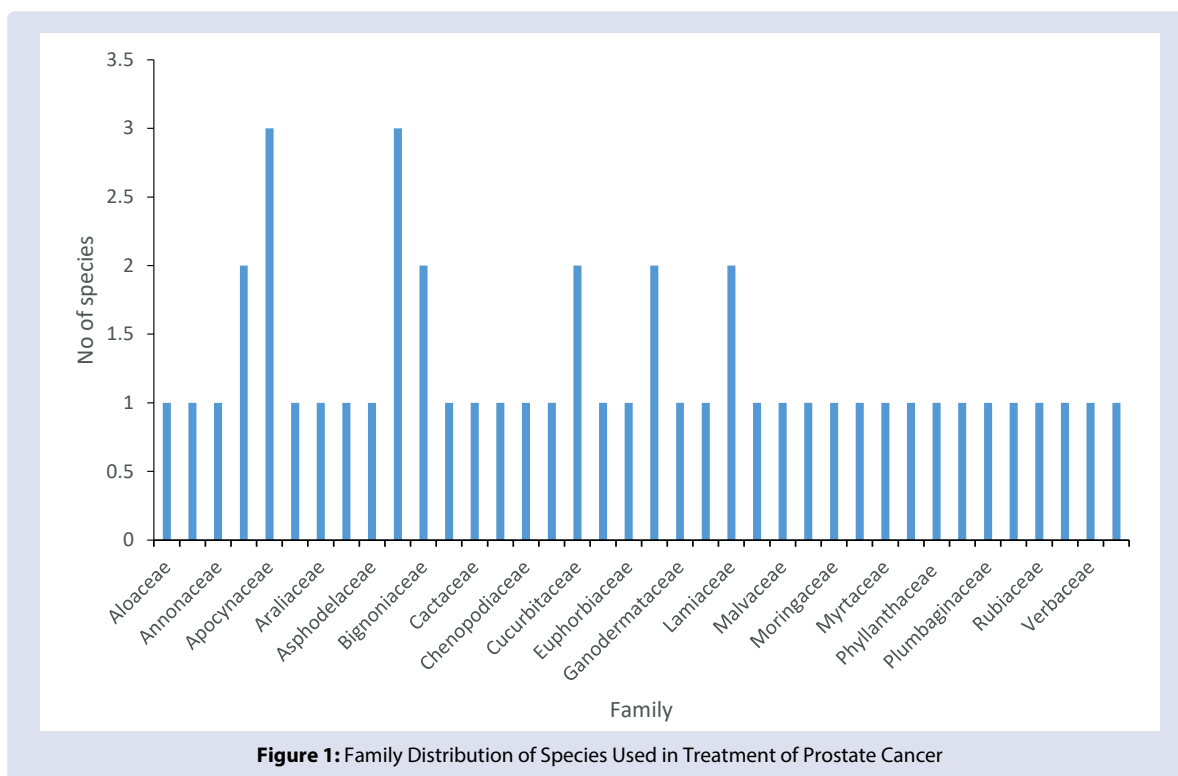


Figure 1: Family Distribution of Species Used in Treatment of Prostate Cancer

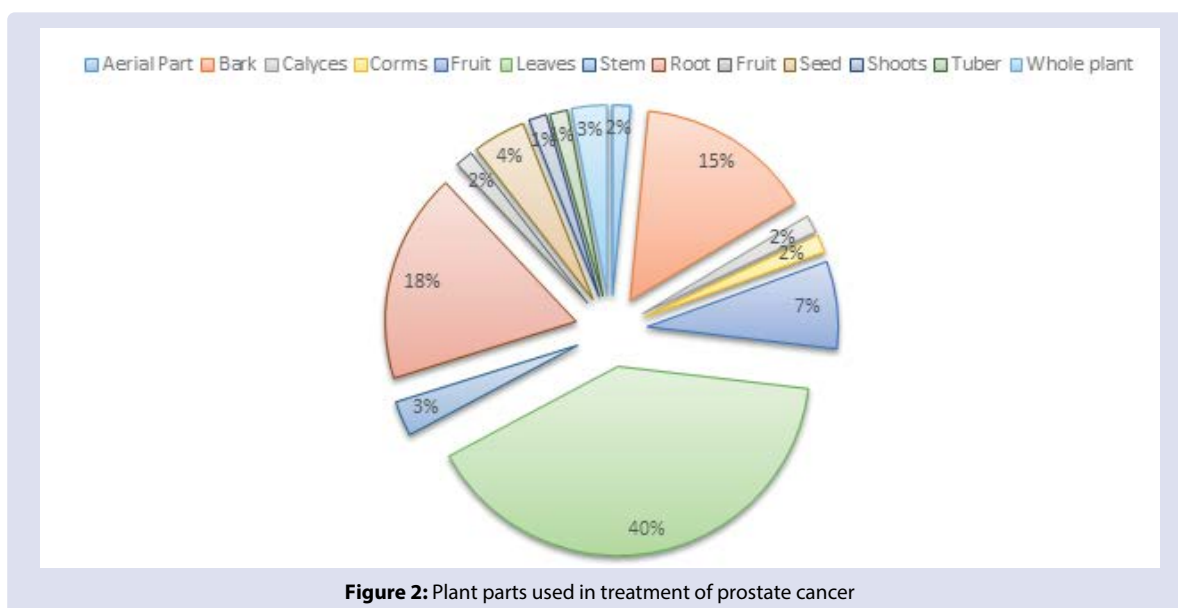


Figure 2: Plant parts used in treatment of prostate cancer

Notably, plants act as reservoir for various phytochemicals (flavonoids, saponins, coumarins, alkaloids, terpenes, lignans, glycosides, etc.) possibly that can elicit the anticancer or antitumor properties. These phytochemicals are safe, cost-effective, less toxic, selective, eco-friendly, and fast in comparison to other traditional methods for cancer treatment.¹² More than 80% of world’s population depends upon traditional herbal medicines for their well-being, and 60% of the clinically approved anticancer drugs are also the derivatives of medicinal flora.^{13,14}

METHODOLOGY

This review assessed new published research papers and review articles only. Notable search engines were used such as ScienceDirect, Google scholar, Web of Science, SpringerLink, Scopus, PubMed, and BioMed

Central. Additional materials were retrieved by consulting books, and ethnopharmacological publications not readily available in electronic form. Keywords such as “medicinal plants used for cancer treatments in Africa”, “medicinal plants and cancer” and “medicinal uses of plant” were used for searching the literature.

RESULTS AND DISCUSSION

Out of the families that were used to treat prostate cancer represented in the figure above, the families Apocynaceae and Fabaceae were predominantly used more than others. These were followed by the families Bignoniaceae, Cucurbitaceae and Lamiaceae. However, all the families had positive effect on the treatment of prostate cancer.

Twenty-five percent (25%) of the world’s biodiversity is reportedly found in Africa.¹⁵ Africa is estimated to contain up to 45,000 plant

species with potential for medicinal use.¹⁶ Much work has been done on the treatment and control of cancer using conventional methods worldwide over time. However, only a few works have been done on prostate cancer. The conventional methods used in the treatment of cancer are usually followed by negative side effects aside high cost of which is usually too expensive for cancer patients to afford especially patients from developing countries; hence the use of medicinal plants that contain anti-cancer bioactive ingredients as alternative to cancer treatment. The present review was done to evaluate the available works done on prostate cancer that have been published in literatures on medicinal plants used for the treatment of prostate cancer in Africa for upwards of twenty years (2001-2021). A total of 48 articles relating to medicinal plants used for prostate cancer treatment in Africa were retrieved from scientific databases. A total of 48 plant species from 40 different plant families were recorded in this review. The dominant plant families documented for treatment of prostate cancer were Apocynaceae, Fabaceae, Asteraceae, Cucurbitaceae, Bignoniaceae, Lamiaceae. The reason for their wide range of use might be that they are more readily available and easily found everywhere. Many species under this dominant family have been proven to possess some phytochemicals such as saponins (frothing), tannins (Ferric chloride), anthraquinones (chloroform/ammonia, terpenoids (chloroform/H₂SO₄), steroids (chloroform/AC.AN/H₂SO₄), and antioxidant activity

From the above figure, the part of plants that is most widely used was leaves (40%); this was followed by roots (18%); which was followed by bark (15%); which was followed by fruit (7%) and followed by seed (4%).

The wide use of the three families for treatment of prostate cancer might be due to the reason that they are ubiquitous, and are among the largest terrestrial plant families throughout the world.⁵⁶ Also, a majority of the species in these two dominant families have been reported to possess highly efficacious secondary metabolites such as flavonoids, terpenoids, saponins, tannins, alkaloids, and phenolics.^{57,58}

Based on the literature, the most used plant in Africa in the treatment of prostate cancer are *Hypoxis hemerocallidea*, *Plumbago zeylanica*, *Gongronema latifolium* and *Mangifera indica*. *Hypoxis hemerocallidea* called African potato's extract contains hypoxoside and its active derivative called rooperol fight the growth of premalignant cancer cells and in turn used in the treatment of prostate cancer among other activities such as anti-oxidants, anti-inflammatories, anti-diabetic, testicular tumour and in more recent times HIV/AIDS.^{59,60} Higher quantity of flavonoids and terpenoids from the ethanolic extract of *Plumbago zeylanica* Linn. exhibit important anticancer activity which reduces high amount of lipid peroxidation. In this way, cancer could be cured through the use of ethanolic extract of *P. zeylanica* Linn.⁶¹

Gongronema latifolium is a plant that has a wide range of nutritional and ethnomedical uses in different tropical African communities. Scientific reports on the chemical composition and bioactivity (anti-inflammatory, antimicrobial, antidiabetic, antioxidant, anticancer and allelopathic properties) of the plant material.⁶² *G. latifolium* leaf extracts were reported by 63 that leaf extracts of *G. latifolium* exhibit strong inhibitory activity against human lung carcinoma (A-549) and human breast adenocarcinoma (MCF-7) *in vitro*.⁶³ Reports have also shown that *G. latifolium* phytochemicals could prevent cancer due to their antioxidant activity as free radical scavengers.⁶⁴⁻⁶⁶ *Mangiferin*, an extract from *Mangifera indica* is known as a simple compound used as a treatment for cancer because it a potential CDK4 inhibitor, can be used as anticancer drug.⁶⁷ CDK4 is a cell cycle regulator which is upregulated in the majority of cancer events.⁶⁷⁻⁷⁰ reported anticancer activity of *M. indica* extract on colon cancer.

CONCLUSION

Based on the plant species used in the treatment of prostate cancer in Africa, we therefore suggest that more research be carried out and

pharmaceutical industries should consider drug formulation from these medicinal plants in order to reduce the mortality rate as a result of prostate cancer.

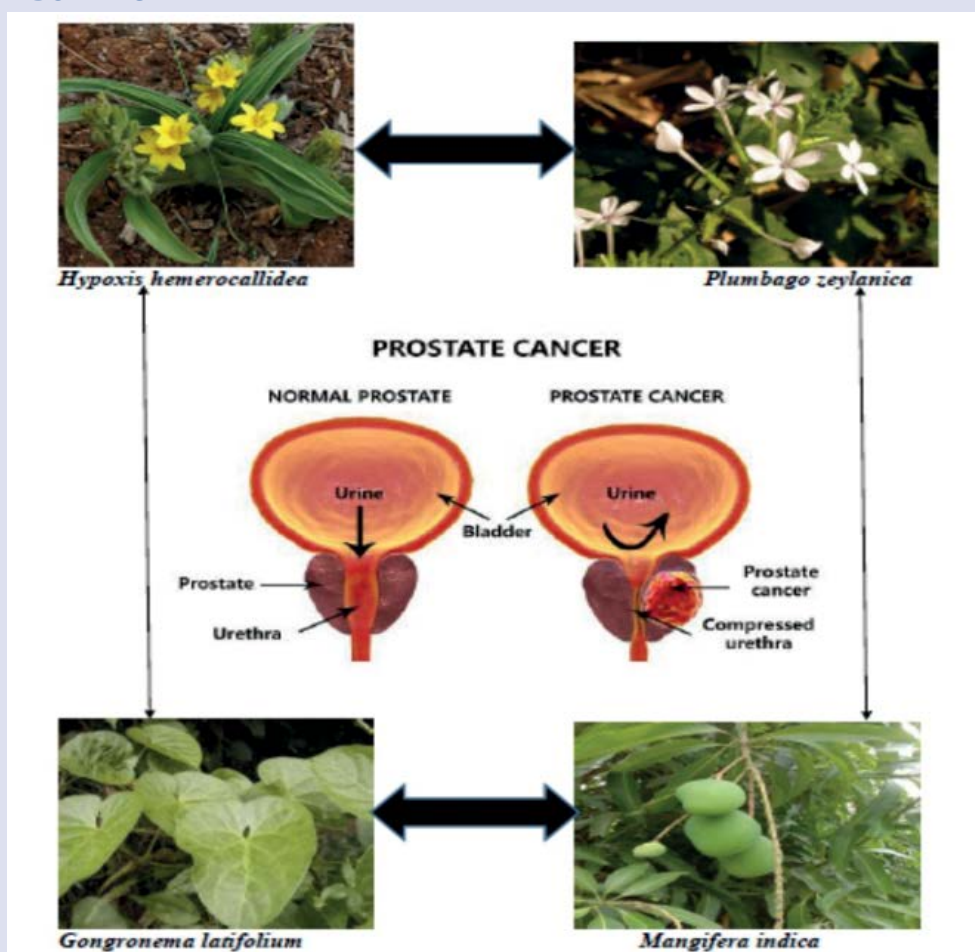
REFERENCES

- Papavramidou N, Papavramidis T, Demetriou T. Ancient Greek and Greco-Roman methods in modern surgical treatment of cancer. *Ann Surg Oncol*. 2010;17(3):665-7.
- He L, Gu J, Lim LY, Yuan ZX, Mo J. Nanomedicine-mediated therapies to target breast cancer stem cells. *Front Pharmacol*. 2016;7:313.
- Zhang LQ, Lv RW, Qu XD, Chen XJ, Lu HS, Wang Y. Aloes in suppresses cell growth and metastasis in ovarian cancer SKOV3 cells through the inhibition of the MAPK signaling path-way. *Anal Cell Pathol*. 2017;2017:8158254.
- World Health Organization. Noncommunicable diseases progress monitor. 2022.
- World Health Organisation (WHO). *Medecine Traditionnelle, Aide-memoire N°134*. Reper'e'a. <http://www.who.int/mediacentre/factsheets/fs134/fr/index.html>. 2012.
- Thakore P, Mani RK, Kavitha SJ. A brief review of plants having anti-cancer property. *Int J Pharm Res Dev*. 2012;3(1):129-36.
- Ferlay J, Ervik M, Lam F, Colombet M, Mery L, Piñeros M. Global Cancer Observatory: Cancer Today. Lyon: International Agency for Research on Cancer. 2020. (<https://gco.iarc.fr/today>, accessed February 2021).
- Faria SS, Morris CF, Silva AR, Fonseca MP, Forget P, Castro MS, et al. A timely shift from shotgun to targeted proteomics and how it can be groundbreaking for cancer research. *Front Oncol*. 2017;7:13.
- American Cancer Society. *Cancer Facts and Figures*. 2012.
- de Martel C, Georges D, Bray F, Ferlay J, Clifford GM. Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. *Lancet Glob Health*. 2020;8(2):180-90.
- Chodak GW. Early detection and screening for prostatic cancer. *Urology*. 1989;34(4 Suppl):10-2.
- Iqbal J, Abbasi BA, Mahmood T, Kanwal S, Ali B, Khalil AT. Plant-derived anticancer agents: a green anticancer approach. *Asian Pac J Trop Biomed*. 2017;1-23.
- Khan H. Medicinal plants in light of history: recognized therapeutic modality. *J Evid Based Complement Alternat Med*. 2014;19(3):216-9.
- Cragg GM, Newman DJ, Yang SS. Natural product extracts of plant and marine origin having antileukemia potential. The NCI experience. *J Nat Prod*. 2016;69(3):488-98.
- Kakakhe MB. Monte Carlo simulations of dynamic radiotherapy treatments (Doctoral dissertation, Queensland University of Technology). 2012.
- Mahomoodally MF. Traditional medicines in Africa: an appraisal of ten potent African medicinal plants. *Evid Based Complement Alternat Med*. 2013;2013:617459.
- Kim SK, Chung JH, Lee BC, Lee SW, Lee KH, Kim YO. Influence of Panax ginseng on alpha-adrenergic receptor of benign prostatic hyperplasia. *Int Neurourol J*. 2014;18(4):179-86.
- Cole C, Burgoyne TH, Lee A, Stehno-Bittel L, Zaid G. Arum palaestinum with isovanillin, linolenic acid and β-sitosterol inhibits prostate cancer spheroids and reduces the growth rate of prostate tumors in mice. *BMC Complement Altern Med*. 2015;15:264.
- Jahanban-Esfahlan R, Seidi K, Monfaredan A, Shafie-Irannejad V, Abbasi MM, Karimian A, et al. The herbal medicine *Melissa officinalis* extract effects on gene expression of p53, Bcl-2, Her2, VEGF-A and hTERT in human lung, breast and prostate cancer cell lines. *Gene*. 2017;613:14-9.

20. Wang X, Fang G, Pang Y. Chinese medicines in the treatment of prostate cancer: from formulas to extracts and compounds. *Nutrients*. 2018;10(3):283-8.
21. Ryu NH, Park KR, Kim SM, Yun HM, Nam D, Lee SG. A hexane fraction of guava leaves (*Psidium guajava* L.) induces anticancer activity by suppressing AKT/mammalian target of rapamycin/ribosomal p70 S6 kinase in human prostate cancer cells. *J Med Food*. 2015;15(3):231-41.
22. Kim JK, Kim JY, Kim HJ, Park KG, Harris RA, Cho WJ. Scoparone exerts anti-tumor activity against DU145 prostate cancer cells via inhibition of STAT3 activity. *PLoS One*. 2013;8(11):80391.
23. Komakech R, Kang Y, Lee JH, Omujal F. A review of the potential of phytochemicals from *Prunus africana* (Hook f.) bark for chemoprevention and chemotherapy of prostate cancer. *Evid Based Complement Alternat Med*. 2017;2017:3014019.
24. Segun PA, Ogbole OO, Ajayioba EO. Medicinal plants used in the management of cancer among the Ijebus of Southwestern Nigeria. *J Herb Med*. 2018;4:2.
25. Richard K, Youngmin K, Jun-Hwan L, Francis O. A Review of the Potential of Phytochemicals from *Prunus africana* (Hook f.) Bark for Chemoprevention and Chemotherapy of Prostate Cancer. *J Evid Based Complement Alternat Med*. 2017;2017:3014019.
26. Ochwang DO, Kimwele CN, Oduma JA, Gathumbi PK, Mbaria JM, Kiama SG. Medicinal plants used in treatment and management of cancer in Kakamega County, Kenya. *J Ethnopharmacol*. 2014;151(3):1040-55.
27. Justus WM, Philip WM, Justin MN, Sarah NK. In vitro anti-cancer efficacy and phyto-chemical screening of solvent extracts of *Kigelia africana* (Lam.) Benth. *Heliyon*. 2020;6(7):e04481.
28. Koduru S, Grierson DS, Afolayan AJ. Ethnobotanical information of medicinal plants used for treatment of cancer in the Eastern Cape Province, South Africa. *Curr Sci*. 2021;26(15):4639.
29. Mofokeng MM, Hintsia TA, Amoo SO, Sehloa D, du Plooy CP, Bairu MW, *et al.* Diversity and Conservation through Cultivation of *Hypoxis* in Africa- A Case Study of *Hypoxis hemerocallidea*. *MDPI*. 2020;12(4):122.
30. Mhalad R. The Therapeutic Value of *Aloe ferox* Mill; MSc Dissertation Department, Health Science Central University of Technology: Free State, South Africa. 2014.
31. Phama HNT, Sakoff B, Vuonga JA, Bowyera QV, Scarlett J, Christopher MC. Screening phytochemical content, antioxidant, antimicrobial and cytotoxic activities of *Catharanthus roseus* (L.) G. Don stem extract and its fractions. *Biocatal Agric Biotechnol*. 2018;16:405-11.
32. Idris OR, Boikanyo GK, Liziwe LM, Francis BL, Stephen OA, Joshua OO. An appraisal of documented medicinal plants used for the treatment of cancer in Africa over a twenty-year period (1998–2018). *J Herbal Med*. 2020;23:2210-8033.
33. Daily Monitor, Natural Remedies and Cancer: What's the Truth? 2019. <https://www.monitor.co.ug/SpecialReports/Natural-remedies-cancer-What-s-truth/688342-5317906-pe8w46z/index.html>.
34. Tugume P, Kakudidi EK, Buyinza M. Ethnobotanical survey of medicinal plant species used by communities around Mabira central forest reserve, Uganda. *J Ethnobiol Ethnomed*. 2016;12:5.
35. Wamai M. Minds Illuminated as Mak Hosts the Day of Moringa Science, Makerere University, Kampala, Uganda. 2019. <https://news.mak.ac.ug/2019/07/minds-illuminated-mak-hosts-day-moringa-science>.
36. Ozolua RI, Idogun SE, Tafamel GE. Acute and Sub-Acute Toxicological Assessment of Aqueous Leaf Extract of *Bryophyllum pinnatum* (Lam.) in Sprague-Dawley Rats. *Am J Pharmacol Toxicol*. 2010;5(3):145-51.
37. Matowa PR, Gundidza M, Gwanzura L, Nhachi CF. A survey of ethnomedicinal plants used to treat cancer by traditional medicine practitioners in Zimbabwe. *BMC Complementary Med Ther*. 2020;20(1):1-13.
38. Ogbonnia S, Adedotun AA, Bosa MK, Veronica EN. Evaluation of acute and subacute toxicity of *Alstonia congolensis* Engler (Apocynaceae) bark and *Xylopiia ethiopica* (Dunal) A. Rich (Annonaceae) fruits mixtures used in the treatment of diabetes. *African J Biotechnol*. 2008;7(6):701-5.
39. Pereira WS, Ribeiro BP, Sousa AIP, Serra ICPB, Mattar NS, Fortes TS, *et al.* Evaluation of the subchronic toxicity of oral treatment with *Chenopodium ambrosioides* in mice. *J Ethnopharmacol*. 2010;127(3):602-5.
40. Sharaibi OJ, Ogundipe OT, Magbagbeola OA, Kazeem MI, Afolayan AJ. Acute and sub-acute toxicity profile of aqueous leaf extract of *Nymphaea lotus* Linn (Nymphaeaceae) in wistar. *Trop J Pharm Res*. 2015;14(7):1231-8.
41. García-pérez MA, Alfonso-Castillo OL, Fong A, Batista-Duharte ZL, Rodríguez. Toxicological evaluation of an aqueous suspension from leaves and stems of *Petiveria alliacea* L. (Phytolaccaceae). *J Ethnopharmacol*. 2018;211:29-37.
42. Kumar D, Patil PA, Roy S, Kholkute SD, Hegde HV, Nair V. Comparative toxicity profiles of *Plumbago zeylanica* L. root petroleum ether, acetone and hydroalcoholic extracts in Wistar rats, Ayu. 2015;36(3):329-34.
43. Teshome K, Gebre-mariam T, Asres K, Perry F, Engidawork E. Toxicity studies on dermal application of plant extract of *Plumbago zeylanica* used in Ethiopian traditional medicine. *J Ethnopharmacol*. 2008;117(2):236-48.
44. Al-hindi B, Yusoff NA, Ahmad M, Atangwho IJ, Asmawi MZ, Almansoub MA, *et al.* Safety assessment of the ethanolic extract of *Gongronema latifolium* Benth. leaves: a 90-day oral toxicity study in Sprague-Dawley rats. *BMC Complement Altern Med*. 2019;19(1):1-10.
45. Effiong G, Udoh I, Mbagwu HO, Ekpe I, Asuquo E, Atangwho I, *et al.* Acute and chronic toxicity studies of the ethanolic leaf extract of *Gongronema latifolium*. *Int Res J Biochem Bioinforma*. 2012;2(7):155-61.
46. Ugbogu EA, Ude VC, Elekwa I, Okuu U, Uche-ikonke C, Nwakanma C. Toxicological profile of the aqueous-fermented extract of *Musa paradisiaca* in rats. *Avicenna J Phytomed*. 2018;8(6):478-87.
47. Rasekh HR, Hosseinzadeh L, Mehri S, Kamli-Nejad M, Aslani M, Tanbakoozazan F. Safety assessment of *Ocimum basilicum* hydroalcoholic extract in wistar rats: acute and subchronic toxicity studies. *Iran J Basic Med Sci*. 2012;15(1):645.
48. Olufunmilayo LA, Oshibugie MJ, Iyobosa AI. Acute toxicity and hypoglycemic properties of ethanolic root extract of *Vernonia amygdalina* (bitter leaf) in alloxan-induced diabetic rats. *Int J Curr Res*. 2017;9(5):50132-8.
49. Deshmukh NS. Safety assessment of *McB-E60* (extract of a *Momordica* sp.): subchronic toxicity study in rats. *Toxicol Rep*. 2016;3:481-9.
50. Kyei S, Koffuor DA, Ramkissoon P, Asante. Oral and Ocular Safety Profile of Whole Plant Aqueous Extract of *Heliotropium indicum* L. in Rodents. *Res J Med Plant*. 2015;9:321-30.
51. Khouadio JH, Bleyere MN, Kone M, Dano SD. Acute and sub-acute toxicity of aqueous extract of *Nauclea latifolia* in swiss mice and in OFA rats. *Trop J Pharm Res*. 2014;13(1):109-15.
52. Pornsiri P, Kumiko O, Shugo S, Satoru T, Makoto A, Teera C, *et al.* *Momordica charantia* leaf extract suppresses rat prostate cancer progression in vitro and in vivo. *Cancer Sci*. 2010;101(10):2234-40.
53. Ping KY, Darah I, Chen Y, Sreeramanan S, Sasidharan S. Acute and subchronic toxicity study of *Euphorbia hirta* L. methanol extract in rats, *Biomed Res*. *Int J Biol Chem*. 2013;282:11221-9.

54. Zhang Y, Li J, Wu Z, Liu E, Shi P, Han L, *et al.* Acute and long-term toxicity of mango leaves extract in mice and rats. *J Evid Based Complement Alternat Med.* 2014;2014:691574.
55. Emmanuel N. Ethno medicines used for treatment of prostatic disease in Fouban, Cameroon. *Afr J Pharm Pharmacol.* 2010;4(11):793-805.
56. Tariq A, Sadia S, Pan K, Ullah I, Mussarat S, Sun F, *et al.* A systematic review on ethnomedicine of anticancer plants. *Phytother Res.* 2017;31(2):202-64.
57. Carvalho TD, Giaretta AA. Bioacoustics reveals two new syntopic species of *Adenomera Steindachner* (Anura: Leptodactylidae: Leptodactylinae) in the Cerrado of central Brazil. *Zootaxa.* 2013;3731:533-51.
58. Mwine TJ, Damme VP. Why do Euphorbiaceae tick as medicinal plants? A review of Euphorbiaceae family and its medicinal features. *J Med Plants Res.* 2011;5(5):652-62.
59. Schwartz ZT, Peter DT, Olaf TB, Mary R, Mauricio AJ, Dallas L, *et al.* Scalable Synthesis and Cancer Cell Cytotoxicity of Rooperol and Analogues. *Molecules.* 2022;27(6):1792.
60. Drewes SE, Elliot E, Khan F, Dhlamini JTB, Gcumisa MSS. Hypoxis hemerocallidea—Not merely a cure for benign prostate hyperplasia. *J Ethnopharmacol.* 2008;119(3):593-8.
61. Sachin H, Kishor D, Vijay K, Bibhilesh M. Evaluation of anticancer activity of *Plumbago zeylanica* linn. leaf extract. *Int J Biomed Res.* 2010;1(2):1-9.
62. Olugbenga M. A Review on *Gongronema latifolium*, an Extremely Useful Plant with Great Prospects. *Eur J Med Plants.* 2015;10(1):1-9.
63. Oluwatoyin BO, Okukwe CO, Gloria NE, Deborah I, Temiloluwa A. Anti-Inflammatory and Anti-Cancer Properties of Selected Green Leafy Vegetables - A Review. *J Nutr Food Processing.* 2021;4:1-5.
64. Sun SY, Lotan R. Retinoids and their receptors in cancer development and chemoprevention. *Crit Rev Oncol Hematol.* 2002;41(1):41-55.
65. Liu RH. Health benefits of fruits and vegetables are from additive and synergistic combinations of phytochemicals. *Am J Clin Nutr.* 2003;78(3 Suppl):517S520S.
66. Liu RH. Potential synergy of phytochemicals in cancer prevention: Mechanism of action. *J Nutr.* 2004;134(12 Suppl):3479S-85S.
67. Arif AM, Shomoita S, Martiniano B, Nazmul H, Rony KC, Saruar A, *et al.* CDK4 as a phytochemical based anticancer drug target, Informatics in Medicine Unlocked. *Res Gate.* 2022;28(6):100826.
68. Kavitha M, Nataraj J, Essa MM, Memon MA, Manivasagam T. Mangiferin attenuates MPTP induced dopaminergic neurodegeneration and improves motor impairment, redox balance and Bcl-2/Bax expression in experimental Parkinson's disease mice. *Chem Biol Interact.* 2013;206(2):239-47.
69. Tolosa L. Multiparametric evaluation of the cytoprotective effect of the *Mangifera indica* L. stem bark extract and mangiferin in HepG2 cells. *J Pharm Pharmacol.* 2013;65(7):1073-82.
70. Lauricella M, LoGalbo V, Cernigliaro C, Maggio A, Palumbo PA, Calvaruso G, *et al.* The Anti-Cancer Effect of *Mangifera indica* L. Peel Extract is Associated to γ H2AX-mediated Apoptosis in Colon Cancer Cells. *Antioxidants.* 2019;8(10):422.

GRAPHICAL ABSTRACT



ABOUT AUTHORS



Dr Agboola is a staff of Department of Biological Sciences, Federal University of Health Sciences, Otukpo, Nigeria. His disciplines include Botany with interest ecology and ethnobotany. He has lots of skills and expertise in species diversity, ecology and evolution, invasive species, ecosystem ecology, plant ecology, applied ecology, biological conservation, plant biodiversity, pollution monitoring, biostatistics, climate change biology, species invasion, ecological statistics, invasion biology and grassland ecology. He has scores of publications in international and reputable journals. His previous affiliations include Sefako Makgatho Health Sciences University, South Africa, University of Lagos, Nigeria.



Ijimbili is a Lecturer at the Department of Biological Sciences, Federal University of Health Sciences, Otukpo, Nigeria. He holds M.Sc. degree in Plant Physiology and Biochemistry from the Department of Botany, University of Ibadan, Nigeria. He obtained his B.Sc. in Biological Sciences at the Ahmadu Bello University, Zaria, Nigeria. His research experiences include phytomedicine, plant physiological ecology, environmental biology and plant ecology. Over the years he has been involved in data collection and fieldwork in forest and grassland ecosystem.



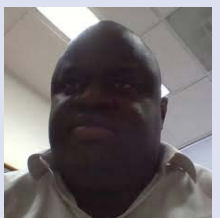
Ofuasia is a researcher with National Biotechnology Development Agency. She is currently a Ph.D. student of Food and Industrial Microbiology, Department of Microbiology, Federal University of Technology, Minna, Nigeria. She received her B.Sc. and M.Sc. in Food and Industrial Microbiology at the Department of Microbiology, University of Abuja, Nigeria. Her research experiences include the use of plant extracts in food preservation.



Anejo-Okopi is a Professor of Microbiology with expertise in virology, cancer and infectious disease epidemiology. He is current the Dean, Faculty of Science, Federal University of Health Sciences, Otukpo, Nigeria. He has lots of skills and expertise in molecular virology, PCR, infectious disease epidemiology, HIV, viral infection, viral diseases, molecular diagnostics, and hepatitis viruses. Professor Anejo-Okopi has several scores of publications in international and reputable journals.



Dr. Wahedi is a Lecturer whose expertise include Parasitology. His Ph.D. and M.Sc. degrees were obtained from the University of Ilorin, Nigeria, after obtaining and B.Sc. Zoology from University of Maiduguri, Nigeria. Dr. Wahedi, is currently a Senior Lecturer at the Department of Biological Sciences, Federal University of Health Sciences, Otukpo, Nigeria. His research interest is in the area of Parasitology. As a Researcher, he has published several articles on the use of plants in dealing with parasites.



Professor Joshua is a C2 NRF researcher at the Department of Biology and Environmental Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa. Department of Health Sciences, Florida Gulf Coast University, Fort Myers, USA. His expertise includes phytomedicine, environmental toxicology, environmental pollution, ecology and human biomonitoring. He has won several research grants and he has several scores of publication in international journals. His earlier published work on medicinal use in treating breast cancer in Africa is a motivation for this study.

Cite this article: Agboola OO, Ijimbili SB, Ofuasia GO, Anejo-Okopi J, Wahedi JA, Olowoyo JO. Prostate Cancer: Causes and Medicinal Plants Used in Africa for Twenty Years (2001-2021). *Pharmacogn J.* 2022;14(6): 822-828.