



Review Article

A review of ten (10) edible plants in Nigeria as promising repositories of anticancer bioactivity: Implications for medical nutrition therapy

Adeoye Bayo Olufunso¹, Oyerinde Ayodeji Michael², Akano Oyedayo Phillips^{3*} , Olatinwo Goodness Olusayo³, Fadeyi Blessing⁴, Oyeleke Ibukun Oyebimpe⁴, Akinnawo Omowumi Olubukola¹, Aanu-Bakare Grace Olajumoke⁵, Adeshina Halliyah Celine¹, Adeoye Ayodeji David³, Adetunji Opeyemi Adebola⁶, Olatinwo Mercy Olajoju⁷, Ademoye Kehinde Aderonke⁸, Achor Corniluis Bangsi¹, Bolade Damilola Comfort¹, Adeyemi Funmilayo Elizabeth¹, Akin-Akanbi Funmilayo Bimbola⁹, Onyeyiriuche Chinecherem Chibundo¹ and Nwawubem Joy Chinas¹

1. Department of Biochemistry, School of Basic Medical Sciences, Babcock University, Ilisan-Remo, Ogun State, Nigeria.
2. Department of Forestry, Faculty of Agricultural Sciences, Federal University of Technology (FUTA), Ondo State, Nigeria.
3. Department of Physiology, School of Basic Medical Sciences, Babcock University, Ilisan-Remo, Ogun State, Nigeria.
4. Faculty of Pharmacy, Obafemi Awolowo University (O.A.U), Osun State, Nigeria.
5. Department of Food Science, University of Ibadan, Oyo State, Nigeria.
6. Department of Anatomy, School of Basic Medical Sciences, Babcock University, Ilisan-Remo, Ogun State, Nigeria.
7. Department of Biochemistry, Faculty of Basic Medical Sciences, University of Ibadan, Oyo State, Nigeria.
8. Department of Physiological Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria.
9. Department of Chemical Pathology, Faculty of Basic Clinical Sciences, Ladoko Akintola University of Technology, Ogbomosho, Oyo State, Nigeria.

Abstract

Globally and in Nigeria, cancer is among the most common diseases there are. It is among the main challenges facing health care as well. Native Southwestern Nigerian plant species have attracted a lot of interest recently as they could be able to combat cancer. These plants are not only edible but also rather remarkable. Extensive investigation of the scholarly literature has turned up many studies examining the chemical composition, biological activity, and traditional use of these plants. This research has helped us to realise, how vitally crucial these plants are in cancer treatment. The research provides a great deal of information on the many bioactive compounds that have been discovered, their modes of action in the body, and their relative importance in treating the most prevalent forms of cancer including breast, cervical, prostate, liver, and colon cancers. According to this research, Southwestern Nigeria has a lot of flora and some of them could be able to cure cancer. This emphasises the need for more research and investigation on how conventional medicine may be able to enhance present cancer therapies by means of natural healing approaches.

Article Information

Received: 27 August 2024
Revised: 22 October 2024
Accepted: 06 November 2024
Published: 14 November 2024

Academic Editor

Prof. Dr. Christian Celia

Corresponding Author

Prof. Dr. Akano Oyedayo Phillips
E-mail:
akanooy@babcock.edu.ng,
akanooyedayo@gmail.com
Tell: +2347035645623

Keywords

Cancer, edible plants, bioactive compounds, Southwestern Nigeria, medical nutrition therapy.

1. Introduction

Unregulated proliferation and distribution of abnormal cells define the multifarious group of diseases that is cancer [1]. Significant health problems arise from these unusual cells invading and upsetting nearby tissues and organs [2]. Depending on its location in the body, cancer may show differently; each kind has distinctive symptoms and calls for different treatment strategies. Usually resulting from a sequence of genetic changes or mutations upsetting the body's regular management of cellular development and division, cancer's emergence may be attributed to. Although the kind and other circumstances affect the causes of cancer, there are some shared characteristics of this illness. The quick multiplication of cells, evasion of the body's immune system, invasion into surrounding tissues, metastases to far-off organs, and encouragement of blood vessel development to support tumour growth constitute the many causes of cancer [3]. Rising as a major global concern, cancer seriously compromises healthcare systems all around. In this fight, Nigeria is setting the example. It is important to note that Nigeria has an estimated yearly cancer death count of 70,327 and 115,950 new cases. The degree of cancer cases calls for the use of effective policies to fight this already common disease, the second main cause of death in the country. Given the frequency of breast, cervical, prostate, liver, and colorectal tumours in Nigeria, effective treatments within the healthcare system are very necessary. Natural products generated from traditional knowledge have rising potential to improve conventional cancer therapy [4-6]. Particularly edible ones, which show promise for cancer research, the area of southern Nigeria has a great richness of plant species [7-10]. This research focused on the possible therapeutic benefits of herbs, particularly their capacity to cure certain kinds of cancer in Nigeria [11]. Recent research [12-15] reveal that natural plant-derived alternative medicines are increasingly used in Nigeria. Particularly considering the restricted availability and great cost of conventional cancer treatment alternatives, these remedies have proven very popular as they are widely accessible and culturally appropriate. The area of southwest Nigeria is a rich ground for research as it is quite abundant in many different plant species [16, 13]. Renowned for its natural beauties, this region has a rich legacy deeply ingrained in traditional therapeutic techniques. There are presently quite high numbers of fatal cancer cases in Nigeria. As such, it is

important to investigate these plants' medical uses. Their bioactive substances show a broad spectrum of effects and might be investigated in cancer studies. These compounds have demonstrated the capacity to stop the development and dissemination of tumours, induce cell death, and interfere with the synthesis of blood vessels supporting tumour growth. The empirical facts of edible plants from Southwestern Nigeria to be strong regulators of the molecular events linked in the development of cancer is investigated in this work. We see the need to tackle the high cancer frequency in our country and want to take advantage of this chance to increase awareness among a bigger community. This project aims to increase medical nutrition treatment's use as a means of fighting cancer in Nigeria.

2. Materials and methods

A comprehensive literature search was conducted to support the review. Multiple electronic databases were utilized, including PubMed, Scopus, Web of Science, and Google Scholar. The search was limited to peer-reviewed articles published within the last 10 years to ensure the inclusion of recent findings. Relevant keywords such as "Cancer," "Edible Plants," "Bioactive Compounds," "Southwestern Nigeria," and "Medical Nutrition Therapy" were used in various combinations to identify studies focusing on the anticancer effects of the specified plants. The search results were screened for relevance, and articles that met the established inclusion criteria were selected for further analysis. A total of 103 journal articles were ultimately included in the review discussion. Table 1 summarises the ten plants, their bioactives and anticancer mechanisms.

3. Results and discussion

3.1. Anticancer bioactivity of edible plants in Nigeria

3.1.1. *Moringa oleifera*

Moringa oleifera, usually referred to as the drumstick tree, is a botanical species that possesses a wide range of therapeutic attributes. It is predominantly cultivated in the northern regions of Nigeria, particularly in Kano, Kaduna, Borno, and Katsina states, but is widely found and used in all parts of the country. *Moringa oleifera* extracts and phytochemicals, such as chlorogenic acid, quercetin, and ellagic acid, have demonstrated the ability to trigger apoptosis in many types of cancer cells, including those seen in breast, liver, and prostate cancer.

Table 1. Anticancer mechanisms of the edible Nigerian plants

Sn.	Scientific Name	Common Name(s)	Family	Part of Plant Used	Bioactive Compounds	Anticancer Mechanism	Ref.
1	<i>Moringa oleifera</i>	Moringa, Ewele, Odudu oyibo, Barambo Lemongrass,	Moringaceae	Leaves, Seeds	Alkaloids, Saponins, Flavanoids, Terpinoids, Phenols, Glycosides and Phytosteroids etc	Downregulating apoptosis, cell cycle arrest, angiogenesis, metastasis, and inflammation.	[17-19]
2	<i>Cymbopogon citratus</i>	Koko oba, Achara, Tsauro	Poaceae	Leaves	isoneural, isogeraniol, geraniol, geranyl acetate, citronellal, citronellol, germacrene-D, and elemol etc	Curtails apoptosis, promotes cell cycle arrest, and inhibits angiogenesis in cancer cell lines.	[20--22]
3	<i>Phoenix dactylifera</i>	Date palm, Ojo-ope, Dabino	Areaceae	Fruits	phenolic acids, carotenoids, flavonoids, polyphenols, and phytosterols etc	Suppresses cancer cell proliferation, induces apoptosis, and inhibits angiogenesis.	[23-26]
4	<i>Ocimum gratissimum</i>	Scent leaf, Effirin, Nchanwu, Daidoya	Lamiaceae	Leaves	alkaloids, saponins, tannins, phlobatannins, glycosides, phenols, anthraquinones, flavonoids, and terpenoids etc	Inhibits cancer features like apoptosis and angiogenesis.	[27-29]
5	<i>Telfairia occidentalis</i>	Fluted pumpkin, Ikong-ubong, Ugu	Cucurbitaceae	Leaves, Seeds	Tannin, cardiac glycoside, and flavonoids etc	Contains various phytochemicals such as phenolic compounds, flavonoids, phytosterols, tannins, saponins, chlorophyll, and glycosides. Exhibits antioxidant properties, effectively suppresses oxidative bursts, and demonstrates anti-inflammatory efficacy, potentially reducing cancer risk associated with chronic inflammation.	[30-33]
6	<i>Ceratonia siliqua</i>	Carob	Fabaceae	Pods	galactomannan, β -sitosterol, unsaturated fatty acids, cyclitols etc	Induces apoptosis, inhibits angiogenesis, and interacts with cancer markers like matrix metalloproteinases (MMPs). Decreases expression of oncogenes like Bcl-2 and c-Myc.	[34-36]
7	<i>Colocasia esculenta</i>	Taro, Koko Ghana	Araceae	Corms	β -carotene, apigenin, luteolin, chrysoeriol, and diosmetin etc	Triggers cell cycle arrest and apoptosis.	[37-42]

Table 1. (Continued)

Sn.	Scientific Name	Common Name(s)	Family	Part of Plant Used	Bioactive Compounds	Anticancer Mechanism	Ref.
8	<i>Persea americana</i>	Avocado	Lauraceae	Fruit	hydroxycinnamic acids, hydroxybenzoic acids, flavonoids, proanthocyanins, acetogenins, phytosterols, carotenoids and alkaloids etc	Induces apoptosis, inhibits inflammation, and possesses antioxidant properties. Inhibits pro-inflammatory cytokines and enzymes.	[43-47]
9	<i>Musa paradisiaca</i>	Banana, Ogede, Unere, Ayama	Musaceae	Fruits	anthocyanins, flavonoids, anthraquinones, and phlorotannins etc	Contains compounds that modulate cancer development and progression, inhibiting PI3K/Akt pathways and activating immune cells. Possesses anti-proliferative and anti-metastatic properties.	[48-50]
10	<i>Annona muricata</i>	Soursop, Apekan	Annonaceae	Fruit	acetogenins, alkaloids, phenolic compounds, essential oils, cyclopeptides, carotenoids, amino acids, anthocyanins, vitamins etc	Causes apoptosis in cancer cells, inhibits angiogenesis, and possesses antioxidant properties. Prevents DNA damage and stimulates the immune system to fight cancer.	[51-54]

The apoptotic effects are achieved by modulating crucial signalling pathways, including the suppression of NF-κB, MAPK, and PI3K/Akt pathways [17]. Phytochemicals found in *Moringa oleifera* have been shown to cause cancer cells to stop progressing through the cell cycle, specifically in the G1 and G2/M stages [18]. The cell cycle arrest is accompanied by alterations in the expression of cell cycle regulatory proteins, including cyclin-dependent kinases (CDKs) and their inhibitors [19].

3.1.2. *Cymbopogon citratus*

Cymbopogon citratus, often referred to as lemongrass, is a medicinal plant that exhibits a diverse array of pharmacological activity, notably including its ability to combat cancer. It is predominantly cultivated in the southern regions of Nigeria, especially in states like Ogun, Oyo, and Ekiti, but is widely found and used in all parts of the country. Research [21] demonstrates that *Cymbopogon citratus* has the ability to inhibit cancer development by affecting different

aspects of the process, such as programmed cell death, halting the cell cycle, and controlling the formation of new blood vessels. *Cymbopogon citratus* has demonstrated the ability to trigger programmed cell death (apoptosis) in many types of cancer cells, such as those found in the breast, prostate, and colon. This is achieved by activating caspases, increasing the ratio of Bax to Bcl-2 proteins, and reducing the expression of anti-apoptotic proteins [20]. The apoptotic effects can also occur by interfering with mitochondrial membrane function and regulating tumour suppressor genes and apoptosis-related enzymes, such as the Fas/FasL signalling pathway [21]. Cancer is characterized by the disruption of the normal cell cycle. *Cymbopogon citratus* has demonstrated the ability to halt the cell cycle in the G0/G1 phase in different types of cancer cells, including those found in breast, prostate, and lung cancer. This is achieved by increasing the production of cell cycle regulatory proteins, such as p21 and p27,

while reducing the levels of cyclins and cyclin-dependent kinases (CDKs) [22]. *Cymbopogon citratus* has demonstrated the ability to hinder the formation of new blood vessels in different types of cancer cells, such as those seen in breast and lung cancer. This is achieved by reducing the production of vascular endothelial growth factor (VEGF) and matrix metalloproteinases (MMPs), as reported by Mukhtar et al. in 2023. Furthermore, studies have demonstrated that *Cymbopogon citratus* can augment the effectiveness of standard anticancer medications, such as doxorubicin and cisplatin, by intensifying their ability to kill cancer cells and diminishing their adverse effects [20].

3.1.3. *Phoenix dactylifera*

Phoenix dactylifera, commonly known as the date palm, has been well-studied for its potent anti-cancer activities towards various cancers. It is predominantly cultivated in the northern regions of Nigeria, especially in states like Sokoto, Kano, and Jigawa. Studies on this plant showed that its extracts, mainly the seed extracts, exhibited significant cytotoxic activity toward breast cancer cell lines such as MDA-MB-231 and MCF-7 [23]. The primary mechanism of action of anticancer therapy is through induction of programmed cell death or apoptosis via the caspase-3-dependent pathway. Caspase-3 activation is a major apoptotic inducer, leading to programmed cell death in the cancer cells. Bioactive chemicals present in *Phoenix dactylifera* have the potential to fight prostate and pancreatic cancer cells. These anti-cancer effects of the date palm can be attributed to its potent antioxidant properties that have been shown to effectively mitigate oxidative stress, one of the well-known determinants for cancer progression. Phenolic compounds from date palm extracts could, more importantly, impair cancer cell proliferation and induce apoptosis, hence efficiently blocking tumor growth and metastasis [24].

Phoenix dactylifera seed extracts are studied on the liver cancer cell lines, HepG2 cells. Date palm extracts, for their anticancer activity against several cancer cell lines, have also been observed to induce apoptosis in the case of breast cancer. This shows the diverse potential of date palm extracts in the fight against cancer [25]. The constituents of *Phoenix dactylifera* are

found to exert an anti-proliferative effect on colorectal cancer cells. The process involves the regulation of gut microbiota and its bacterial metabolites, which can influence the growth of colon cancer cells. Polyphenols in date palms can modify the gut microbial profile, reducing cancer cell viability. *Phoenix dactylifera* has several anticancer activities. It induces apoptosis, cell cycle arrest, and a decrease in the count of proliferating cells. There are multiple investigations to support this finding. In one comprehensive study, it is postulated that the effects are mediated through the regulation of major cellular signaling pathways, including those of NF- κ B, MAPK, and PI3K/Akt, which have all been closely associated with the pathogenesis and progression of cancer [26].

3.1.4. *Ocimum gratissimum*

This has been intensely studied for its anti-cancer potential on various cancer models and focused studies on gastric cancer and breast cancer. It is mainly grown in the southern regions of Nigeria, especially in Ondo, Edo, and Delta states, but its use and presence extend across the entire country. A study using gastric cancer cells found that the extract of the plant, *Ocimum gratissimum* OGE in a very effective manner reduced the survival of these cancerous cells by inducing apoptosis. OGE led to apoptosis through the accumulation of reactive oxygen species (ROS) and proteolytic cleavage of poly-ADP-ribose polymerase (PARP) and caspase-3). OGE was also observed to inhibit the ERK1/2 pathway but activate stress-stimulated kinase p38 in the gastric cancer model, contributing to its anticancer properties [27]. The study conducted on breast cancer indicated that OGE exerts effective cytostatic effects on cell growth, migration, and anchorage-independent development of breast cancer cells through the hydrophobic (HB) and hydrophilic (HL) fractions. More particularly, the OGE and its HL fraction were determined to inhibit motility and invasion of breast cancer cells through the suppression of matrix metalloproteinase-activities (MMP-2 and MMP-9), as reported by Nangia-Makker et al. [28]. The aqueous extract of *Ocimum gratissimum* was also determined to markedly block growth, migration, anchorage-independent growth, COX-2

protein activation, as well as three-dimensional growth and morphogenesis of breast cancer cells [29].

3.1.5. *Telfairia occidentalis*

Telfairia occidentalis is a green vegetable commonly consumed in many parts of Africa, especially southwest Nigeria. It is primarily cultivated in the southern regions of Nigeria, particularly in states like Delta, Edo, and Rivers, but it is also found and utilized throughout the country. Leaves and seeds of *Telfairia occidentalis* are rich in various groups of phytochemicals known to exert several health-beneficial effects. Among them are phenolic compounds, flavonoids, phytosterols, tannins, saponins, chlorophyll, and glycosides [30]. These chemicals are known for their antioxidant properties, which play an essential role in preventing cancer. *Telfairia occidentalis* contains antioxidants that help in the removal of free radicals and the protection of cells from oxidative stress, which is known to be one of the causes of cancer [31]. The raw extract of the seed, for instance, exhibited anti-cancer activities, ensuring the effective suppression of oxidative burst activity in both whole blood and isolated cells. The extracts of *T. occidentalis* effectively suppressed the activity of oxidative bursts in whole blood, isolated polymorphonuclear cells (PMNs), and mononuclear cells (MNCs). The extracts exhibited considerable anti-inflammatory efficacy against egg albumin and xylene-induced oedema [32]. Chronic inflammation is a well-established condition that predisposes the body to cancer. *Telfairia occidentalis* has been proven to bear anti-inflammatory effects that could help reduce the risk of cancer. The leaf extract has been shown to significantly reduce inflammation in various experimental models. This could prove beneficial in avoiding the development of cancer associated with inflammation [33].

3.1.6. *Ceratonia siliqua*

Ceratonia siliqua, commonly known as carob, is a plant whose anticancer potential has been extensively studied and described. It is mainly found in the northern regions of Nigeria, particularly in Sokoto and Kebbi states. Extracts from its leaves, seeds, and pods have proved to be very effective in many models of cancer. The high content of phenolic compounds, flavonoids, and tannins in carob

contributes to its potent anti-oxidant and anti-inflammatory effects. These characteristics help to reduce oxidative stress and inflammation, which are well-known to be related to cancer pathogenesis. A polyphenolic extract from the leaves of carob can bring about caspase-3 activation and the modulation of apoptotic proteins to cause the occurrence of apoptosis in colon cancer cells [34]. Carob pulp has cytotoxic effects against prostate, liver, colon, and lung cancer cell lines through the loss of mitochondrial membrane potential and activation of caspase pathways. Carob extracts can also arrest the cell cycle. CSEE induced G1 phase arrest in breast cancer cells; thus, it inhibited the growth of the same. The polyphenolic chemicals of carob also blunt some critical signaling pathways. This includes NF- κ B and PI3K/Akt, which are essential for the growth and development of cancer cells and blood vessels. The methanolic extract from carob pods alleviates doxorubicin-induced nephrotoxicity by its antioxidant and anti-inflammatory properties, thus potentiating its anticancer benefits [35]. Carob extracts were shown to act on specific pathways like Keap-1/Nrf2 and NF- κ B, which causes an inhibitory effect on the growth, invasion, and metastasis of the tumor. This only emphasizes carob as a potential natural and effective anticancer drug [36].

3.1.7. *Colocasia esculenta*

Taro, commonly known as *Colocasia esculenta*, is a tropical plant grown for human use as its corms and leaves are starchy and traditionally substantial. It is predominantly cultivated in the southern regions of Nigeria, especially in states like Akwa Ibom, Cross River, and Rivers. In addition, it was used earlier for medicinal purposes, especially in managing cancer [37]. Taro exhibits various mechanisms that explain its anti-cancer properties, like the ability to induce programmed cell death (apoptosis), inhibit excessive cell growth and movement (migration), and target of CSCs; modulate the immune system; antioxidant and anti-inflammatory activities, and sensitize chemotherapy to exert its effects. Thus, data available so far disclose that Taro could be a natural source for developing agents against cancer [38]. Taro extracts cause apoptosis in programmed cell death in cells of breast, ovary, gastric, and colon cancer. This is

viewed by regulating essential signaling pathways that include activation of caspases, disruption of mitochondrial membrane potential, and control of the pro-apoptotic and anti-apoptotic proteins [37]. Besides, these extracts suppress cancer cell growth and movement through the blocking of pathways that are essential in cell growth, survival, and mobility signaling, such as COX-1/COX-2/PGE2 [39]. Taro acts directly on breast CSCs to suppress their capacity for tumor development and to block the activity of aldehyde dehydrogenase, a critical factor in evading tumor recurrence and metastasis [40]. Taro stimulates immune-modulating activity that augments the responsiveness of the organism's immune response against cancer cells. This involves activating hematopoietic cells, such as B lymphocytes, for their anti-metastatic activity [41, 42]. The root vegetable taro contains a high quantity of antioxidants and anti-inflammatory substances like flavonoids and phenolic acids, which decrease oxidative stress and inflammation in the body. By so doing, taro can help prevent cancer and make traditional ways of dealing with the disease more effective. Taro extracts have also managed to potentiate the activity of chemotherapeutic drugs, such as cyclophosphamide, through improved bioavailability and reduced drug toxicity in the body.

3.1.8. *Persea americana*

The *Persea americana*, known scientifically, is a fruit that has taken much attention in scientific research about its putative effects on carcinogenesis [43]. It is primarily grown in the southern regions of Nigeria, particularly in states such as Edo, Delta, and Ogun, but it is also found and utilized in various parts of the country. The extract from this fruit, particularly its seeds and leaves, have been shown to elicit programmed cell death and apoptosis from various types of cancer cells. Some of the cancers affected include those affecting the breasts, prostate, and colorectal cancers. This is achieved through activating essential signaling pathways: caspase, disruption of the mitochondrial membrane potential, and modulation of pro-/anti-apoptotic proteins [44]. The extracts explained in the paper produce cell cycle arrest, mainly at the S and G2/M phases, in various ovarian, lung, breast, and colorectal cancer cells. For

example, arrest, in this case, refers to the arrest of cell division and growth of the cancer cells involved [45]. Likewise, avocado extracts markedly prevent the proliferation and migration of cancer cells via the insufficiency of such cellular signaling pathways for growth, survival, and motility as NF- κ B, MAPK, and PI3K/Akt, among others [46]. The fruit contains antioxidant and anti-inflammatory compounds such as flavonoids, phenolic acids, and carotenoids. The compounds aid in reducing oxidative stress and inflammation, hence helping prevent the occurrence of cancer and improving the effectiveness of mainstream treatment [47]. Avocado extracts hold the potential to block the development, invasion, and spread of tumors and to heighten the sensitivity of cancer cells to chemotherapeutic drugs. This is achieved through the regulation of NF- κ B, MAPK, PI3K/Akt, and COX-1/COX-2/PGE2.

3.1.9. *Musa paradisiaca*

Musa paradisiaca, commonly known as banana, is a fruit eaten by people in all parts of the world. Bananas have been shown to possess anti-carcinogenic effects. *M. paradisiaca* is predominantly cultivated in the southern regions of Nigeria, especially in states like Cross River, Akwa Ibom, and Ogun, but it is widely found and used throughout the country. Anti-cancerous activity of the ethyl acetate extract from *Musa paradisiaca* has been exhibited against cervical carcinoma (HeLa) and malignant *M. paradisiaca* melanoma cell lines by inducing apoptosis in these cell lines [48]—the ethanolic crude flower extracts of *M. paradisiaca* cytotoxic activity against breast cancer cell lines, MDA-MB-231, and MCF-7 was shown in *M. paradisiaca* [49]. Furthermore, the extracts of *M. paradisiaca* flowers were effective at reducing tumor growth and volume. The morphological study on histopathology showed that the floral extracts could efficiently reestablish damage in tissue morphology compared to untreated groups. Another study also found that the methyl angolensate (MAL) molecule isolated from could arrest the cell cycle at the G2/M phase in HeLa cells. Floral extracts of *Musa paradisiaca* showed potent anti-proliferative and anti-migratory effects against breast cancer cells (MDA-MB-231 and MCF-7) that play crucial roles in the growth of tumors and their metastasis—the molecule MAL

obtained from *M. Extract* of *M. paradisiaca* has been demonstrated to induce programmed cell death (apoptosis) in HeLa cells. This is mediated through suppression in the production of phosphorylated Akt (pAkt), an antiapoptotic protein, via the PI3K/Akt signaling pathway. MAL has been reported to inhibit the phosphorylation of ERK1/2 and JNK in HeLa cells [50].

3.1.10. *Annona muricata*

Recent studies have demonstrated the anti-carcinogenic activity of *Annona muricata* through different mechanisms. *A. muricata* is primarily grown in the southern regions of Nigeria, particularly in states like Ondo, Ekiti, and Lagos, but it is also found and utilized across various parts of the country. Extracts and chemicals from *A. muricata*, especially annonacin, have been shown to induce apoptosis in most types of cancer cells, including those found in the breast, lung, liver, prostate, and blood malignancies [51]. The induction of such vital signaling pathways includes the activation of caspases, modulation of mitochondrial membrane potential alteration, and the induction of pro-apoptotic (e.g., Bax) and anti-apoptotic (e.g., Bcl-2) proteins [52]. Among this class of acetogenins from *A. muricata*, annonacin is the most potent inhibitor of the mitochondrial electron transport chain. This inhibition leads to ATP depletion and an energy crisis in the cancer cells. This approach shows remarkable effectiveness against cancer cells that proliferate fast, as they have a high energy demand [53]. Cell cycle arrest in a plethora of cancer cells is induced by the extracts from *A. muricata*, specifically in the G0/G1 and G2/M phases. The cellular arrest of the cell cycle is concomitant with alteration in the expression of cell cycle regulatory proteins such as cyclins and cyclin-dependent kinases (CDKs) [53]. *A. muricata* extracts have shown potent inhibitory effects on the proliferation and migration of cancer cells, both processes being necessary for the growth and metastasis of tumors. Such effects are mediated by altering signaling pathways involved in cell growth, survival, and motility, including the NF- κ B, MAPK, and PI3K/Akt pathways, among others [54].

4. Conclusion and future direction

Research into the anticancer actions of several edible

plants demonstrates excellent potential for natural chemicals in the treatment of cancer. The investigations reveal the wide variety of bioactive chemicals these plants possess, which effectuate many strategies to combat cancer through cell death induction, inhibition of growth and migration, cessation of cell division, and modulation of crucial signal pathways. The prospects of therapeutic diet therapeutic utility in these Indigenous edible plants of Southwestern Nigeria are high, and rich in flavonoids, phenolic acids, and other bioactive compounds. Beyond providing key nutrients, they also possess potent antioxidant, anti-inflammatory, and anticancer properties. The inclusion of these indigenous foods in diet therapy may increase the potency of conventional cancer treatments, reduce the side effects, and improve the quality of health outcomes. Hence, promotion of the use and further study of these indigenous plants may be a crucial key to establishing effective dietary strategies for cancer prevention, stopping the process of carcinogenesis, or designing some cost-effective and easily accessible treatments for cancer in regions where medical facilities are a luxury.

Future research should focus on conducting comprehensive phytochemical analyses of the selected edible plants to isolate and identify specific bioactive compounds responsible for their anticancer properties. Additionally, clinical studies are needed to evaluate the efficacy and safety of these plants as complementary treatments in cancer therapy, potentially leading to innovative and sustainable treatment options.

Authors' contributions

Conceptualization, A.B.O., O.A.M.; Literature search and data extraction, O.G.O., F.B.; Organized and synthesized the relevant literature, O.I.O., A.O.O.; Critical analysis and interpretation of the findings, A.B.G.O., A.H.C.; Drafted the initial manuscript, A.A.D., A.O.P.; Substantial revisions and edits, A.O.A., O.M.O., A.K.A.; Formatting and proofreading, A.C.B., B.D.C.; Final manuscript revisions and ensured consistency across sections. A.F.E., A.A.F.B., O.C.C., N.J.C.

Acknowledgements

The authors don't have anything to acknowledge.

Funding

The authors did not receive any funding for this review.

Availability of data and materials

All relevant data are within the paper and its supporting information files. Additional data will be made available on request according to the journal policy.

Conflicts of interest

The authors declare that there is no known conflict of interest.

References

- Brown, J.S.; Amend, S.R.; Austin, R.H.; Gatenby, R.A.; Hammarlund, E.U.; Pienta, K.J. Updating the definition of cancer. *Mol. Cancer Res.* 2023, 21(11), 1142–1147. <https://doi.org/10.1158/1541-7786.MCR-23-0411>
- Upadhyay, A. Cancer: An unknown territory; rethinking before going ahead. *Gen. Diseases.* 2020, 8(5), 655–661. <https://doi.org/10.1016/j.gendis.2020.09.002>
- Mattiuzzi, C.; Lippi, G. Current cancer epidemiology. *J. Epidemiol. Glob. Health.* 2019, 9(4), 217–222. <https://doi.org/10.2991/jegh.k.191008.001>
- Adeoye, B.; A.; Iyanda, A.; Daniyan, M.; Ayodeji, A.; Michael, O.; Olatinwo, G. Botanical and Bioactive Markers of Nigerian Bitter Honey. *Trop. J. Nat. Prod. Res.* 2022, 6(11), 1848–1853.
- Adeoye, B.; Ayobola, I.; Daniyan, M.; Victor, O, E.; David, A.; Abijo, A.; Bimbola, A.-A. Ameliorative effects of Nigerian bitter honey on streptozotocin-induced hepatorenal damage in Wistar rats. *J. Krishna Inst. Med. Sci. Univ.* 2022, 11, 65–76.
- Adewole, A.; Shittu, M.; Adeoye, B. Additive effect of polyalthia longifolia leaf meal on growth performance and blood profile of growing rabbits (*Oryctolagus cuniculus*). 2023, 10, 412–417.
- Adeoye, B.; Iyanda, A.; Michael, O.; Oyebimpe, O.; Fadeyi, B. Inhibitory effects of Nigerian Sweet and Bitter Honey on Pancreatic Alpha Amylase Activity. *Niger. J. Nutr. Sci.* 2022, 43, 19–24.
- Adeoye, A.D.; Oladele, A.; Oyedayo, A.; Abijo, A.; Adeoye, B.; Oyebanjo, O.; Adebola, A. Neuroprotective Effects of *Garcinia kola* ethanol Seed extract on haloperidol-induced catalepsy in mice. *Trop. J. Nat. Prod. Res.* 2022, 6, 281–286.
- Olajide, L.; Adeoye B.; A.; Amadi, N.; Olajide, O.; Adetayo, M.; & Ogunbiyi, B. Costus afer ker gawl rhizome ethyl acetate fraction mitigated diclofenac-induced renal toxicity in male wistar rats by suppressing oxidative stress. *World Journal of Advanced Healthcare Research*, 2023, 7 (12), 31-37.
- Oyerinde, M.; O.; Banji, O.; Adeoye, B.; A.; Abiodun, O.; Gbenga, O.; Adebola, J.; Bori, O.; Oluwamayowa, A.; O, A.; Damilola, A. Determination of nutrients, antinutrients and antioxidants concentrations in some edible forest vegetables in Ondo and Oyo State, South Western Nigeria. *Niger. J. Nutr. Sci.* 2023, 44, 212–222.
- Gaobotse, G.; Venkataraman, S.; Brown, P. D.; Masisi, K.; Kwape, T. E.; Nkwe, D.O.; Rantong, G.; Makhzoum, A. The use of African medicinal plants in cancer management. *Front. Pharmacol.* 2023, 14, 1122388. <https://doi.org/10.3389/fphar.2023.1122388>
- Adeoye, B.; Bangsi, A.; Oluwadunsin, A.; Fadeyi, B.; Oyeleke, I.; Olatinwo, G.; Ayodeji, A.; Adebola, A.; Akano, O.; Temitope, A.; Olajolu, O.; Sosimi, O.D. Heat shock proteins as guardians of proteostasis in non-communicable diseases. *Int. J. Med. Sci. Dent. Res.* 2024, 07(02), 41-55.
- Adetunji, A.; Adeoye, B.; Akano, O.; Ayodeji, A.; Adeogun, A.; Oluwadunsin, A.; Sunday, F.; Ogunsanya, S.; Linda, N.; Nwobi, J.; Oluwseun, O.; Bangsi, A.; Olatinwo, G.; Emmanuel, K.; Adetato, L.; Temitope, A.; Aderonke, A. Theobroma cacao Seed Extract Attenuates Reserpine-Induced Hematotoxicity and Stomach Tissue Distortions in Male Wistar Rats. *Int. Res. J. Med. Pharm. Sci.* 2024, 9(2), 23-37.
- Asiimwe, J.B.; Nagendrappa, P.B.; Atukunda, E.C.; Kamatenesi, M.M.; Nambozi, G.; Tolo, C.U.; Ogwang, P.E.; Sarki, A. M. Prevalence of the use of herbal medicines among patients with cancer: A systematic review and meta-analysis. *Evid. Based Complement. Altern. Med.* 2021, 9963038. <https://doi.org/10.1155/2021/9963038>
- Daniyan, M.; Asiyanbola, I.; Olufunso, A.; Oyemitan, I. Effects of the essential oil of dried fruits of piper Guineense (Piperaceae) on neurological syndromes associated with cerebral malaria in mice. *Universal Journal of Pharmaceutical Research.* 2023, 8(1), 61-68. <https://doi.org/10.22270/ujpr.v8i1.902>
- Adeoye, B.; Iyanda, A.; Daniyan, M.; Ayodeji, A.; Olajide, L.; Akinnawo, O.; Adebola, A.; Oluwaseun, O.; Olatinwo, M. Anti-dyslipidaemia and cardio-protective effects of nigerian bitter honey in streptozotocin induced diabetic rats. *Univers. J. Pharm. Res.* 2023, 8, 10–18. <https://doi.org/10.22270/ujpr.v8i2.920>

17. Zubairu, I.H.; Balogun, M.S. Population-based cancer registries in Nigeria and the national cancer control programme. *E-cancer*, 2023, 17, 1592. <https://doi.org/10.3332/ecancer.2023.1592>
18. Singh, J.; Gautam, D.N.S.; Sourav, S.; Sharma, R. Role of *Moringa oleifera* Lam. in cancer: Phytochemistry and pharmacological insights. *Food Front*. 2023, 4(1), 164–206. <https://doi.org/10.1002/fft2.181>
19. Sultan, R.; Ahmed, A.; Wei, L.; Saeed, H.; Islam, M.; Ishaq, M. The anticancer potential of chemical constituents of *Moringa oleifera* targeting CDK-2 inhibition in estrogen receptor positive breast cancer using *in-silico* and *in vitro* approaches. *BMC Complement. Med. Ther.* 2023, 23(1), 396. <https://doi.org/10.1186/s12906-023-04198-z>
20. Rojas-Armas, J. P.; Arroyo-Acevedo, J. L.; Palomino-Pacheco, M.; Herrera-Calderón, O.; Ortiz-Sánchez, J. M.; Rojas-Armas, A.; Calva, J.; Castro-Luna, A.; Hilario-Vargas, J. The essential oil of *Cymbopogon citratus* Stapf and Carvacrol: An approach of the antitumor effect on 7,12-dimethylbenz-[α]-anthracene (DMBA)-induced breast cancer in female rats. *Molecules*, 2020, 25(14), 3284. <https://doi.org/10.3390/molecules25143284>
21. Chen, Y.; Qiao, S.; Liu, H.; Xing, H.; Chen, P. Structural characterization and anti-breast cancer activity *in vitro* of a novel polysaccharide from *Cymbopogon citratus*. *Front. Nutr.* 2022, 9, 911838. <https://doi.org/10.3389/fnut.2022.911838>
22. Otto, T.; Sicinski P. Cell cycle proteins as promising targets in cancer therapy. *Nat Rev. Cancer*. 2017 17(2), 93-115. <https://doi.org/10.1038/nrc.2016.138>.
23. Khan, M.A.; Singh, R.; Siddiqui, S.; Ahmad, I.; Ahmad, R.; Upadhyay, S.; Barkat, Md. A.; Ali, A.M. A.; Zia, Q.; Srivastava, A.; Trivedi, A.; Husain, I.; Srivastava, A. N.; Mishra, D.P. Anticancer potential of *Phoenix dactylifera* L. seed extract in human cancer cells and pro-apoptotic effects mediated through caspase-3 dependent pathway in human breast cancer MDA-MB-231 cells: An *in vitro* and *in silico* investigation. *BMC Complement. Med. Ther.* 2022, 22(1), 68. <https://doi.org/10.1186/s12906-022-03533-0>
24. Ghazzawy, H.S.; Gouda, M.M.; Awad, N.S.; Al-Harbi, N.A.; Alqahtani, M.M.; Abdel-Salam, M.M.; Abdein, M.A.; Al-Sobeai, S.M.; Hamad, A.A.; Alsberi, H.M.; Gabr, G.A.; Hikal, D.M. Potential bioactivity of *Phoenix dactylifera* fruits, leaves, and seeds against prostate and pancreatic cancer cells. *Front. Nutr.* 2022, 9. <https://doi.org/10.3389/fnut.2022.998929>
25. Zein, N.; Elewa, Y.H.A.; Alruwaili, M.K.; Dewaard, M.; Alorabi, M.; Albogami, S.M.; Batiha, G.E.S.; Zahran, M.H. Barhi date (*Phoenix dactylifera*) extract ameliorates hepatocellular carcinoma in male rats. *Biomed. Pharmacother.* 2022, 156, 113976. <https://doi.org/10.1016/j.biopha.2022.113976>
26. Habib, H M.; El-Fakharany, E. M.; El-Gendi, H.; El-Ziney, M. G.; El-Yazbi, A. F.; Ibrahim, W.H. Palm fruit (*Phoenix dactylifera* L.) pollen extract inhibits cancer cell and enzyme activities and DNA and protein damage. *Nutrients*, 2023, 15(11), 2614. <https://doi.org/10.3390/nu15112614>
27. Sheu, M.J.; Tsai, J.N.; Tam, W.L.; Liu, J.Y.; Hsu, L.S. *Ocimum gratissimum* extract induces apoptosis in gastric cancer cells via modulation of reactive oxygen species and mitogen-activated protein kinase. *Curr. Top. Nutr. Res.* 2021, 19(4), 514–520.
28. Nangia-Makker, P.; Raz, T.; Tait, L.; Shekhar, M. P. V.; Li, H.; Balan, V.; Makker, H.; Fridman, R.; Maddipati, K.; Raz, A. *Ocimum gratissimum* retards breast cancer growth and progression and is a natural inhibitor of matrix metalloproteases. *Cancer Biol. Ther.* 2013, 14(5), 417–427. <https://doi.org/10.4161/cbt.23762>
29. Chen, H.M.; Lee, M.J.; Kuo, C.Y.; Tsai, P.L.; Liu, J.Y.; Kao, S.H. *Ocimum gratissimum* aqueous extract induces apoptotic signalling in lung adenocarcinoma cell A549. *Evid. Based Complement. Altern. Med.* 2011, 739093. <https://doi.org/10.1155/2011/739093>
30. Usunomena, U.; Egharevba, E. Phytochemical analysis, proximate and mineral composition and *in vitro* antioxidant activities in *Telfairia occidentalis* aqueous leaf extract. *J. Basic Appl. Sci.* 2014, 1(1), 74 – 87.
31. Osukoya, O.A.; Adegbenro, D.; Onikanni, S.A.; Ojo, O.A.; Onasanya, A. Antinociceptive and antioxidant activities of the methanolic extract of *Telfairia occidentalis* seeds. *Anc. Sci. Life*, 2016, 36(2), 98–103. https://doi.org/10.4103/asl.ASL_142_16
32. Okokon, J.; Farooq, A.; Choudhary, M.; Antia, B. Immunomodulatory, anticancer and anti-inflammatory activities of *Telfairia occidentalis* seed extract and fractions. *Int. J. Food Nutr. Saf.* 2012, 2, 72–85.
33. Akindele, A.J.; Oladimeji-Salami, J.A.; Usuwah, B.A. Antinociceptive and anti-inflammatory activities of *Telfairia occidentalis* hydroethanolic leaf extract (Cucurbitaceae). *J. Med. Food*, 2015, 18(10), 1157–1163. <https://doi.org/10.1089/jmf.2014.0146>
34. Dahmani, W.; Elaouni, N.; Abousalim, A.; Akissi, Z.L.E.; Legssyer, A.; Ziyat, A.; Sahpaz, S. Exploring carob (*Ceratonia siliqua* L.): A comprehensive assessment of its characteristics, ethnomedicinal uses, phytochemical aspects, and pharmacological activities. *Plants*, 2023, 12(18), Article 18. <https://doi.org/10.3390/plants12183303>

35. Elbouzidi, A.; Taibi, M.; Ouassou, H.; Ouahhoud, S.; Ou-Yahia, D.; Loukili, E. H.; Aherkou, M.; Mansouri, F.; Bencheikh, N.; Laaraj, S.; Bellaouchi, R.; Saalaoui, E.; Elfazazi, K.; Berrichi, A.; Abid, M.; & Addi, M. Exploring the Multi-Faceted Potential of Carob (*Ceratonia siliqua* var. *Rahma*) Leaves from Morocco: A Comprehensive Analysis of Polyphenols Profile, Antimicrobial Activity, Cytotoxicity against Breast Cancer Cell Lines, and Genotoxicity. *Pharmaceuticals*, 2023, 16(6), Article 6. <https://doi.org/10.3390/ph16060840>
36. Atta, A.H.; Atta, S.A.; Khattab, M.S.; ElAziz, T.H.A.; Mouneir, S.M.; Ibrahim, M.A.; Nasr, S.M.; Emam, S.R. *Ceratonia siliqua* pods (Carob) methanol extract alleviates doxorubicin-induced nephrotoxicity via antioxidant, anti-inflammatory and anti-apoptotic pathways in rats. *Environ. Sci. Poll. Res.* 2023, 30(35), 83421–83438. <https://doi.org/10.1007/s11356-023-28146-z>
37. Mitharwal, S.; Kumar, A.; Chauhan, K.; Taneja, N.K. Nutritional, phytochemical composition and potential health benefits of taro (*Colocasia esculenta* L.) leaves: A review. *Food Chem.* 2022, 383, 132406. <https://doi.org/10.1016/j.foodchem.2022.132406>
38. Baro, M.R.; Das, M.; Kalita, A.; Das, B.; Sarma, K. Exploring the anti-inflammatory potential of *Colocasia esculenta* root extract in in-vitro and in-vivo models of inflammation. *J. Ethnopharmacol.* 2023, 303, 116021. <https://doi.org/10.1016/j.jep.2022.116021>
39. Esposito, T.; Pisanti, S.; Mauro, L.; Mencherini, T.; Martinelli, R.; Aquino, R.P. Activity of *Colocasia esculenta* (Taro) corms against gastric adenocarcinoma cells: Chemical study and molecular characterization. *Int. J. Mol. Sci.* 2024, 25(1), Article 1. <https://doi.org/10.3390/ijms25010252>
40. Ribeiro Pereira, P.; Bertozzi De Aquino Mattos, É.; Nitzsche Teixeira Fernandes Corrêa, A.C.; Afonso Vericimo, M.; Margaret Flosi Paschoalin, V. Anticancer and Immunomodulatory Benefits of Taro (*Colocasia esculenta*) Corms, an Underexploited Tuber Crop. *Int. J. Mol. Sci.* 2020, 22(1), 265. <https://doi.org/10.3390/ijms22010265>
41. Kundu, N.; Ma, X.; Hoag, S.; Wang, F.; Ibrahim, A.; Godoy-Ruiz, R.; Weber, D. J.; Fulton, A.M. An extract of taro (*Colocasia esculenta*) mediates potent inhibitory actions on metastatic and cancer stem cells by tumor cell-autonomous and immune-dependent mechanisms. *Breast Cancer: Basic Clin. Res.* 2021, 15, 11782234211034937. <https://doi.org/10.1177/11782234211034937>
42. Park, H.R.; Lee, H.S.; Cho, S.Y.; Kim, Y.S.; Shin, K.-S. Anti-metastatic effect of polysaccharide isolated from *Colocasia esculenta* is exerted through immunostimulation. *Int. J. Mol. Med.* 2013 31(2), 361–368. <https://doi.org/10.3892/ijmm.2012.1224>
43. Collignon, T.; Webber, K.; Piasecki, J.; Rahman, A.; Mondal, A.; Barbalho, S.; Bishayee, A. Avocado (*Persea americana* Mill) and its phytoconstituents: Potential for cancer prevention and intervention. *Crit. Rev. Food Sci. Nutr.* 2023, 1–21. <https://doi.org/10.1080/10408398.2023.2260474>
44. Bhuyan, D. J.; Alsherbiny, M. A.; Perera, S.; Low, M.; Basu, A.; Devi, O. A.; Barooah, M. S.; Li, C. G.; Papoutsis, K. The odyssey of bioactive compounds in avocado (*Persea americana*) and their health benefits. *Antioxidants*, 2019, 8(10), Article 10. <https://doi.org/10.3390/antiox8100426>
45. Falodun, A.; Engel, N.; Kragl, U.; Nebe, B.; Langer, P. Novel anticancer alkene lactone from *Persea americana*. *Pharmaceutical Biology*, 2013, 51(6), 700–706. <https://doi.org/10.3109/13880209.2013.764326>
46. Ahmed, O.M.; Fahim, H.I.; Mohamed, E. E.; Abdel-Moneim, A. Protective effects of *Persea americana* fruit and seed extracts against chemically induced liver cancer in rats by enhancing their antioxidant, anti-inflammatory, and apoptotic activities. *Environ. Sci. Poll. Res. Int.* 2022, 29(29), 43858–43873. <https://doi.org/10.1007/s11356-022-18902-y>
47. Dabas, D.; Elias, R. J.; Ziegler, G. R.; Lambert, J. D. In vitro antioxidant and cancer inhibitory activity of a colored avocado seed extract. *Int. J. Food Sci.* 2019, 6509421. <https://doi.org/10.1155/2019/6509421>
48. Nadumane, V.K.; Timsina, B. Anti-cancer potential of banana flower extract: An in vitro study. *Bangladesh J. Pharmacol.* 2014, 9(4), 628-35, <https://doi.org/10.3329/bjp.v9i4.20610>.
49. Lavudi, K.; S, H.; Hemalatha S.; Kokkanti, R.R.; Harika, G.V.S.; Patnaik, S.; Penchalaneni, J. Anti-tumour efficacy of *Musa paradisiaca* flower extracts on DMBA induced Mammary carcinogenesis in female Wistar rats 2022, 502223, bioRxiv. <https://doi.org/10.1101/2022.08.27.502223>
50. Mondal, A.; Banerjee, S.; Bose, S.; Das, P.P.; Sandberg, E.N.; Atanasov, A.G.; Bishayee, A. Cancer preventive and therapeutic potential of banana and its bioactive constituents: A systematic, comprehensive, and mechanistic review. *Front. Oncol.* 2021, 11, Article 697143. <https://doi.org/10.3389/fonc.2021.697143>
51. Piña-Sánchez, P.; Chávez-González, A.; Ruiz-Tachiquín, M.; Vadillo, E.; Monroy-García, A.; Montesinos, J.J.; Grajales, R.; Gutiérrez de la Barrera, M.; Mayani, H. Cancer Biology, epidemiology, and treatment in the 21st century: current status and future challenges from a biomedical perspective. *Cancer*

- Control: J. Moffitt Cancer Centr. 2021, 28, 10732748211038735.
<https://doi.org/10.1177/10732748211038735>
52. Moghadamtousi, S.Z.; Kadir, H.A.; Paydar, M.; Rouhollahi, E.; Karimian, H. *Annona muricata* leaves induced apoptosis in A549 cells through mitochondrial-mediated pathway and involvement of NF- κ B. *BMC Complement. Altern. Med.* 2014, 14(1), 299. <https://doi.org/10.1186/1472-6882-14-299>
 53. Cassé, C. Molecular mechanisms of *Annona muricata* anti-proliferative/anti-cancer properties. *Biomed. Gen. Genom.* 2018, 4(1), 1-4. <https://doi.org/10.15761/BGG.1000138>
 54. Ilango, S.; Sahoo, D.K.; Paital, B.; Kathirvel, K.; Gabriel, J.I.; Subramaniam, K.; Jayachandran, P.; Dash, R.K.; Hati, A. K.; Behera, T.R.; Mishra, P.; Nirmaladevi, R. A review on *Annona muricata* and Its anticancer activity. *Cancers.* 2022, 14(18), Article 18. <https://doi.org/10.3390/cancers14184539>
 55. Abotaleb, M.; Samuel, S. M.; Varghese, E.; Varghese, S.; Kubatka, P.; Liskova, A.; Büsselberg, D. Flavonoids in cancer and apoptosis. *Cancers*, 2018, 11(1), 28. <https://doi.org/10.3390/cancers11010028>
 56. Ahmad, R.; Alqathama, A.; Aldholmi, M.; Riaz, M.; Mukhtar, M.H.; Aljishi, F.; Althomali, E.; Alamer, M.A.; Alsulaiman, M.; Ayashy, A.; Alshowaiqi, M. Biological screening of *Glycyrrhiza glabra* L. from different origins for antidiabetic and anticancer activity. *Pharmaceuticals.* 2023, 16(1), Article 1. <https://doi.org/10.3390/ph16010007>
 57. Alkhalaf, M.; Alansari, W.; Ibrahim, E.; Elhalwagy, M. Anti-oxidant, anti-inflammatory and anti-cancer activities of avocado (*Persea americana*) fruit and seed extract. *J. King Saud Univ. Sci.* 2018, 31 (4). 1358-1362. <https://doi.org/10.1016/j.jksus.2018.10.010>
 58. Arafa, E.S.A.; Shurrab, N.T.; Buabeid, M.A. Therapeutic implications of a polymethoxylated flavone, tangeretin, in the management of cancer via modulation of different molecular pathways. *Adv. Pharm. Pharm. Sci.* 2021, 4709818. <https://doi.org/10.1155/2021/4709818>
 59. Asiyabola, I.; Daniyan, M.; Opopgen, T.; Olayemi, I.; Olufunso, A.; Victor O.E.; Oyemitan, I. Neuroprotective potentials of the essential oil of *Curcuma aeruginosa* Roxburg rhizomes in mice with cerebral malaria. *Phytomed. Plus*, 2024, 4, 100581. <https://doi.org/10.1016/j.phyplu.2024.100581>
 60. Ayodipupo, B.; Ifeolu, A.; Otunba, A.A.; Ebenezer A.G.; Babalola, O.; Nwufo, C. Therapeutic benefits of *Carica papaya*: A review on its pharmacological activities and characterization of papain. *Arab. J. Chem.* 2024, 17(1), 105369. <https://doi.org/10.1016/j.arabjc.2023.105369>
 61. Bode, A.M.; Dong, Z. Chemopreventive effects of licorice and its components. *Curr. Pharm. Repor.*, 2015, 1(1), 60-71. <https://doi.org/10.1007/s40495-014-0015-5>
 62. Castro-Vazquez, L.; Alañón, M. E.; Rodríguez-Robledo, V.; Pérez-Coello, M. S.; Hermosín-Gutierrez, I.; Díaz-Maroto, M. C.; Jordán, J.; Galindo, M. F.; Arroyo-Jiménez, M. Bioactive Flavonoids, Antioxidant Behaviour, and Cytoprotective Effects of Dried Grapefruit Peels (*Citrus paradisi* Macf.). *Oxidat. Med. Cell. Longev.* 2016, 8915729. <https://doi.org/10.1155/2016/8915729>
 63. Cirmi, S.; Maugeri, A.; Ferlazzo, N.; Gangemi, S.; Calapai, G.; Schumacher, U.; Navarra, M. Anticancer potential of citrus juices and their extracts: A systematic review of both preclinical and clinical studies. *Front. Pharm.* 2017, 8, 420. <https://doi.org/10.3389/fphar.2017.00420>
 64. Devanesan, S.; Jayamala, M.; AlSalhi, M.S.; Umamaheshwari, S.; Ranjitsingh, A.J.A. Antimicrobial and anticancer properties of *Carica papaya* leaves derived di-methyl flubendazole mediated silver nanoparticles. *J. Infect. Public Health.* 2021, 14(5), 577-587. <https://doi.org/10.1016/j.jiph.2021.02.004>
 65. Eid, N.; Enani, S.; Walton, G.; Corona, G.; Costabile, A.; Gibson, G.; Rowland, I.; Spencer, J. The impact of date palm fruits and their component polyphenols, on gut microbial ecology, bacterial metabolites and colon cancer cell proliferation. *J. Nutri. Sci.* 2014, 3, e46. <https://doi.org/10.1017/jns.2014.16>
 66. El-Zeftawy, M.; Ghareeb, D. Pharmacological bioactivity of *Ceratonia siliqua* pulp extract: In vitro screening and molecular docking analysis, implication of Keap-1/Nrf2/NF- κ B pathway. *Sci. Repor.* 2023, 13(1), 12209. <https://doi.org/10.1038/s41598-023-39034-4>
 67. Ezenkwa, U.S.; Imam, M.I.; Yusuf, M.O.; Giade, A. S.; Imoudu, I.A.M.; Katagum, D.A.; Audu, B.M. Cancer histotypes and trends in Azare, Northeast Nigeria: Impact of diagnostic support disparity in data reporting. *E-cancer.* 2023, 17, 1538. <https://doi.org/10.3332/ecancer.2023.1538>
 68. Ferdaus, M.J.; Chukwu-Munsen, E.; Foguel, A.; da Silva, R.C. Taro roots: An underexploited root crop. *Nutrients.* 2023, 15(15), 3337. <https://doi.org/10.3390/nu15153337>
 69. Guran, K.; Buzatu, R.; Pinzaru, I.; Boruga, M.; Marcovici, I.; Coricovac, D.; Avram, S.; Poenaru, M.; Susan, M.; Susan, R.; Radu, D.; Dehelean, C.A. In vitro pharmaco-toxicological characterization of *Melissa officinalis* total extract using oral, pharynx and

- colorectal carcinoma cell lines. *Processes*. 2021. 9(5), Article 5. <https://doi.org/10.3390/pr9050850>.
70. Hasan, M.R.; Alotaibi, B.S.; Althafar, Z.M.; Mujamammi, A. H.; Jameela, J. An Update on the therapeutic anticancer potential of *Ocimum sanctum* L.: "Elixir of Life". *Molecules*, 2023. 28(3), Article 3. <https://doi.org/10.3390/molecules28031193>
71. Jahanban-Esfahlan, A.; Modaeinama, S.; Abasi, M.; Abbasi, M. M.; Jahanban-Esfahlan, R. Anti proliferative Properties of *Melissa officinalis* in Different Human Cancer Cells. *Asia. Pacific J. Cancer Prevent*. 2015, 16(14), 5703–5707. <https://doi.org/10.7314/apjcp.2015.16.14.5703>
72. Jarisarapurin, W.; Kunchana, K.; Chularojmontri, L.; Wattanapitayakul, S.K. Unripe *Carica papaya* protects methylglyoxal-invoked endothelial cell inflammation and apoptosis via the suppression of oxidative stress and Akt/MAPK/NF-κB signals. *Antioxidants*. 2021. 10(8), 1158. <https://doi.org/10.3390/antiox10081158>
73. Jha, N.; Mangukia, N.; Patel, M.P.; Bhavsar, M.; Gadhavi, H.; Rawal, R. M.; Patel, S.K. Exploring the MiRnome of *Carica papaya*: A cross kingdom approach. *Gen. Report*. 2021. 23, 101089. <https://doi.org/10.1016/j.genrep.2021.101089>
74. Jimenez-Champi, D.; Romero-Oregon, F.L.; Moran-Reyes, A.; Muñoz, A.M.; Ramos-Escudero, F. Bioactive compounds in potato peels, extraction methods, and their applications in the food industry: A review. *CyTA – J. Food*. 2023, 21(1), 418–432. <https://doi.org/10.1080/19476337.2023.2213746>
75. Kalalinia, F.; Karimi-Sani, I. Anticancer properties of solamargine: A systematic review. *Phytother. Res. PTR*, 2017, 31(6), 858–870. <https://doi.org/10.1002/ptr.5809>
76. Khallouki, F.; Breuer, A.; Akdad, M.; Laassri, F.E.; Attaleb, M.; Elmoualij, B.; Mzibri, M.; Benbacer, L.; Owen, R.W. Cytotoxic activity of Moroccan *Melissa Officinalis* leaf extracts and HPLC-ESI-MS analysis of its phyto-constituents. *Future J. Pharm. Sci*. 2020, 6(1), 20. <https://doi.org/10.1186/s43094-020-00037-x>
77. Khattak, M.N.K.; Shanableh, A.; Hussain, M.I.; Khan, A.A.; Abdulwahab, M.; Radeef, W.; Samreen, M.H. Anticancer activities of selected Emirati Date (*Phoenix dactylifera* L.) varieties pits in human triple negative breast cancer MDA-MB-231 cells. *Saudi J. Biol. Sci*. 2020, 27(12), 3390–3396. <https://doi.org/10.1016/j.sjbs.2020.09.001>
78. Kowalczyk, T.; Merez-Sadowska, A.; Rijo, P.; Mori, M.; Hatziantoniou, S.; Górski, K.; Szemraj, J.; Piekarski, J.; Śliwiński, T.; Bijak, M.; Sitarek, P. Hidden in plants—A review of the anticancer potential of the Solanaceae family in in vitro and in vivo studies. *Cancers*. 2022, 14(6), 1455. <https://doi.org/10.3390/cancers14061455>
79. Kuo, T.T.; Chang, H.Y.; Chen, T.Y.; Liu, B.C.; Chen, H.Y.; Hsiung, Y.C.; Hsia, S.M.; Chang, C.J.; Huang, T.C. *Melissa officinalis* Extract Induces Apoptosis and Inhibits Migration in Human Colorectal Cancer Cells. *ACS Omega*. 2020, 5(49), 31792–31800. <https://doi.org/10.1021/acsomega.0c04489>
80. Kyei-Barffour, I.; Kwarkoh, R.K.B.; Acheampong, D.O.; Brah, A.S.; Akwetey, S.A.; Aboagye, B. Alkaloidal extract from *Carica papaya* seeds ameliorates CCl4-induced hepatocellular carcinoma in rats. *Heliyon*, 2021, 7(8), e07849. <https://doi.org/10.1016/j.heliyon.2021.e07849>
81. Li, P.G.; Mu, T.H.; Deng, L. Anticancer effects of sweet potato protein on human colorectal cancer cells. *World J. Gastroenterol*. 2013, 19(21), 3300–3308. <https://doi.org/10.3748/wjg.v19.i21.3300>
82. Mahrous, N.S.; Noseer, E.A. Anticancer potential of *Carica papaya* Linn black seed extract against human colon cancer cell line: In vitro study. *BMC Complement. Med. Ther*. 2023, 23, 271. <https://doi.org/10.1186/s12906-023-04085-7>
83. Maran, M.; Gangadharan, S.; Emerson, I.A. Molecular dynamics study of quercetin families and its derivative compounds from *Carica papaya* leaf as breast cancer inhibitors. *Chem. Phys. Lett*. 2022, 793, 139470. <https://doi.org/10.1016/j.cplett.2022.139470>
84. Mukarram, M.; Choudhary, S.; Khan, M.A.; Poltronieri, P.; Khan, M.M.A.; Ali, J.; Kurjak, D.; Shahid, M. Lemongrass essential oil components with antimicrobial and anticancer activities. *Antioxidants*, 2021, 11(1), 20. <https://doi.org/10.3390/antiox11010020>
85. Mukhtar, M.H.; El-Readi, M.Z.; Elzubier, M.E.; Fatani, S.H.; Refaat, B.; Shaheen, U.; Adam Khidir, E.B.; Taha, H.H.; Eid, S.Y. *Cymbopogon citratus* and citral overcome doxorubicin resistance in cancer cells via modulating the drug's metabolism, toxicity, and multidrug transporters. *Molecules*, 2023, 28(8), 3415. <https://doi.org/10.3390/molecules28083415>
86. Muruganatham, N.; Solomon, S.; Senthamilselvi, M.M. Anti-cancer activity of *Cucumis sativus* (cucumber) flowers against human liver cancer. *Int. J. Pharm. Clinic. Res*. 2016, 8, 39–41.
87. Ohiagu, F. O.; Chikezie, P.C.; Chikezie, C.M.; Enyoh, C.E. Anticancer activity of Nigerian medicinal plants: A review. *Future J. Pharm. Sci*. 2021, 7(1), 70. <https://doi.org/10.1186/s43094-021-00222-6>
88. Pereira, C.V.; Duarte, M.; Silva, P.; Bento da Silva, A.; Duarte, C.M.M.; Cifuentes, A.; García-Cañas, V.; Bronze, M.R.; Albuquerque, C.; Serra, A.T. Polymethoxylated flavones target cancer stemness and

- improve the antiproliferative effect of 5-fluorouracil in a 3D cell model of colorectal cancer. *Nutrients*, 2019, 11(2), Article 2. <https://doi.org/10.3390/nu11020326>
89. Pieme, C.A.; Kumar, S.G.; Dongmo, M.S.; Moukette, B.M.; Boyoum, F.F.; Ngogang, J.Y.; Saxena, A.K. Antiproliferative activity and induction of apoptosis by *Annona muricata* (Annonaceae) extract on human cancer cells. *BMC Complement. Altern. Med.* 2014, 14. <https://doi.org/10.1186/1472-6882-14-516>
 90. Rasheed, H.; Ahmad, D.; Bao, J. Genetic diversity and health properties of polyphenols in potato. *Antioxidants*, 2022, 11(4), 603. <https://doi.org/10.3390/antiox11040603>
 91. Rawson, N. E.; Ho, C.T.; Li, S. Efficacious anti-cancer property of flavonoids from citrus peels. *Food Sci. Human Well.* 2014, 3(3), 104–109. <https://doi.org/10.1016/j.fshw.2014.11.001>
 92. Reddivari, L.; Vanamala, J.; Chintharlapalli, S.; Safe, S. H.; Miller, J.C.; Jr. Anthocyanin fraction from potato extracts is cytotoxic to prostate cancer cells through activation of caspase-dependent and caspase-independent pathways. *Carcinogenesis*. 2007, 28(10), 2227–2235. <https://doi.org/10.1093/carcin/bgm117>
 93. Saha, S.; Giri, T. Breaking the Barrier of Cancer through Papaya Extract and their Formulation. *Anti-Canc. Agent. Med. Chem.* 2019. 19. <https://doi.org/10.2174/1871520619666190722160955>
 94. Stabrauskiene, J.; Kopustinskiene, D.M.; Lazauskas, R.; Bernatoniene, J. Naringin and Naringenin: Their mechanisms of action and the potential anticancer activities. *Biomedicines*, 2022, 10(7), 1686. <https://doi.org/10.3390/biomedicines10071686>
 95. Syed Najmuddin, S.U.F.; Romli, M.F.; Hamid, M.; Alitheen, N.B.; Nik Abd Rahman, N.M.A. Anti-cancer effect of *Annona muricata* Linn leaves crude extract (AMCE) on breast cancer cell line. *BMC Complement. Altern. Med.* 2016, 16(1), 311. <https://doi.org/10.1186/s12906-016-1290-y>
 96. Tibenda, J.J.; Du, Y.; Huang, S.; Chen, G.; Ning, N.; Liu, W.; Ye, M.; Nan, Y.; Yuan, L. Pharmacological mechanisms and adjuvant properties of Licorice *Glycyrrhiza* in treating gastric cancer. *Molecules*, 2023, 28(19), 6966. <https://doi.org/10.3390/molecules28196966>
 97. Tuama, A.A.; Mohammed, A.A. Phytochemical screening and in vitro antibacterial and anticancer activities of the aqueous extract of *Cucumis sativus*. *Saudi J. Biol. Sci.* 2019. 26(3), 600–604. <https://doi.org/10.1016/j.sjbs.2018.07.012>
 98. Tuli, H. S.; Garg, V. K.; Mehta, J. K.; Kaur, G.; Mohapatra, R. K.; Dhama, K.; Sak, K.; Kumar, A.; Varol, M.; Aggarwal, D.; Anand, U.; Kaur, J.; Gillan, R.; Sethi, G.; Bishayee, A. Licorice (*Glycyrrhiza glabra* L.)-Derived Phytochemicals target multiple signaling pathways to confer oncopreventive and oncotherapeutic effects. *Oncotarget. Ther.* 2022, 15, 1419–1448. <https://doi.org/10.2147/OTT.S366630>
 99. Varela, C.; Melim, C.; Neves, B. G.; Sharifi-Rad, J.; Calina, D.; Mamurova, A.; Cabral, C. Cucurbitacins as potential anticancer agents: New insights on molecular mechanisms. *J. Trans. Med.* 2022, 20, 630. <https://doi.org/10.1186/s12967-022-03828-3>
 100. Wahab, S.; Annadurai, S.; Abullais, S. S.; Das, G.; Ahmad, W.; Ahmad, M. F.; Kandasamy, G.; Vasudevan, R.; Ali, M. S.; Amir, M. *Glycyrrhiza glabra* (Licorice): A comprehensive review on its phytochemistry, biological activities, clinical evidence and toxicology. *Plants*, 2021, 10(12), Article 12. <https://doi.org/10.3390/plants10122751>
 101. Winkiel, M.J.; Chowański, S.; Słocińska, M. Anticancer activity of glycoalkaloids from *Solanum* plants: A review. *Front. Pharm.* 2022, 13. <https://doi.org/10.3389/fphar.2022.979451>
 102. Yengwa Bakam, B.; Fosso, R.U.; Grein, T.; Ndinteh, D.T.; Maxeiner, S.; Zingue, S.; Blaheta, R.A.; Njamen, D. *Cucumis sativus* (Cucurbitaceae) inhibits prostate carcinoma cell growth and prevents the testosterone-induced benign prostatic hyperplasia in Wistar rat. *J. Func. Food.* 2024, 114, 106088. <https://doi.org/10.1016/j.jff.2024.106088>
 103. Zhang, X.; Yan, Z.; Xu, T.; An, Z.; Chen, W.; Wang, X.; Huang, M.; Zhu, F. Solamargine derived from *Solanum nigrum* induces apoptosis of human cholangiocarcinoma QBC939 cells. *Oncol. Lett.* 2018, 15(5), 6329–6335. <https://doi.org/10.3892/ol.2018.8171>