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Review Article

Anticancer Mechanisms of Indigenous Food Plants in Nigeria

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Abstract

Cancer continues to pose a substantial public health problem in Nigeria, characterized by rising rates of occurrence and mortality. While there is increasing interest in using natural products for cancer treatment, comprehensive data on the specific bioactive compounds in these plants and how they modulate different types of cancer are still lacking. Additionally, although traditional knowledge about these food plants is rich and valuable, it has not been fully integrated with modern scientific research to create standardized treatment protocols. Scientific databases like PubMed, ScienceDirect, Google Scholar, and ResearchGate were explored to retrieve empirical data. The key plants discussed are *Spondias mombin, Xanthosoma sagittifolium, Elaeis guineensis, Irvingia gabonensis, Allium cepa, Blighia sapida, Dioscorea dumetorum, Psidium guajava,* and *Talinum triangulare*. These plants demonstrate a wide range of anticancer properties, including the ability to induce apoptosis (cell death), halt the cell cycle, inhibit angiogenesis, and regulate inflammatory responses. They contain a variety of phytochemicals, such as flavonoids, tannins, terpenoids, alkaloids, and organosulfur compounds, which contribute to their anticancer effects. For example, Spondias mombin contains flavonoids that inhibit the formation of tumors, whereas *Xanthosoma sagittifolium* exhibits cytotoxic effects against leukemia cells. Additionally, *Elaeis guineensis* exhibits antioxidant properties that counteract oxidative stress, a crucial factor in cancer progression. This review highlights the significance of these plants in developing complementary cancer therapies that can be used alongside conventional treatments. By combining traditional knowledge with contemporary scientific methods, these medicinal plants have the potential to provide innovative approaches to cancer prevention and treatment, addressing the pressing demand for safer and more efficient therapeutic alternatives.

Keywords: Cancer; Xanthosoma sagittifolium; Spondias mombin; Irvingia gabonensis; Allium cepa; Psidium guajava; Gallotannin; Diosgenin.

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Introduction

Cancer is the second most common cause of death globally and a major public health challenge for the twenty-first century, particularly in Nigeria, where over 120,000 new cases and more than 78,000 cancer-related deaths are reported annually.[1] In Nigeria, breast cancer, cervical cancer, prostate cancer, and liver cancer are the most prevalent among the various cancer types.[2] Though cancer therapy and care have made significant progress, more ef-

fective and safer therapeutic alternatives are urgently needed.[3] Recent research has increasingly focused on the potential of tropical plants as sources of novel anticancer agents, given that many effective anticancer drugs have historically been derived from plant sources.[4] For instance, vinca alkaloids from *Catharanthus roseus* and paclitaxel from *Taxus brevifolia* have demonstrated significant therapeutic efficacy.[5]

Tropical plants are rich in diverse bioactive compounds, including alkaloids, flavonoids, terpenoids, and phenolic compounds, which exhibit promising anticancer properties.[6] These phytochemicals work through many mechanisms; they can induce apoptosis, inhibit cell proliferation, modulate signaling pathways, and reduce oxidative stress and inflammation.[7] Their multifaceted nature may offer advantages over synthetic drugs, which often target specific pathways.[8]

Moreover, research on tropical plants for their anticancer properties aligns with the growing interest in complementary and integrative cancer therapies.[9] Many patients are actively seeking natural alternatives to enhance treatment efficacy and minimize side effects.[10] This paper aimed to provide a comprehensive review of various tropical plants with promising anticancer activities, focusing on their bioactive compounds, mechanisms of action, and potential applications in cancer prevention and treatment. By synthesizing current research and identifying gaps in knowledge, we hope to encourage further investigation into these natural resources and their potential impact on cancer therapy.

Spondias mombin

The tropical plant *Spondias mombin* demonstrates a complex anticancer mechanism due to the variety of phytochemicals it contains.[11] The carotenoid isolates from *Spondias mombin* exhibit strong anticancer effects, including inducing cancer cell death, inhibiting the X-linked Inhibitor of Apoptosis Protein, and providing antioxidant and anti-inflammatory properties that hinder tumor growth, particularly in breast cancer models.[12] Quercetin, another flavonoid found in *Spondias mombin,* is known for its potent anticancer properties. It induces cancer cell apoptosis, inhibits the actions of B-cell lymphoma (Bcl)-2 and Bcl-extra large proteins, prevents Nuclear Factor kappa-light-chain-enhancer of activated B cells (NF-κB) activation, reduces the expression of inflammatory cytokines, and modifies key cancer pathways such as phosphoinositide 3-kinase/Akt and mitogen-activated protein kinase (MAPK). Additionally, quercetin functions as an antioxidant and anti-inflammatory agent.[13] Another potential mechanism by which *Spondias mombin* may inhibit cancer is through the inhibition of angiogenesis—the formation of new blood vessels from tumors. *Spondias mombin* contains significant amounts of the flavonoid kaempferol, which has been shown to reduce angiogenesis by decreasing vascular endothelial growth factor (VEGF) levels and inhibiting protein kinase B activation.[14] Research has also demonstrated that the leaf extract of *Spondias mombin* can inhibit the synthesis of pro-inflammatory proteins, such as tumor necrosis factor-alpha and inducible nitric oxide.[15] Furthermore, antioxidants present in the plant, such as astaxanthin and β-carotene-15,15′-epoxide, help eliminate free radicals and reduce oxidative stress, thus protecting against DNA damage and the progression of cancer.[16]

Xanthosoma sagittifolium

Xanthosoma sagittifolium, a tropical plant known as tannia or malanga,[17] has shown promising anticancer properties, particularly against leukemia cells, due to its bioactive compounds. The mechanism of action involves multiple targets, including the induction of apoptosis through the activation of pro-apoptotic proteins and inhibition of anti-apoptotic proteins, cell cycle arrest at the G1/S and G2/M phases by inhibiting cyclin-dependent kinases and inducing cyclin-dependent kinase inhibitors, and the inhibition of angiogenesis by blocking VEGF and other angiogenic factors.[18] The anti-inflammatory and antioxidant properties of X. *sagittifolium* may also contribute to its anticancer effects by reducing oxidative stress and inflammation.[19] The hydroethanolic extract from *Xanthosoma sagittifolium* exhibits cytotoxic effects against leukemia cells by inducing apoptosis, halting the cell cycle, inhibiting nitric oxide production, and chelating metal ions.[20] The plant's compounds have been shown to target specific cellular and molecular pathways, including transcription factors such as NF-κB and signal transducer and activator of transcription 3, as well as the phosphatase and tensin homolog.[21] These findings suggest that *Xanthosoma sagittifolium l*eaf extract may have practical applications in cancer therapy due to its antitumor properties and the presence of bioactive compounds.

Elaeis guineensis

Elaeis guineensis, commonly referred to as the oil palm, and its phytochemical components, particularly tocotrienols and phenolic compounds, play a significant role in its reported anticancer effects.[22] Studies have shown that extracts derived from *Elaeis guineensis* can induce cell death in various cancer cells. The methanol extract of *Elaeis guineensis* has demonstrated the ability to suppress cell growth in a dose-dependent manner. Its IC50 value, which is less than 20 μg/mL, suggests that it has the potential to be a remarkably potent anticancer agent. The mechanism of action involves the induction of apoptosis, characterized by specific morphological changes in cells, including cell shrinkage, membrane blebbing, and chromatin condensation.[23] In addition, tocotrienols, a form of vitamin E present in palm oil, have demonstrated antioxidant properties, effectively reducing oxidative stress and preventing DNA damage—both of which play a critical role in cancer progression.[24] In studies involving MCF-7 breast cancer cells, tocotrienols have been shown to decrease cell viability and promote cell cycle arrest, particularly at the G1 phase, thereby inhibiting proliferation.[25] The phenolic compounds found in *Elaeis guineensis* also exhibit anti-proliferative properties by inhibiting the proliferation of cancer cells through various mechanisms, such as reducing tumor formation and regulating cell signaling pathways,[26] including the NF-κB and MAPK pathways, which are involved in cancer progression. These compounds also exhibit strong free radical scavenging activity, which contributes to their ability to inhibit tumor growth and metastasis.[23] As a result, *Elaeis guineensis* shows great potential for further investigation and prospective use in cancer treatment.

Irvingia gabonensis

Irvingia gabonensis, also known as African mango or bush mango, exhibits promising anticancer properties due to its diverse phytochemical composition, including flavonoids, tannins, saponins, and terpenoids.[27] These compounds contribute to its strong antioxidant activity, ability to trigger apoptosis in cancer cells, modulation of signaling pathways related to cancer growth, anti-inflammatory effects, and inhibition of angiogenesis. Gallotannins found in the seeds have significant antioxidant potential and the ability to suppress cancer cell growth. Furthermore, the extracts stimulate internal apoptotic pathways, resulting in mitochondrial dysfunction, the release of cytochrome c, and subsequent activa-

tion of caspases.[27] *Irvingia gabonensis* also regulates signaling pathways related to cancer progression, such as the inhibition of protein tyrosine phosphatases, which are involved in cell growth and survival. This inhibition can increase glucose uptake and improve metabolic parameters, potentially reducing the risk of cancer associated with metabolic disorders.[28] Additionally, it enhances the immune response and decreases inflammatory markers, creating an unfavorable environment for tumor growth.

Allium cepa L

Allium cepa L., commonly known as onion, has been extensively studied for its anticancer qualities, attributed to its abundant concentration of bioactive components such as organosulfur compounds, flavonoids, phenolic acids, and saponins. These bioactive constituents contribute to its anticancer effects through several mechanisms.[29] They function as antioxidants, reducing oxidative stress and DNA damage, while also regulating detoxification enzymes such as glutathione S-transferase to improve the elimination of carcinogens.[30] Onions also possess anti-inflammatory properties, inhibiting pro-inflammatory cytokines and enzymes like tumor necrosis factor-alpha and cyclooxygenase-2 (COX-2).[31] Allium cepa can induce programmed cell death in cancer cells, such as AGS human gastric cancer cells, by upregulating the expression of the tumor suppressor protein p53. This, in turn, leads to the activation of pro-apoptotic proteins like Bax and the suppression of anti-apoptotic proteins like Bcl-2.[32] This modulation results in impaired mitochondrial activity and the activation of caspases, which are crucial enzymes in the apoptosis pathway.[33] Furthermore, *Allium cepa* extracts have been shown to inhibit the phosphoinositide 3-kinase/protein Kinase B signaling pathway, which is often dysregulated in cancer, promoting apoptosis and inhibiting cell proliferation.[34] Onions also inhibit cancer cell proliferation by causing cell cycle arrest and suppress angiogenesis by downregulating VEGF.[35] They prevent metastasis by inhibiting matrix metalloproteinases and adhesion molecules.[36] The organosulfur compounds in onions, such as thiosulfinate, also exhibit anticancer effects by inhibiting the growth and metastasis of various cancer cell lines.[37] Furthermore, *Allium cepa* has shown potential in overcoming multidrug resistance in cancer cells, indicating its role in enhancing the efficacy of existing chemotherapeutic agents.[38] The multifaceted mechanisms through which *Allium cepa* exerts its anticancer effects highlight its potential as a complementary therapeutic agent in cancer treatment.

Blighia sapida

Blighia sapida, commonly known as ackee, exhibits significant anticancer properties through various mechanisms. It contains bioactive compounds such as saponins, phenolic compounds, and alkaloids, which contribute to its efficacy.[39] One of the key mechanisms by which *Blighia sapida* exerts its anticancer effects is the inhibition of specific signaling pathways involved in cancer progression. For instance, recent studies have highlighted the potential of flavonoids extracted from *Blighia sapida* as promising inhibitors of the extracellular signal-regulated kinase 5 pathway, which is implicated in breast cancer progression.[40] By inhibiting this pathway, the flavonoids can disrupt the proliferation and survival of cancer cells, leading to reduced tumor growth. Additionally, the antioxidant properties of *Blighia sapida* play a critical role in combating oxidative stress, which is a significant contributor to cancer development. The high levels of phenolic compounds in the fruit arils enhance this antioxidant activity, helping to neutralize free radicals and prevent DNA damage.[41] Furthermore, extracts from *Blighia sapida* have demonstrated anti-inflammatory properties, which are essential since chronic inflammation is often linked to cancer progression. The plant's ability to modulate inflammatory responses can create a less favorable environment for tumor growth.[42] Moreover, *in vitro* studies have shown that *Blighia sapida* extracts can induce apoptosis in cancer cells, promoting programmed cell death and thus eliminating potentially malignant cells.[43] These combined actions highlight its potential as a chemopreventive and therapeutic agent against various types of cancer.

Dioscorea dumetorum

Dioscorea spp. has been reported to possess anticancer effects through several mechanisms. Various studies have highlighted the phytochemicals present in Dioscorea, such as diosgenin.[44] Diosgenin is a steroidal sapogenin found in *Dioscorea species* that has been extensively investigated due to its significant anticancer properties.[45] Notably, diosgenin can potentially inhibit the proliferation and metastasis of tumor cells, facilitate programmed cell death (apoptosis), induce cell differentiation and autophagy, and impede the spread and infiltration of tumor cells.[46] The acetone extract of *Dioscorea alata* contains unique active compounds with specific biological properties that may prevent certain types of cancer. Diosgenin has been shown in preclinical tests to effectively suppress the growth of multiple cancer cell lines, including oral squamous cell carcinoma, laryngeal cancer, esophageal cancer, liver cancer, gastric cancer, lung cancer, cervical cancer, prostate cancer, glioma, and leukemia.[47] Diosgenin may exert its anticancer effects by initiating cell cycle arrest, triggering apoptosis, and modulating signaling pathways, including NF-κB, Akt, and MAPK.[47]

In addition to diosgenin, other phytochemicals present in these species have demonstrated the potential to inhibit the growth of cancer cells. A study by Wallace *et al*.[48] revealed that the acetone extract of *Dioscorea alata* (DaJa-3) can initiate programmed cell death in prostate (DU145) and lung (A549) cancer cells. Moreover, research studies have indicated that *Dioscorea species* possess antioxidant and anti-inflammatory characteristics, which could contribute to their ability to combat cancer.[49] Studies have also shown that the rhizome of *Dioscorea deltoidea* can modulate the immune system and alleviate pain and inflammation, which is promising for advancing cancer therapy.[50]

Psidium guajava

Psidium guajava, commonly known as guava, is a tropical fruit extensively cultivated in various regions around the world.[51] It has garnered significant attention due to the medicinal benefits provided by various plant parts, including the leaves and fruits, which range from antimicrobial activity to potential anticancer properties.[52] This anticancer property has been attributed to its polyphenolic compounds, including flavonoids and tannins. Guava leaves are reported to be a good source of tannins, triterpenoids, sesquiterpenes, volatile oils, and flavonoids.[53] These bioactive compounds exhibit antioxidant and free radical scavenging activities, protecting cells from oxidative stress, inhibiting cell proliferation, and preventing DNA damage associated with cancer development.[54] A study on the hexane fraction of guava leaves demonstrated that guava extracts can induce apoptosis in cancer cells and inhibit key signaling pathways, such as the AKT/mechanistic target of rapamycin/ribosomal protein S6 kinase 1 pathway, in prostate cancer cells.[55] Additionally, apigenin and β-caryophyllene, both flavonoids found in guava leaves, exhibited significant anti-proliferative activity against human colon cancer cell lines Caco-2, HT-29, and SW480. The anti-angiogenic effects of β-caryophyllene are

attributed to its interaction with the transcriptional mechanisms of hypoxia-inducible factor 1-alpha, which control biological pathways related to hypoxia, tumor-induced angiogenesis, and tumor metastasis.[56]

Talinum triangulare

Talinum triangulare, commonly known as waterleaf, has emerged as a promising candidate in cancer research due to its rich bioactive compounds and potential anticancer mechanisms. A review of the bioactive compounds of *Talinum triangulare* reveals that this plant possesses antitumor properties.[57] According to an ethnobotanical survey, it has been traditionally used to treat various diseases, including cancer. Some of the phytochemicals found in *T. triangulare* have been shown to inhibit the growth of cancer cells.[58] These include capsaicin, cucurbitacin B, quercetin, lycopene, baicalin, apigenin, catechins, and isoflavones.[59] Quercetin, a naturally occurring flavonoid in *T. triangulare,* has been found to induce anticancer effects in human leukemia U937 cells by inhibiting the activity of heat shock protein 27.[60] Apigenin has garnered significant attention as a chemotherapeutic agent, among other substances.[57] Different studies have revealed multiple pathways through which *T. triangulare* extracts may benefit cancer treatment. Notably, *T. triangulare* extracts have demonstrated immunoregulatory and antitumor properties, suggesting an enhanced immune response against cancer cells.[58] Additionally, *T. triangulare* exhibits notable antioxidant properties, neutralizing free radicals and reducing oxidative stress and DNA damage, which are critical factors in cancer development.[61] It has also been reported that *T. triangulare* causes a reduction in malondialdehyde and H_2O_2 levels, thereby impeding the advancement of lipid peroxidation cascades.[62]

Launaea taraxacifolia

Launaea taraxacifolia, also known as African lettuce, has been extensively investigated for its anticancer properties.[63] A research by Adinortey *et al*.[64] suggests that the methanolic leaf extract demonstrates significant potential as a therapeutic agent in preventing diseases associated with increased oxidative stress and DNA Damage, such as cancer. This indicates that the extract may play a crucial role in mitigating oxidative damage. The plant's phytochemical composition, including flavonoids, phenolic acids, and tannins, provides potent antioxidant properties, reducing oxidative stress and protecting cells from DNA damage.[65] Laboratory studies have shown that *L. taraxacifolia* extracts inhibit the growth of various cancer cells, including esophageal cancer cells (WHC01), by inducing cell cycle arrest and programmed cell death.[66].

Solanum macrocarpon

Solanum macrocarpon, also known as African eggplant or gboma eggplant, has garnered attention for its potential anticancer properties, attributed to its rich phytochemical content.[67] In a study, it was demonstrated that *S. macrocarpon* extracts induce apoptosis in various cancer cells, including MCF-7 breast cancer and HeLa cervical cancer cells.[68] The cytotoxic effects are enhanced by bioactive compounds, particularly glycoalkaloids like solamargine.[69] Moreover, the high levels of flavonoids and phenolic compounds in *S. macrocarpon* provide potent antioxidant properties, effectively mitigating oxidative stress and protecting against DNA damage.[70] Furthermore, these chemopreventive agents can enhance the body's immune system, including detoxification enzymes that neutralize carcinogens, through their synergistic actions, thereby bolstering the body's defense against cancer.[71,72]

Chrysophyllum albidum

Chrysophyllum albidum, the African star apple, has been extensively studied for its anticancer potential, with recent research uncovering various mechanisms of action. Numerous studies have reported that the plant's rich bioactive compound profile, comprising flavonoids and phenolic acids, provides potent antioxidant activity, which is crucial for combating oxidative stress—a significant contributor to cancer development.[73–75] In their research,[76] it was reported that the methanolic pulp residue of *C. albidum* has strong antioxidant and anti-inflammatory properties, further enhancing its anticancer effects, as chronic inflammation is a recognized risk factor for cancer progression. This activity can be attributed to the phytochemicals present, especially flavonoids and phenols.[77] Studies have demonstrated that *C. albidum* extracts effectively scavenge free radicals, inhibit lipid peroxidation, and protect cellular components from oxidative damage.[78]

Tetracarpidium conophorum

Tetracarpidium conophorum, commonly known as African walnut, has been recognized for its potential anticancer properties, particularly through the bioactive compounds found in its seed oil.[79] Recent studies by Uhunmwangho *et al*.[80] have elucidated several mechanisms by which *T. conophorum* exerts its anticancer effects, particularly in the context of prostate cancer. The primary mechanisms involve the modulation of COX-2 and peroxisome proliferator-activated receptor gamma signaling pathways. *T. conophorum* seed oil has been shown to significantly reduce COX-2 expression, which is often upregulated in cancerous tissues and associated with inflammation and tumor progression.[81] Additionally, *T. conophorum* seed oil has been found to increase peroxisome proliferator-activated receptor gamma activity, suggesting an anti-inflammatory effect that contributes to its anticancer properties. The seed oil is rich in polyunsaturated fatty acids, particularly gamma-linolenic acid, which is associated with reduced tumor growth and selective cytotoxicity towards cancer cells with no adverse effect on normal cells.[82] The antioxidant properties of *T. conophorum*, attributed to its high flavonoid content, play a crucial role in mitigating oxidative stress and preventing DNA damage—critical factors in cancer initiation and progression.[83] As reviewed by Ojobor *et al*.,[84] the anticancer mechanisms of *T. conophorum* appear to involve a combination of anti-inflammatory, antioxidant, and direct cytotoxic effects on cancer cells, warranting further investigation into its potential as a therapeutic agent in cancer treatment.

Recommendations and future directions

The pictures and summary of the remarkable anticancer mechanisms of the plants discussed in this study is presented in Figure 1 and Table 1 respectively.[18,24,25,27,28,30,37,40,44,45,54,55,58,63,65,71-74,80,85] Although numerous edible plants have medicinal and nutritional value, their consumption is limited.[86] It is important to realize that even edible plants may cause health problems if consumed in too great quantities or if any of their components are toxic.[87] Some plants may have bioactive compounds that are beneficial in low doses but harmful in high ones.[88] Therefore, careful control of consumption levels is necessary. Moreover, environmental factors, including soil pollution and exposure to toxins, might influence the safety of wild edible plants,[89] leading to the accumulation of harmful elements, including heavy metals.[90] Therefore, it is important to ensure the proper identification and preparation of these plants before consumption, as certain types may require specific cooking methods to eliminate toxins. Additionally, procedures for safe con-

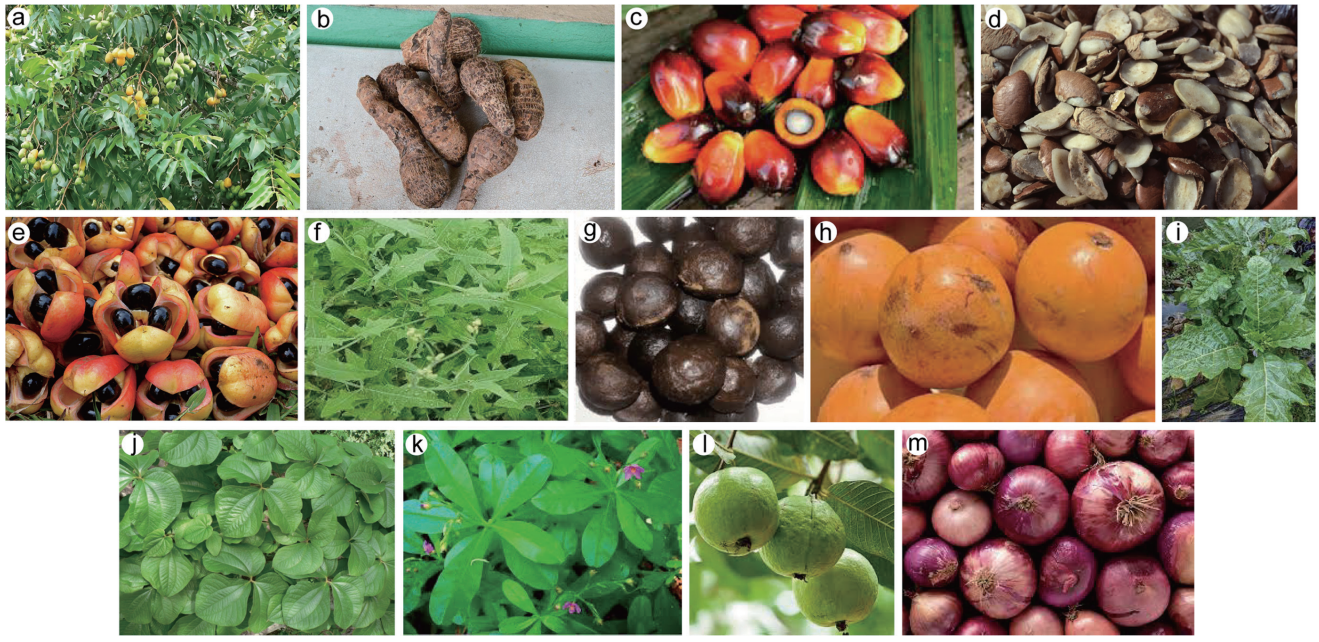

Fig. 1. Selected edible Nigerian plants with anti-cancer properties. (a) *Spondias mombin*; (b) *Xanthosoma sagittifolium*; (c) *Elaeis guineensis*; (d) *Irvingia gabonensis*; (e) *Blighia sapida*; (f) *Launaea taraxacifolia*; (g) *Tetracarpidium conophorum*; (h) *Chrysophyllum albidum*; (i) *Solanum macrocarpon*; (j) *Dioscorea dumetorum*; (k) *Talinum triangulare*; (l) *Psidium guajava*; (m) *Allium cepa L.* Photo credit: google photo.

sumption must be developed, including recommended maximum daily intake thresholds for various plant species.[91] Studies suggest a limit of about 50 grams per day for certain types.[92] Therefore, people must approach the usage of edible plants with awareness, using accepted safety precautions and recognizing their potential risks to maintain a balanced diet.

Importantly, thorough phytochemical research should identify and characterize the bioactive elements in these plants that could have anticancer properties.[93] Carefully planned clinical trials are then required to assess their safety and efficacy across many cancer types, particularly those prevalent in certain populations.[94] Furthermore, culinary developments and recipe formulations may promote their acceptance into daily meals. Consequently, this will enhance patient adherence and satisfaction. The development of standardized dietary supplements from these plants may help incorporate them into treatment regimens.[95] The creation of regulatory systems is necessary to ensure that these supplements meet safety and efficacy standards. Moreover, targeted public awareness campaigns are vital to educate patients and healthcare professionals about the benefits of these plants.[96] This may improve understanding of their role in comprehensive cancer therapy. With the ultimate aim of enhancing patient outcomes through better nutritional support, cooperative efforts among researchers, nutritionists, healthcare practitioners, and community organizations will be crucial in supporting the health benefits of these plants and properly integrating them into holistic cancer treatment protocols.

Limitations

Studies on the effectiveness of edible plants in cancer treatment have many limitations that can affect their results and translation. One major limitation is the variation in phytochemical composition, which is affected by soil quality, geographical location, and farming methods.[97] Furthermore, many studies are conducted *in vitro* or using animal models, which may not sufficiently reflect the behavior of these compounds in human physiology.[98] This may potentially limit the relevance of findings to clinical practice. The lack of accepted techniques for separating and quantifying bioactive compounds makes the comparability of results from many studies more difficult. Additionally, while the traditional usage of these plants is well known, there is a lack of synthesis between ethnobotanical knowledge and modern scientific research, which may exclude important information on their therapeutic value. Regulatory challenges create difficulties, as the creation of safety and efficacy criteria for new supplements made from these plants could be a slow process.[99] Public understanding and acceptance of different natural medicines may vary, which ultimately affects how they are incorporated into accepted therapeutic guidelines. Improving the role of edible plants in cancer therapy depends on overcoming these limitations through thorough research, standardized approaches, and collaboration between traditional and modern medicine.

Conclusions

Research on the anticancer properties of numerous edible plants suggests great potential for using naturally occurring compounds in cancer therapy. These plants contain a wide range of bioactive compounds, according to studies, which could fight cancer through processes including cell death, inhibition of growth and migration, prevention of cell division, and modification of important signaling pathways. Due to their high concentration of flavonoids, phenolic acids, and other bioactive substances, the therapeutic potential of these indigenous edible plants from Southwestern Nigeria is promising. Apart from providing basic nutrients, they exhibit strong anti-inflammatory, antioxidant, and anticancer effects. Including these indigenous foods in diet therapy helps to maximize the efficacy of conventional cancer therapies, limit side effects,

Table 1. Anticancer mechanism of selected indigenous food plants in Nigeria

S/N	Scientific name of food plants	Common name(s)	Bioactive component	Anticancer mechanism	References
1	*Spondias mombin*	Yellow mombin, Hog plum, Iyeye, Icheku, Tsada, Sunka & Akika	Carotenoids, quercetin, kaempferol, astaxanthin & β-carotene-15,15′-epoxide	Induced apoptosis, inhibits cell proliferation, modulates inflammatory responses, and reduces oxidative stress.	85
2	*Xanthosoma sagittifolium*	Tannia or Malanga	Flavonoids tannins, saponins, alkaloids	Induction of apoptosis, cell cycle progression inhibition, and angiogenesis suppression by VEGF and other angiogenic factors. Exhibits anti-inflammatory and antioxidant properties that reduce oxidative stress.	18
3	*Elaeis guineensis*	Oil palm, epo pupa, kwakwan manja, and aku	Tocotrienols and phenolic compounds	Possess strong antioxidant properties that reduce oxidative stress and prevent DNA damage, leading to decreased cell viability and promotion of apoptosis in cancer cells, such as MCF-7 breast cancer cells.	24,25
4	*Irvingia gabonensis*	African mango or Bush mango	Flavonoids, tannins, saponins, terpenoids, gallotannins	Regulates signaling pathways related to cancer progression by inhibiting PTPs, enhancing glucose uptake, improving metabolic parameters, and reducing cancer risk associated with metabolic disorders. Gallotannins found in the seeds have significant antioxidant potential and the ability to suppress the growth of cancer cells.	27,28
5	*Allium cepa L*	Onion, Alubosa, Albasa, Yabasi	Organosulfur compounds, flavonoids, phenolic acids, saponins	Induce apoptosis in cancer cells by upregulating the tumor suppressor protein p53. Inhibits cancer cell proliferation by causing cell cycle arrest, suppress angiogenesis by downregulating VEGF, and prevent metastasis by inhibiting matrix metalloproteinases and adhesion molecules.	30,37
6	*Blighia sapida*	Ackee or Akee, Isin and ikong-ubong.	Flavonoids, phenolic compounds, alkaloids and saponins	Inhibition of the ERK5 signaling pathway, which is implicated in cancer progression, particularly in breast cancer. Possess antioxidant and anti-inflammatory properties	40
7	*Dioscorea dumetorum*	Bitter yam, Esuru, and Ji una	Diosgenin, tannins, flavonoids, alkaloids, saponins and cyanogenic glycosides	Inhibits cancer cell proliferation, induces apoptosis, and modulates key signaling pathways such as NF-κB, AKT, and MAPK, while also possessing antioxidant and anti-inflammatory properties that contribute to its overall anticancer effects.	44,45
8	*Psidium guajava*	Guava, Gwaiba, guaba & ugwoba	Flavonoids, tannins triterpenoids, sesquiterpenes, volatile oils, carotenoids, ellagic acid, and phenolic compounds	Induce apoptosis in cancer cells and inhibit key signaling pathways like AKT/mTOR/S6K1, thereby disrupting tumorigenesis and reducing cell proliferation.	54,55
9	*Talinum triangulare*	Water Leaf, Gbure, mgborodidi, alenyruwa	Capsaicin, cucurbitacin B, quercetin, lycopene, baicalin, apigenin, catechins, and isoflavones	Induced apoptosis, inhibits cancer cell proliferation, enhances immune response, and reduces oxidative stress.	58
10	*Launaea taraxacifolia*	Wild lettuce or African lettuce, efo yanrin and nonanbarya	Flavonoids, triterpenoids, saponins, alkaloids, phenolic acids, and tannins	Exhibits anticancer mechanisms primarily through its antioxidant properties, which help neutralize free radicals, reduce oxidative stress, and inhibit cancer cell proliferation.	63,65
11	*Solanum macrocarpon*	African eggplant or garden egg, Ganyen gauta, efo igba, and Akwukwo anyara	Solasodine glycosides, nasunin, anthocyanins flavonoids, saponins, alkaloids, phenolic acids,	Induces apoptosis, inhibit cancer cell proliferation, and modulate key signaling pathways. Enhance the body's immune systems, including detoxification enzymes that neutralize carcinogens, through their synergistic actions, thereby bolstering the body's defense against cancer.	71,72
12	*Chrysophyllum albidum*	African star apple, cherry, agbalumo, udara	Flavonoids, Alkaloids, Phenolic acids and Triterpenoids	Possess antioxidant properties, exhibit anti-inflammatory effects, and may induce apoptosis in cancer cells, thereby contributing to its potential as a natural therapeutic agent in cancer prevention and treatment.	73,74
13	*Tetracarpidium conophorum*	African walnut, awusa or asala, ukpa, and gawadi bairi	Flavonoids, saponins, alkaloids, phenolic acids, and tannins	The primary mechanisms involve the modulation of COX-2 and PPAR-γ signaling pathways. Possess antioxidant properties, induce apoptosis, and inhibit cancer cell proliferation.	80

Akt, protein kinase B; COX-2, cyclooxygenase-2; ERK5, extracellular signal-regulated kinase 5; MAPK, mitogen-activated protein kinase; mTOR, mechanistic target of rapamycin; NF-κB, nuclear factor kappa-light-chain-enhancer of activated B cells; PPAR-γ, peroxisome proliferator-activated receptor gamma; PTP, protein tyrosine phosphatases; S6K1, ribosomal protein S6 kinase 1; VEGF, vascular endothelial growth factor.

and generally improve health outcomes. Thus, encouraging the use and further research of these native plants could be a vital element in developing effective dietary approaches for cancer prevention, halting the carcinogenesis process, or producing reasonably priced and easily accessible cancer treatments in areas where medical resources are limited.

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Conflict of interest

The authors report no conflict of interest.

Author contributions

Conceptualization (ABO, OIO), methodology (ABO, ASO, OOB, ABT, OOO), supervision (ABO, OAM, FB), software (AFE, BDC, OGO, UNA, OMO, ABT), writing original draft (AFE, BDC, OIO, OGO, UNA, AHC, AGO, AAD, AOP, ALA, OMO, OOO), review (OAM, FB, AHC, OCC, AGO, AAD, AOP, ALA, ACB, ASO, OOB, ABT, OOO), and editing (OAM, FB, OGO, UNA, AHC, OCC, AGO, AAD, AOP, ALA, ACB, ASO, OOB, OMO, OOO). All authors have approved the final version and publication of the manuscript.

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