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Research Article

Potential Anticancer Activity of Bioactive Compounds from *Ipomoea batatas*

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ABSTRACT

Ipomoea batatas L. (Lam.) known as "sweet potato" is a plant species of great importance in the human diet due to the contribution of nutrients and also for its bioactive compounds that have various medicinal properties. Its anticancer activity is one of the properties that attract the attention of researchers in the study of plant species. This review aims to make a critical compilation of current information on research that evaluated the antitumor and antiproliferative activity of *Ipomoea batatas*. The studies included in this review show a diversity of bioactive compounds present in *Ipomoea batatas* such as phenolic compounds, anthocyanins, flavonoids, coumarins and sterols; also isolated compounds such as pectin, peptides and glycoproteins that can be related to their biological activity. It is concluded that there are positive results about *Ipomoea batatas* and its anticancer activity evaluated through *in vitro* and *in vivo* tests. In humans, safety and efficacy trials are still lacking to support its future use and allow drug development. Further research evaluating the safety and efficacy of reported bioactive compounds in *Ipomoea batatas* is important for the development of this promising area.

Key words: Cancer, Sweet potato, Antiproliferative, Antitumoral.

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INTRODUCTION

The enormous advances and efforts that have been made in the prevention and treatment of cancer in recent years have not been enough, since they have not achieved control of the disease. Cancer remains the leading cause of morbidity worldwide.[1]

Evidence shows that the cause of cancer is multifactorial. Neoplastic cells change for a variety of reasons, including mutations that disrupt post- and co-transcriptional regulation of gene expression, natural selection, and genetic drift.[2,3] Dietary patterns with a high glycemic index and high glycemic load are associated with moderate adverse effects on colorectal and probably bladder and kidney cancers. There is also a possible moderate positive association between glycemic load and endometrial cancer.[4] Diets rich in saturated and trans-fatty acids (fatty dairy products and processed meats) and deficient in vitamins and minerals (low in vegetables and fruits) predispose to the development of prostate cancer through a series of mechanisms that stimulate cell proliferation cancer cells and the processes of angiogenesis.[5]

Myeloid neoplasms, a product of mutations, caused by prior exposure to chemotherapy and/or radiotherapy of primary hematologic malignancies, solid tumors and autoimmune diseases have been reported.[6] Also, there is evidence that an alteration of the microbiome (viruses, bacteria, fungi, and parasites) can be a cause of neoplasia and is an informative biomarker.[7]

Today, various methods are used for cancer treatment, such as surgery, radiation therapy and chemotherapy.[8] These methods have no selectivity and cause a high percentage of destruction of healthy cells and cancer cells.[9] In addition, chemotherapy causes adverse side effects and drug resistance; so there is a current trend to search for new compounds as therapeutic agents.[1,10]

Evidence suggests that the foods included in our diet usually contain high levels of bioactive compounds that help reduce the risk of developing degenerative diseases, such as cancer.[11,12] Plant species are considered an important source of bioactive compounds that have various therapeutic properties.[13] *Ipomoea batatas* L. *(Lam.)* known as "sweet potato", is a dicot belonging to the *Convolvulaceae* family, which is cultivated in China, sub-Saharan Africa, Indonesia, Asia and South America.[14,15] *Ipomoea batatas* are ranked as the seventh most important food crop after crops such as rice, wheat, potato, maize and cassava, due to their high yield, high adaptability and resistance.[16,17]

In this work, a critical compilation of the current information on the main bioactive compounds reported in *Ipomoea batatas* and their anticancer activity was carried out, discussing the possible underlying mechanisms. This review hopes to provide a perspective for future research on anticancer compounds from *Ipomoea batatas*.

ANTICANCER EVALUATION OF SWEET POTATO

Sweet potato (*Ipomoea batatas*) is one of the world's most important food crops. Its leaves, stems, and tubers are consumed by an increasing number of people, especially in Asian countries,[18] because it plays an important role as a source of energy and phytochemicals in human nutrition.[19] *Ipomoea batatas* are characterized by the diversity of colors of the skin and roots that vary from white to yellow, orange and dark purple. The peels contain different

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bioactive compounds (such as phenolics, flavonoids, anthocyanins and carotenoids),[20] which have a high nutritional value and great therapeutic importance, including antioxidants, antimutagenic, anti-inflammatory, antimicrobial and anticancer properties. Therefore, they are important for various health-promoting functions in humans.[21,22]

Extracts from different parts of *Ipomoea batatas* exhibit anticancer and antitumor properties by inhibiting proliferation and inducing apoptosis in cancer cells.[23] Plant extracts are evaluated both *in vitro* on cancer cell lines and *in vivo* using different animal models.[24] The main anticancer evaluation studies of *Ipomoea batatas* are described in Table 1.

ANTICANCER MECHANISMS OF BIOACTIVE COMPOUNDS

Ipomoea batatas have in their various parts (leaf, stalk, stem, skin and flesh) main compounds such as phenolic acids, flavonoids, and anthocyanins.[48] Other phytochemicals, such as alkaloids, anthraquinones, oxalates and steroids, are reported in the leaves at concentrations of 345.7, 328.4, 1.66 and 0.375 mg/100 g dry weight, respectively and lesser amounts of phytic acid, cyanide, saponins and tannins.[49]

These bioactive compounds exert anticancer effects independently or synergistically with other compounds through regulation of metabolic and signaling pathways, inhibition of enzymes vital for cancer progression, angiogenesis, microtubule assembly and induction of apoptosis.[50] (Figure 1)

Flavonoids

Flavonoids are a type of natural antioxidant substance capable of eliminating free superoxide radicals, thus showing anti-inflammatory properties and reducing the risk of cancer.[51] The concentration of quercetin in leaves of *Ipomoea batatas* purple variety reports a concentration of 0.26 Mm.[52] *In vitro* and *in vivo* studies showed that quercetin was capable of inhibiting cell viability when tested in leukemic cells, colon, and ovarian carcinoma cells, and especially human breast cancer cells.[51] The leaves of *Ipomoea batatas* report the presence of hyperoside, quercetin-3-O-hexoside, luteolin-7-O-glucoside and kaempferol-3-O-glucoside.[53]

Quercetin, rutin and other dietary flavonoids inhibit carcinogenesis in animal models, inducing apoptosis in tumor cells and alternative cell death processes in epithelial cells, including autophagy and paraapoptosis.[54] Quercetin inhibits metastasis due to suppression of extracellular matrix remodeling and reduces tumor promotion and progression events via suppressor matrix metalloproteinase. Quercetin increases the expression of proapoptotic proteins, including Bax and Bak; while the expression of Bcl-2 decreases. Bax causes apoptosis by directly modulating caspase-3 expression.[55]

Flavonoids acting as pro-oxidants could suppress cancer cell proliferation by inhibiting epidermal growth factor receptor/mitogen-activated protein kinase (EGFR/MAPK), phosphatidylinositide 3-kinase, protein kinase B and nuclear factor kappa light chain enhancer of activated B cells.[56]

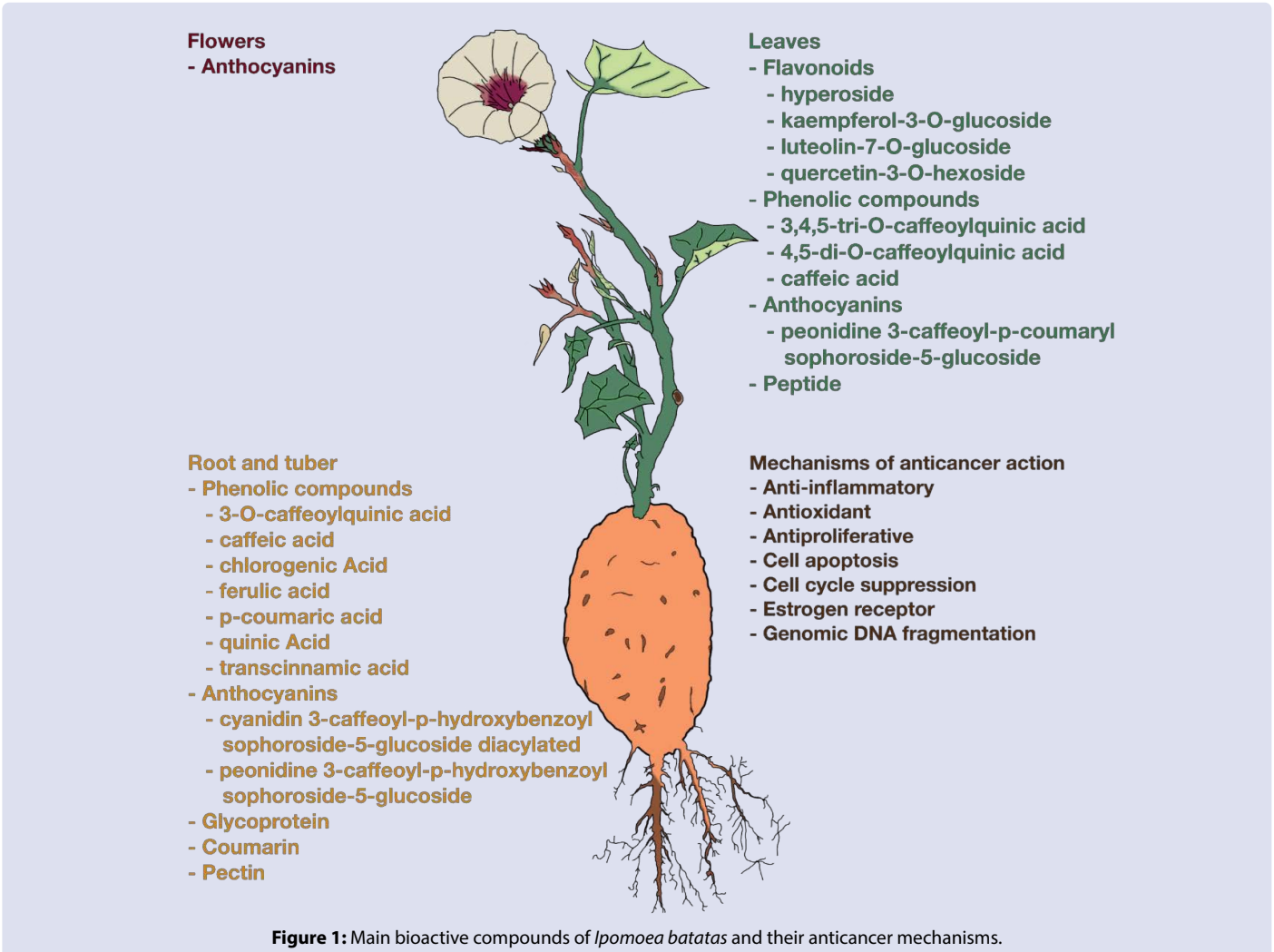

Figure 1: Main bioactive compounds of *Ipomoea batatas* and their anticancer mechanisms.

Table 1: Studies evaluating the anticancer activity of *Ipomoea batatas*.

Plant part	Extract	Doses	Bioactive compounds	Experimental model	Results	Mechanisms	Conclusion	Ref.
Root, leaves	Aqueous and ethanolic	25, 50, 100, 200, 400, 800 and 1000 µg / mL	Phenolic compounds and flavonoids	Antiproliferative Assay: NB4 Human Lymphoma Cell Line	$IC_{50:}$ Water extract of vein 449.6 µg/mL, Root aqueous extract: 594.6 µg/mL, aqueous leaf extract: 697.8 µg/mL, ethanolic root extract: 791,9 µg/mL and ethanolic leaf extract: 1221,1 µg/mL.	Antioxidant activity is associated with the ability to inhibit tumor cell proliferation	Water extract of the vein showed strong antiproliferative activity	(25)
Tubers	Acidified ethanolic of tuber peeled (SP) y no peeled (SNP)	1, 2, 3, 4, 5, and 6 mg/ mL	Anthocyanins	Antiproliferative assay: MCF-7 (breast cancer), WiDr (colon adenocarcinoma), and SNU-1 (gastric cancer).	IC_{50} at 72 h: MCF-7 (SP: 4.1 mg/mL, SNP: 3.4 mg/ mL), SNU-1 (SP: 2.7 mg/ mL, SNP: 3.6 mg/mL), WiDr (SP: 5.9 mg/mL, SNP: 4.6 mg/mL)	Anti-inflammatory mechanism: Suppresses the production of nitric oxide (NO) and some proinflammatory cytokines, such as NFκ-β, TNF-α e IL-6	The extracts of *Ipomoea batatas* purple variety showed anti-inflammatory and anticancer activities.	(26)
Leaves	Methanolic extract	8, 40, 200, 1,000 and 5,000 µg/ml	Polyphenolic components	Antiproliferative assay: Rat liver epithelial cell (WB-F344), Liver cancer cell (ATCC-HB-8065), Stomach cancer cell (SNU-1), Colon cancer cell (SNU-C-1), Lung cancer cell (ATCC-CCL-185) and Uterus cancer cell (ATCC-CCL-2)	IC_{50} (µg/ml) WB-F344: 1,035, SNU-1:244, SNU-C-1:854, ATCC-CCL-2: 950, ATCC-HB-8065: 2,125, ATCC-CCL-185: 2,494	Inhibition of tumor cell proliferation	IC_{50} of stomach cancer cells was lower than that of normal rat liver epithelial cells	(27)
Tubers	Hydroalcoholic extract and fractions	1, 2.5, 5 and 10 µg/ml	Anthocyanins	Antiproliferative assay: PC-3 and LNCaP (prostate cancer)	IC_{50} (µg/ml) Extract: 5–10 Fractions: 2.5–5	Cancer cell apoptosis	The caspase-independent pathway is the major pathway for cell death in PC-3 cells, whereas LNCaP cell death was both caspase-dependent and caspase-independent.	(28)
Leaves	16-amino-acid peptide	1,10 y 100 (pM,nM,µM)	Peptide	Antiproliferative assay: PANC-1 (pancreatic cancer)	20–30% of inhibition	Cancer cell apoptosis and genomic DNA fragmentation	Caspase-3 and poly(ADP-ribose) polymerase are activated, increasing levels of cleaved caspase 3 and 9.	(29)
Tubers	Ethanolic extract (n-hexane fraction) of sweet potato peel	100 µg/ml	Polyphenolic components	Antiproliferative assay: Colon 1-DLD-1, Colon-2-SW-620, Lung-A549, Breast-1-MCF-7, Breast-2-MDA-MB-231 and Head and neck-FaDu	Inhibitory activity 76.79%, 64.31%, 93.72%, 84.35% and 77.72% for colon-1, colon-2, breast, lung and head, and neck cancer cell lines, respectively	Inhibition of tumor cell proliferation	The chromatographic fraction IB F002c has greater anticancer potential	(30)
Leaves	caffeic acid, chlorogenic acid, 3,4-di-O-caffeoylquinic acid, 3,5-di-O-caffeoylquinic acid, 4,5-di-O-caffeoylquinic acid, and 3,4,5-tri-O-caffeoylquinic acid	10-1000 µM.	Polyphenolic components:	Antiproliferative assay: stomach cancer (Kato III), promyelocytic leukemia cell (HL-60) and colon cancer (DLD-1).	Kato-III cells, 3,5- and 4,5-diCQAs suppressed 20-40% of the proliferation at concentrations of 100-500 µM, DLD-1 cells, 3,4-, 3,5-, and 4,5-diCQAs dose dependently suppressed 20-40% of the proliferation, HL-60, 3,4-, 3,5-, and 4,5-diCQAs and 3,4,5-triCQA dose dependently suppressed 40-90% of the proliferation at concentrations between 100 and 1000 µM.	Cancer cell apoptosis and genomic DNA fragmentation	The 3,4,5-tri-O-caffeoylquinic acid effectively depressed the growth of three kinds of cancer cells.	(31)

Roots	Purple sweet potato (flesh), Purple sweet potato (skin) and Anthocyanin-rich extract	Diets containing 10% sweet potato flesh, 10% sweet potato skin, or 0.12% Anthocyanin rich-extract for 18 weeks.	Anthocyanins	Genetic model of colorectal cancer C57BL/6J-APCMIN/+ (APCMIN) mouse	The reduction of polyps ≤ 2 mm in diameter with the three supplemented diets	Inhibition of tumor cell proliferation	The sweet potato-supplemented diets reduced the adenoma number in the APCMIN mice	(32)
Roots	Anthocyanin from purple sweet potato (PSP)	100, 500, or 1,000 mg/kg	Anthocyanins	Animal model: (implanted with tumor cells S180)	PSP at 500 and 1000 mg/kg inhibits tumor growth by 43.28 and 68.03%, respectively	Antioxidant activity is associated with the ability to inhibit tumor cell proliferation	PSPA effectively suppressed tumor growth with the highest inhibition rate of 68.03%.	(33)
Roots	Daucosterol linolenate (DLA), daucosterol linoleate (DL), and daucosterol palmitate (DP).	DLA (10, 20, 40, 80, and 160 µg/mL), DL (5, 10, 20, 40, 80, and160 µg/mL), or DP (10, 20, 40, 80, 160, and 320 µg/mL)	Sterols	– Cell viability assay: MCF-7 and MDA-MB-231 (breast cancer) – Animal model: xenograft nude mice	DLA survival rates at 40, 80, and 160 µg/mL were 62.77%, 44.85%, and 41.02%, respectively; DL at 10 and 160 µg/ml ranged from 38.64 to 84.47% DL at 40 to 160 µg/mL was 16.26 to 23.52%. The decrease in tumor weight for DLA, DL, and DP was 56.53% and 45.97%, and 62.53%, respectively.	Phytosterols can influence estrogen receptor function, resulting in inhibition of cell proliferation	Treatment with DLA, DL, and DP resulted in a marked decrease in tumor development and in the expression of tumor markers.	(34)
Tubers	Anthocyanin-enriched extract	Anthocyanins	Anthocyanins	- Antiproliferative assay: SW480 (colon cancer) - Animal model: CF-1 mice, inducer: azoxymethane (AOM)	Viability after treatment was generally greater than 80% in adherent cells Reduction of aberrant crypts induced by AOM in doses of 10 to 30%. The 30% dose decreased the expression of caspase-3 as a biomarker of apoptosis.	A dose-dependent decrease in cell number due to cytostatic cell cycle arrest in the G1 phase	Anthocyanin extract inhibits the growth of cancer cells by inducing cell cycle arrest.	(35)
Leaves	Methanolic extract	1–1000 µg/ml 400 mg/kg	Polyphenols and anthocyanins	Antiproliferative assay: Human prostate cancer cell lines (LNCaP, DU145, PC-3, C4-2, C4-2B)	DNA degradation and inactivation of Bcl2, upregulation of BAX, cytochrome c release, and activation of apoptotic signaling. Oral administration markedly inhibited the growth and progression of prostate tumor xenografts by 69% in mice	Cancer cell apoptosis and genomic DNA fragmentation	There is a significant antiproliferative activity in a panel of prostate cancer cell lines, but normal prostate epithelial cells are not affected.	(36)
Roots	daucosterol linoleate (DL)	5, 10, 20, 40, 80 and 160 µg/ml 25, 50 and 100 mg/kg	Sterols	– Cell viability assay: 4T1, MCF-10A, MCF-7 and MDA-MB-231 (breast cancer) – Animal model: xenograft nude mice (Breast Cancer)	IC50 53.27 µg/mL (MCF-7) DL inhibited tumor growth and tumor weight at 100 mg/kg in MCF-7 xenograft nude mice.	DL inhibited the cell viability of estrogen receptor (ER)-positive MCF-7 breast cancer cells, DL diminished the expression of Bcl-xl, Bcl-2, and XIAP. DL regulated the expression of phosphoinositide 3-kinase/protein kinase B and repressed Insulin-induced phosphoinositide 3-kinase/protein kinase B activation.	There is an antiproliferative activity in cancer lines that inhibits tumor growth in the mouse model.	(37) (38)

Roots	Sweet potato pectin (SPP), 200 W and 400 W sonication (SSPP)	0.1, 0.25, 0.5, 0.75 and 1 mg/ml	Pectin	Antiproliferative assay: HT-29 (human colon cancer)	SSPP of 400 W produces a reduction of cell proliferation by more than 70%. IC50 for 400 W SSPP was 0.5 mg/ml, while for 200 W SSPP it was about 0.75 mg/ml	Caspase-3 involvement in pectin-induced cell death indicates apoptotic cell death.	SPP showed the lowest inhibition, with a maximum of 25% at 0.75 mg/mL, and SSPP 400 W had higher activity than SSPP 200 W	(39)
Tubers	Alcoholic extract and fractions of sweet potato peel	100 and 200 µg/ml	Glucocerebroside, Octadecyl coumarate, 7-hydroxycoumarin, and 6-methoxy-7-hydroxycoumarin	Antiproliferative assay: MCF-7 (breast cancer), DLD-1 and SW-620 (colon cancer), SK-OV-3 (ovary cancer), A-549 (lung cancer), FaDu (Head and Neck Cancer)	IC50 of IB-F002C values 24.75, 47.91, 52.37, 34.17, 46.07, and 25.89 mg/ml against breast, colon-1, colon-2, ovary, lung, and head/neck cancer cell lines, respectively	Antioxidant activity is associated with the ability to inhibit tumor cell proliferation	The IB-F002c fraction has anticancer potency against breast cancer cell lines-1 and head and neck cancer	(40)
Tubers	Acidified ethanolic extract of purple sweet potato anthocyanins (PSPA)	100, 300, 500, 800 and 1000 µg/ml	Anthocyanins	Antiproliferative assay: 5637 and T24 (Bladder cell lines)	The inhibition rate of the PSPA at 800 µg / ml was > 60% after a 72-h incubation	PSPA produces G2/M arrest which is a DNA damage checkpoint in cell cycle regulation and suppresses cell cycle progression. In addition, there is a decrease in caspase-3, Fas, Fasl, Bcl-2 and inhibition of PI3K / Akt	PSPA exerts antitumor effect through suppression of cell viability, promotion of apoptosis, and induction of cell cycle arrest	(41)
Tubers	Extract from baked sweet potato and fractions	0.5, 1,1.5 and 2 µg/ml	Phenolic compounds	Antiproliferative assay: HL-60 (leukemia)	Maximum inhibition was observed at the concentration of 2 mg/mL, inhibition of 65% with fraction II-a and 57% with fraction III, respectively	Genomic DNA Fragmentation	The antiproliferative effect was dose-dependent.	(42)
Tubers	SPG-56 Extract	5 to 320 µg/ml	Glycoprotein	Animal model: xenograft nude mice (Breast Cancer)	The serum tumor markers CEA, CA125, and CA153 in a 240 mg/kg/d SPG-56 decreased by 54.8%, 91.8%, and 90.3%, respectively.	SPG-56 inhibited the metastasis of breast cancer in MCF-7 and 4T1-bearing mice by altering the expression of MMP2, MMP9, VEGF, Occludin, and Claudin.	SPG-56 may have potential as a novel anti-tumor candidate for breast cancer	(43)
Tubers	Ten varieties: YS7, HX22, YS43, WS7, YS25, YZ7, YY153, CS1, XY34 and YS15	2,4 and 6 mg/ml	Phenolic compounds	Antiproliferative assay: Liver Cancer HepG2 Cell	YS43, YS7 and YZ7 appeared to show the strongest antiproliferative activity with IC50 values of 4.663 mg/mL fresh weight (FW), 5.162 mg/mL FW and 5.287 mg/mL FW respectively.	Antioxidant activity is associated with the ability to inhibit tumor cell proliferation	Purple-fleshed varieties, such as YS43, YZ7 and YY153, have higher total phenol content and antioxidant capacities, as well as higher antiproliferative activity.	(44)
Tubers	SPG-8700 extract	25 and 50 µg/mL	Glycoprotein	- Antiproliferative assay: HCT-116 (colon cancer) - Animal model: xenograft nude mice.	IC50 of SPG-8700 against HCT-116 cells is 44.7 µg/mL After SPG-8700 treatment, the three indicators with CA242 decreased by 24.1%, CA199 decreased by 15.7%, CA125 decreased by 34.8% in the therapy group.	SPG-8700 promoted apoptosis in HCT-116 cells by regulating Bcl-2 and Bax expression	SPG-8700 has antitumor activity and had no effect on normal cell growth	(45)

Leaves and tubers	Methanol/ trifluoroacetic acid extract.	100, 200 and 400 µg/mL	Anthocyanins	Antiproliferative assay: MCF-7, HCT-116, and HeLa cancer cells	The apoptotic effect was relatively greater in MCF-7 cell lines at concentrations of 100 µg/ml and above	Cell cycle arrest in G0/G1 phase, by direct inhibition of CdK4 and cyclin D1 protein expression	MCF-7 cancer cells treated with leaf and tuber anthocyanins (100 µg/mL) for 48 h exhibited substantial cell cycle arrest and induction of apoptosis. (46)
Tubers	Lipid-soluble fraction of polyphenols (PPL)from fermented sweet potato.	120 mg/kg/ day	Phenolic compounds	Animal model: E0771 murine breast cancer cells	PPL arrested the cell cycle at G0/G1 by suppressing Akt activity and enhancing the cytotoxicity of anticancer agents. PPL inhibió significativamente el crecimiento tumoral (Día 22, control: 1.470,2 mm^3; PPL: 973,1 mm^3)	Antioxidant activity is associated with the ability to inhibit tumor cell proliferation	PPL inhibited tumor growth and enhanced the efficacy of chemotherapy drugs (47)

Phenolic compounds

The main phenolic compounds of *Ipomoea batatas* are caffeic acid, p-coumaric acid, ferulic acid and 3-O-caffeoylquinic acid.[57] The polyphenol content in the roots of *Ipomoea batatas* varies from 23.3 to 43.8 mg of caffeic acid/g,[58] and in a range of 146 to 266 mg of gallic acid/100 g.[59] In *Ipomoea batatas* leaves, caffeic acid, 4,5-di-O-caffeoylquinic acid, and 3,4,5-tri-O-caffeoylquinic acid are reported as its main phenolic compounds.[60]

Phenolic compounds are antioxidant molecules;[57] that possess important biological activities such as anti-inflammatory and anticancer activities.[11,61] The anticancer property includes a wide variety of regulatory mechanisms including cell cycle progression, promotion, modulation of enzyme activities, mitogen-activated protein kinase (MAPK) signaling pathway, apoptosis induction, and metastatic invasion.[11,62]

Anthocyanins

Anthocyanins are widely distributed in the leaves, flowers, roots, fruits and grains of many colorful fruits and vegetables.[63] Anthocyanins are responsible for the purple coloration of the pulp and peel of *Ipomoea batatas*.[14] The inclusion of anthocyanins in the diet is associated with decreased risk of cardiovascular and metabolic degenerative diseases, improvement of visual and brain function, cancer chemoprevention, anti-inflammatory, hepatoprotective and hypoglycemic activities even when bioavailability is low.[64] The average anthocyanins in purple *Ipomoea batatas* is 110-210 mg/100 g[65] and 515-1747 mg/kg.[66]

Anthocyanin glycosides that inhibit cancer cell growth include cyanidin, peonidin, delphinidin, malvidin, pelargonidin, and petunidin.[67] The main anthocyanins of *Ipomoea batatas* morada are peonidin 3-sophoroside-5-glucoside and cyanidin 3-sophoroside-5-glucoside, which are mono or diacylated with caffeic, ferulic and p-hydroxybenzoic acids. These acylated anthocyanins represent more than 98% of the total anthocyanin content in the purple variety.[66] A new anthocyanin (peonidin 3-caffeoyl-p-coumaryl sophoroside-5-glucoside) has also been identified in the leaves of purple *Ipomoea batatas*.[68]

The amounts of diacylated cyanidin 3-caffeoyl-p-hydroxybenzoyl sophoroside-5-glucoside and peonidin 3-caffeoyl-p-hydroxybenzoyl sophoroside-5-glucoside in the roots of purple *Ipomoea batatas* are 137.0 and 565.9 mg/100 g dry weight, respectively. But by steaming the roots, the total anthocyanin content was almost halved; while roasting only slightly reduced the total anthocyanin content.[69]

Anthocyanins possess anti-inflammatory activities by suppressing the production of nitric oxide and some proinflammatory cytokines such as NFκ-β, TNF-α and IL-6, in LPS-induced macrophage cells[26] and control the proliferation of malignant cells probably also by cell cycle arrest.[70] A large positive relationship between anthocyanin content and anticancer action is reported, due to overexpression of the anthocyanidin synthase gene, which is related to antioxidant capacity and cytotoxic effects.[71] Cyanidin-3-glucoside is an effective agent in the ApcMin intestinal cancer model, interfering with experimental skin tumorigenesis, resulting in decreased lung tumor growth and metastasis in the A549 nude mouse xenograft model.[72]

FUTURE PERSPECTIVES

Many isolated plant compounds are being rigorously tested for their anti-cancer properties and it is increasingly recognized that the beneficial effects of plants are due to a complex interaction of the composite mixture of bioactive compounds present throughout the plant either by additive or synergistic.[73]

Studies need to focus on evaluating the bioavailability of a bioactive compound that is incorporated into the diet as a nutrient.[74] Furthermore, the use of bioactive compounds is limited because insufficient data is available regarding safety and efficacy. Therefore, future studies should encourage the evaluation of pharmacokinetic activities and *in silico* analyzes of bioactive compounds.[24]

CONCLUSIONS

The use of *Ipomoea batatas* is a potential alternative in cancer prevention and therapy, due to its bioactive compounds such as phenolic compounds, anthocyanins, flavonoids, coumarins and sterols. Also isolated compounds such as pectin, peptides, and glycoproteins with *in vitro* and *in vivo* evidence of anticancer activity. Safety and efficacy studies are recommended.

CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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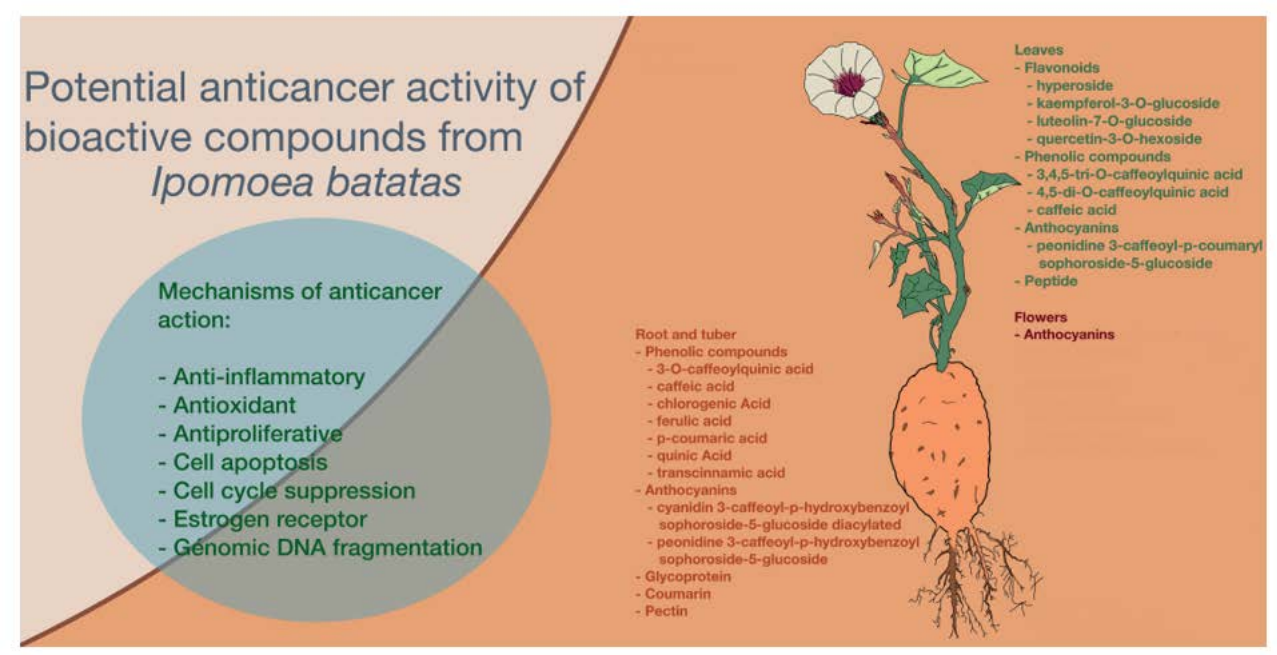
GRAPHICAL ABSTRACT



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