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REVIEW ARTICLE

Nature's Pharmacy: Harnessing Plant and Animal-Derived Agents for Cancer Therapy

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ABSTRACT

Objective and Background: Studies have shown that phytochemicals from plants like flavonoids, terpenes, and alkaloids and peptides from animal sources can be very effective in cancers remission. Current review explores the potential of natural compounds from plants and animal sources in cancer treatment and examining how they complement or serve as alternatives to traditional therapies.

Methods: In order to conduct the review; literature has been collected from 2004-2024 by pre-defined literature inclusion criteria. Literatures included based upon PRISMA and quality assessed by GRADE criteria.

Findings: Flavonoids, terpenes, and alkaloids from plants and peptides from animal sources demonstrated strong anticancer activity by persuading apoptosis, inhibiting tumor cell growth, and preventing metastasis with potentially lower toxicity than conventional treatments. Paclitaxel from *Taxus brevifolia*, curcuma from *Curcuma longa*, asparaguses from *Asparagus racemosus*, vinblastine from *Catharanthus roseus*, solamargine from *Solanum nigrum*, ß-carotenoids from *Moringa olefera*, silamyrin from *Silybum marianum*, apigenin from *Apium graveolens*, plumbagin from *Plumbago zeylanica*, and many others have shown efficacy in inhibiting tumor growth of breast, colon, and prostate. Animal-derived products; melittin from bee venom, brevinin-2 and esculentin-1 from frog's skin, chlorotoxin from scorpion venom, l-amino acid oxiase from snake venom, halichondrin B from marine sponge has inhibited cancer cells migration in multiple types of cancers.

Conclusion: The integration of these natural compounds in oncology could yield more accessible, effective, and less toxic treatment options and contribute to sustainable, innovative approaches in healthcare. Nature's pharmacy offers a plethora of natural remedies that are beneficial in oncological intervention.

Keywords
Phytochemicals, Peptides, Cancers, Apoptosis, Metastasis, Remission.

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INTRODUCTION

Cancer is a complex, multi-factorial disease characterized by uncontrolled cellular proliferation and the potential for metastasis making it one of the major global cause of death[1]. Conventional therapies like chemotherapy, radiation and surgery are commonly employed in cancer treatment; these methods often come-up with significant side effects and are not always effective in curing the disease or prevention of recurrence[2]. Consequently, there has been an increase in interest in exploring alternative or complementary therapies derived from natural sources, including both plant and animal-based agents. The use of nature's pharmacy, which harnesses the therapeutic potential of bioactive compound present an exciting frontier in the fight against cancer. Over the centuries, various

civilizations have turned to the natural world for remedies, particularly to medicinal plants and certain animal-derived substances that exhibit potent anticancer properties.

Role of Plant-Derived Agents in Cancer Therapy

For ages, plants considered as a reservoir of bioactive compounds that could have therapeutic benefits; some of these compounds have been used clinically or found to have anticancer activity; hundreds of plant-derived compounds that are being studied in cancer research for in vitro or in vivo anticancer effects[3]. Plants are suited for those phytochemicals and medicinal compounds that are not synthetic. Most products including polysaccharides, flavonoids and polyphenols are being studied in the treatments for cancers with promising results[4].

Paclitaxel is utilized in the management of many cancers especially breast, ovarian and lung cancers and is an integral component in chemotherapy today[5]. Vincristine, an exctract from a plant called periwinkle (*Catharanthus roseus*) which inhibits the formation of spindle microtubules in eukaryotic cells and is given for the treatment of leukemia is another example[6]. The compound curcumin, derived from the spice turmeric (*Curcuma longa*) has also received much interest because of its anticancer effects[7]. Specifically, it has been proven to inhibit the growth of several cancer cell lines through alteration of the signaling pathways involved in cell growth, apoptosis and angiogenesis[7]. Its anti-inflammatory as well as the antioxidant effects have potential to be more attractive as a chemopreventive agent[8]. Nonetheless, the challenges faced by curcumin are its low bioavailability and strategies are being sought to improve its delivery and absorption in humans[9].

Animal-Derived Products in Cancer Treatment

Phytochemicals are the most popular subject of research; on the other side some bioactive compounds of animal origin have shown anticancer activity as well. This included extracts from ingests, marine life or various animal glands, which represents a variety of bioactive agents which may have different action on cancer cells[10]. One of bioactive agents of animal origin that has been studied for anticancer activity included beeswax which comes from honey bee (*Apis mellifera*)[10]. Importantly, beeswax has also been active against melanoma and leukemia by protein synthesis inhibition and apoptosis induction[11]. Furthermore, in the area of cancer treatment, shark cartilage is another animal product that has attracted considerable attention.[12] It is believed to possess anti-angiogenic activity[12]. Toad venom, particularly bufotoxin has long been employed in traditional Chinese medicine; Huachansu, a toad venom extract has shown effectiveness in hepatocellular carcinoma (HCC) treatment[13]. The available scientific data conclusively supporting cancer treatment with the use of shark cartilage, however, data is remaining scarce, thus other studies are aimed for proving its effectiveness and safety.

Mechanisms of Action and Molecular Targets

The effectiveness of natural substances in the treatment of malignancy can be explained by their ability to interfere in the molecular pathways specific to cancer development and progression[14]. A number of such compounds act as scavengers; they eliminate reactive oxidative species (ROS) that cause damage to the DNA and leading to cancerous cells formation[14]. Some others possess the ability to inhibit inflammation and hence disrupt pathways that are known to be activated in cancer[15]. In addition, a few natural agents have been shown to promote apoptosis which is a natural mechanism of cell elimination that is often lost in cancer cells leading to unregulated proliferation[16].

The main objective of current narrative review is an evaluation, which focuses on the prospects of plants and animal-derived agents in cancer therapy with their mechanisms of action, efficacy, and difficulties in their application in clinical practice; further underscoring the therapeutic potential of such natural agents as an alternative or complements to conventional cancer treatments.

MATERIALS AND METHODS

To write a narrative review on harnessing plant and animal-derived agents for cancer therapy from 2004 to 2024, three authors have conducted a literature survey. The key word and truncation techniques were used to gather pertinent information from literature; PubMed, Directory of Open Access Journals (DOAJ), BioMed Central, Google Scholar, PakMediNet, National Database of Indian Medical Journals, African Journals Online (AJOL), Bioline International, and Emerald were the databases used for collection of literature. Eighty-two articles on cancer

therapy were downloaded; seventy-nine were selected after abstracting the pertinent information from the studies; data synthesized and presented by PRISMA diagram shown in Figure **1**. The PRISMA diagram was identified, how outcomes of abstract was screening, the consequences of eligibility assessment; a detail of reasons for exclusion, and details of included studies[17]. Articles eligible for a full text were 48. All articles assessed for type of journal, method of data collection, statistical tests applied, corresponding p-values, and their interpretations. Quality of literature was assessed using Grade (Grading of Recommendation Assessment, Development and Evaluation) criteria[18]. Grade is a system for rating quality of evidence in systematic reviews regarding the best available literature.

Literature Inclusion Criteria

Evidences regarding cancers, its current modes of treatments by the use of natural sources, new developments and role of different plants and animal derived agents in cancer treatment published from 2004 to 2024.

Evidences/Literature Exclusion Criteria

Prior to 2004, there was literature on cases of malignancies treated with various medicines derived from plants and animals.

RESULTS

After cirtical review and evaluation of the literature; finding refers to treatment of cancer through plant derived drugs explained in Table **1**, where as animal derived anti cancer drugs are explained in Table **2.**

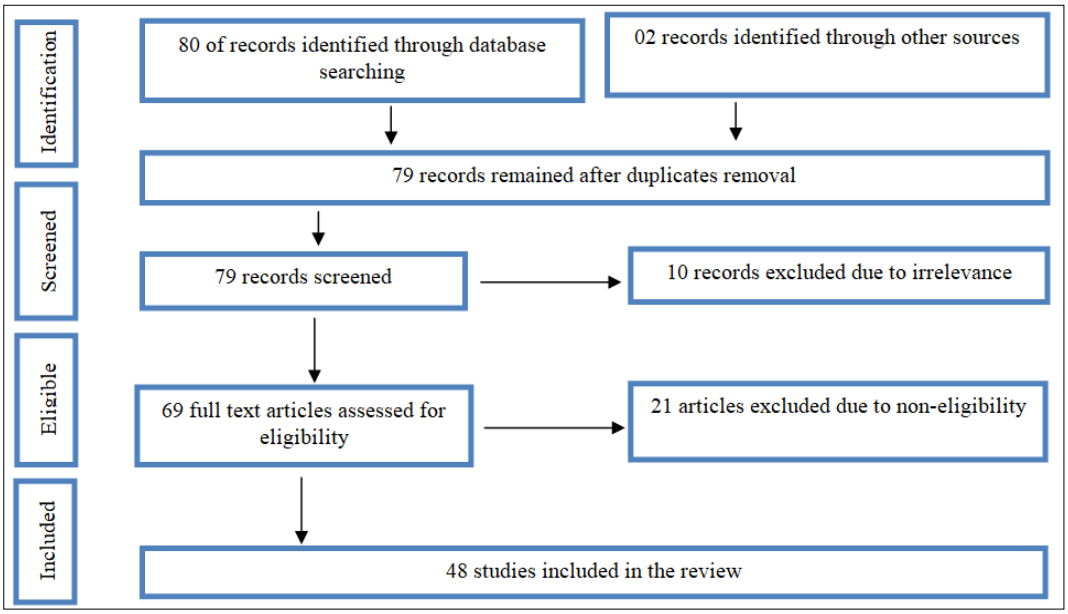

Figure 1. PRISMA diagram.

Table 1. Medicinal Plants and Their Phytochemicals Used Against Specific Type of Cancers.

No.	Type of cancer	Study year	First Author	Source	Phytochemicals	Outcomes and References	Quality of Evidence
1	Ovarian Cancer, Colon Cancer, Skin Cancer, Breast Cancer, Lung Cancer	2013	Ranjani Ramakrishnan	*Zingiber officinale* (Zingiberaceae)	zingeberene, shagol, gingeol, curcumene, farnesene, bisabolene, b-sesquiphellandrene	The constituent of ginger roots acts on non-small-cell lung cancer cells by mechanism release of cytochrome c;	High

					linalool, and geraniol	while whole giner root and gingerol used to treat ovarian cancer by inhibiton of NF-Kb cell; gingerol also used in breast cancer by inhibiting leukotriene mediated inflammatory activity; it also increases apoptosis in skin cancer cells[19].	
2	Colorectal, Breast, and Prostate Cancers	2015	Zoya Tahergorabi, Mohammad Reza Abedini, Moodi Mitra	*Ziziphus jujube* (Rhamnaceae)	zizyberanalic, epiceanothic, ceanothenic, betulinic, oleanolic, ursonic, and zizyberenalic acids, ziziberanalic acid and ursolic acid	Antitumor effects noted on the human colon carcinoma cell lines HC-T15 (Colorectal cancer); ursolic acid and oleanolic acid induced apoptosis in HL-60 leukemia cells; B16F10 melanoma cells; MCF-7 breast cancer cells; and DU-145 prostate cancer cells[20].	High
3	Colon and Lung Cancer	2016	Peter Amwoga Ayeka	*Glycyrrhiza uralensis* (Fabaceae)	Iso-liquiritigenin, glycyrrhizin and glabridin	*G. uralensis* has shown inhibitory effect on colon carcinoma cell lines (CT-26)[21].	Moderate
4	Breast Cancer	2016	Ying-Jang Lai	*Solanum nigrum*(solanaceae)	solanine, solasonine, solamargine, a-L-rhhamnopyranose, uttroside B, degalactotigonin, glycoprotein	The study concluded that aqueous extract of *Solanum nigrum* is potentially beneficial in the treatment of breast cancer cells MCF-7[22].	High
5	Breast, Pancreatic, Skin Cancers, and Leukemia	2016	M. Chamikara, Ali Al-Samydai	*Capsicum annuum* (Solanaceae)	Capsaicin, Beta Carotene, Vitamin A and vitamin C	Activity observed against cancer cell lines (Breast cancer (MC7), Cancer of pancrease (PANC1), and Skin cancer (A375) epithelial	Moderate

						cells, and Leukemic (K562) lymphoblast cells. the extract show significant selectivity against these cancer cells[23].	
6	Hodgkin's Disease, Breast Cancer, Skin Cancer and Lymphoblastic Leukemia	2017	Jai Narayan Mishra, Navneet Kumar Verma	*Catharanthus roseus* (Apocynaceae)	Vinblastine, vincristine, Vindoline, ajmalicine, serpentine, and reserpine	*Catharanthus roseus* was shown the substantial antitumor efficacy against a variety of cells in the in-vitro condition as well as against the tumors that are resistant to many drugs[24,25].	Moderate
7	Breast cancer, Prostate Cancer, Colorectal cancer, Leukemia, Bladder cancer, Glioblastoma	2018	Shahindokht Bassiri-Jahromi	*Punica granatum L.* (Lythraceae)	Polyphenols, Ellagitannin-derived compound, Ellagic acid, urolithins A and Punicalagin	Preclinical animal tests have shown that pomegranate extract can suppress the growth of lung, skin, colon, and prostate malignancies[26].	High
8	Breast Cancer	2019	Marium Batool, Samina Afzal, Khurram Afzal	*Ziziphus mauritana* (Rhamnaceae)	Abssenine B, Zazyphine D, Amphibine C, Oxyphylline A, rhamnose and arabinose	The study indicated that *Ziziphus mauritiana* has anticancer activity against human breast cancer cell line (MCF-7 cell line)[27].	Moderate
9	Breast And Gastric Cancers, Lung Malignant Growth Cells, Pancreatic Cells, Prostate Carcinomas, Malignant Ovarian Growth, and Ehrlich Ascites Carcinomas	2020	H. S. Kapare	*Plumbago zeylanica* (Plumbaginaceae)	plumbagin, Coumarins	Plumbagin has been shown to induce cell death in human gastric cancer cells and may be able to distinguish between malignant development cells in vitro and in vivo[28].	Low
10	Liver, Colorectal,	2020	Dharmeswar Barhoi	*Moringa olefera* (Moringaceae)	flavnoid, a-tocopherol, b-carotenoids	The anti-proliferation was tested on	Moderate

	and Breast Cancers					hepatocarcinoma (HepG2), colorectal adenocarcinoma (Caco-2) and breast adenocarcinoma (MCF-7) cells and human fibroblast cells; the results are very satisfactory[29].	
11	Lung, Liver, Skin, Colon Cancer	2021	M Azadpour	*Silybum marianum* (asteraceae)	Silymarin, Silibinin	Silymarin is utilized as an anticancer drug and is recommended in inhibition of Kappa Beta markers and also recommended in A549 cancer cell lines[30].	Low
12	Breast, Pancreatic, Skin Cancers, and Leukemia	2021	M. Chamikara, Ali Al-Samydai	*Capsicum annuum* (Solanaceae)	Capsaicin, Beta Carotene, Vitamin A and vitamin C	Activity observed against cancer cell lines (Breast cancer (MC7), Cancer of pancrease (PANC1), and Skin cancer (A375) epithelial cells, and Leukemic (K562) lymphoblast cells. the extract show significant selectivity against these cancer cells[31].	Moderate
13	Lung Cancer, Liver Cells Proliferation	2021	Mohammed Saleh Al Aboody	*Apium graveolens* (Apiaceae)	Apigenin, carotenes, tocopherols	The study revealed stronger cytotoxic effects against five respective cancer cell lines, L6, Vero, BRL 3A, A-549, L929, and L-929[21]	Low
14	Liver Cancer	2022	Nighat Gull, Arif Ahmad	*Asparagus racemosus* (Asparagaceae)	Asparaguses, diosgenin and shatavarins I and IV	Hepatic tissues treated diethyl nitrosamine immune-histo-chemically, clusters of cells with mutated p53 antigen are	High

						observed and Phytochemicals were useful in the treatment hepatocellular carcinoma[32].	
15	Human Melanoma, Colorectal, Endometrial, Breast and Liver Cancers	2022	Arif Ahmad, Nighat Gull	*Solanum nigrum* (Solanaceae)	solamargine, solasonine, alpha, and beta solanigrinechez	*S. nigrum* can minimize the CCl4-, which caused lipid peroxidation, and ultimately inhibits the liver carcinoma[32].	High
16	Colorectal Carcinoma, Breast Cancer	2022	Rizwan Ahmad	*Glycyrrhiza glabra* (leguminosa)	licochalcone-A, glycyrrhizinic acid, Isoliquiritigenin, formononetin, and glabridin	*Glycyrrhiza glabra* has higher cytotoxic effect against the HCT-116 and MCF7 cell lines[33].	Low
17	Digestive System Cancers	2023	Hongyu Pei.	*Solanum nigrum*(solanaceae)	solanine, solasonine, solamargine, a-L-rhhamnopyranose, uttroside B, degalactotigonin, glycoprotein	*S. nigrum* L. also offers enormous strength for treating digestive tract cancers[34].	High
18	Lung Cancer, Hepatocellular Carcinoma, Gastric Cancer, Breast Cancer, Colorectal Cancer, and Cervical Cancer.	2024	Jing Yu	*Ginkgo biloba* (Ginkgoaceae)	flavonoids and terpene lactones	The outcomes of this study shows positive impact in treatment of different cancerous cell[35].	Moderate

Table 2. Animal Derived Proteins and Peptides Used as Anti-Cancer Agents.

No	Type Of Cancer	Study Year	First Author	Source	Peptide Use	Outcome and Reference	Quality of Evidence
1	Prostate Cancer	2011	Park, Mi Hee	Bee (Bee venom)	Melittin	Reduced cell viability induced apoptosis[36].	Low
2	Breast Cancer	2015	Di Grazia, Antonio	Frog (Skin of frog)	Esculentin-1	Induced apoptosis in breast cancer cells[37].	High
3	Pancreatic Cancer	2020	Mikaelian, Arthur G	Scorpion (Scorpion venom)	Chlorotoxin	Inhibited cancer cells migration and invasion[38].	High
4	Melanoma	2021	Ju, Xiaoman	Frog (frog skin)	Brevinin-2	Reduced tumor size and migration[39].	Moderate
5	Colon Cancer	2022	Han, Ningning	Fish (Atlantic cod)	Gadusol	Improved survival rate, suppressed tumor growth[40].	High

6	Lung Cancer	2024	Prak, Krisna	Snake (snake venom)	L-amino acid oxiase	Induced apoptosis and inhibited lungs cells proliferation[41].	Moderate
7	Liver Cancer	2024	Dissanayake	Sponge (marine sponge)	Halichondrin B	Inhibited tumor growth, improved survival rate[42].	Low

DISSCUSSION

In this review, plants and animal base therapies possessed significant benefits including the apoptotic, anti-angiogenic, anti-inflammatory and antioxidant properties are discussed. The gathered data in this review highlighted the potential of natural compounds to inhibit cancer growth and to enhance patient survival. These benefits place them as complementary treatment to conventional therapies, offering alternatives with fewer side effects. However, challenges such as bioavailability, toxicity, and standardization remain a major focus for future research.

In an example of Paclitaxel, derived from *Taxus brevifolia* has become a cornerstone of chemotherapy by stabilizing microtubules to inhibit mitosis and induce cell death[5]. Studies reported that *Solanum nigrum* is effective in fighting the infections of breast and digestive systems cancers because of preventing the lipid per-oxidation reactions and proliferation of tumor cells[43]. Other plants that exert anticancer actions are *Moringa oleifera* which induces cyto-toxicity against cancerous cells of the liver, colon, and breast[44]; while *Glycyrrhiza glabra* exhibits cyto-toxic activities against each of the colorectal and the breast cancer cell lines[45]. The *Zingiber officinale*, popularly known as ginger also inhibits cancers across a large number of targets that include inhibition of NF-kß in ovarian and colon cancers; it also induced apoptosis in skin cancer cells.[19] Such findings suggested the fact that drugs based on plants not only target cancer cells of various types but also have natural alternatives with the right possibilities of fewer side effects than synthetic drugs[46]. Flavone flavopiridol is made from the plant alkaloid rohitukine, which was extracted from the stem and leaves of *Amoora rohituka*as as well as from *Dysoxylum binectariferum* respectively and possess anti-cancer activity against various types of cells.[47] According to another research study, plants like *Moringa oleifera* and *Punica granatum* (Pomegranate) have shown effectiveness against cancerous cells in preclinical studies[26,29]. Research on semi-synthetic tocopherol derivatives appeared promising in augmenting cancer therapy by helping to improve delivery and minimize side effects when applied as adjuncts to chemotherapy[48]. *Epigallocatechin gallate* (EGCG), a prominent poly-phenolic component present in green tea has proved potential in the treatment of cancer through its effect on tumor growth inhibition and cancer cells apoptosis across multiple cancer types including breast, liver and skin cancers[49]. Sulforaphane from *Brassica oleracea* (broccoli) exhibited anti-neoplastic characteristics by triggering detoxifying enzymes and encouraging apoptosis, especially in breast, colon and prostate malignancies[50].

Similarly, the inclusion of animal derived agents in Table **2** also offers unique mechanism for cancer treatment. These studies revealed that bioactive peptides and venom from frogs[37], scorpions[38], snakes[41], bees[36], and marine[42] organisms exhibit anticancer activity. Esculentin-1 from frog's skin effectively induce apoptosis in breast cancer cells[37], melittin from bee venom reduced cell viability and induced apoptosis in prostate cancer[36]. In addition, chloro-toxin from scorpion venom has demonstrated efficacy in treating pancreatic cancer by inhibiting cancer cell migration and invasion[38]. Notably, L-amino acid oxidase from snake venom has been used to inhibit lung cancer proliferation[41], while gadusol from fish enhanced survival rates in colon cancer.[40] Shark cartilages further exemplify how natural products can inhibit angiogenesis and promote apoptosis, though more clinical evidence is needed to confirm their efficacy[12]. Another recent research has investigated that the encapsulation of caffeic acid phenethyl ester (CAPE), a natural substance made from the propolis of honey-bees within iron oxide nanoparticles (IONPs) targeted towards cancer therapy; particularly in treating multiple myeloma (MM)[51]. This study highlights that encapsulation in iron oxide nano-particles enhances caffeic acid phenethyl ester (CAPE's) stability under physiological conditions and allow regulated release in acidic environments ideal for the targeting action at the site of tumors.[51] Marine-derived molecules like trabectedin

have been approved for soft-tissue sarcoma and ovarian cancers, underscoring the therapeutic potential of marine-based compounds in oncology[52].

The incorporation of such natural treatments into contemporary oncology may provide an increase in the availability and efficacy of treatment while simultaneously minimizing the toxicity to patients, thereby enhancing the quality of cancer treatment across different types of cancers.

CONCLUSION

Natural compounds exhibit anticancer effects by reducing tumor growth and selectively targeting cancer cells, thereby offering less toxic alternatives to conventional treatment. Alkaloids, flavonoids and other bioactive compounds from plant sources and bioactive peptides derived from animal sources demonstrated promising anticancer activity by modulating the immune response and inducing cell death in tumors. Together, these natural therapies offer accessible therapeutic possibilities in oncology, though further research is essential to confirm their clinical benefits.

CONFLICT OF INTEREST

All authors declare that they have no competing interests.

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