



SUMEJ

Sumatera Medical Journal

Journal homepage: <https://talenta.usu.ac.id/smj>



Review Article

Herbal Therapies in Cancer Patients: Managing Side Effects and Improving Quality of Life

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ARTICLE INFO

Article history:

Received 05 December 2023

Revised 26 December 2023

Accepted 15 December 2023

Available online 01 January 2024

E-ISSN: 2622-1357

P-ISSN: 2622-9234

How to cite:

Keshav Anand, Harpreet Kaur Massaon, P. K. Prabhakar, "Herbal Therapies in Cancer Patients: Managing Side Effects and Improving Quality of Life", SUMEJ, Vol. 07, No. 01, January 2024.



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<https://doi.org/10.32734/sumej.v7i1.14603>

ABSTRACT

Background: As conventional cancer treatments often induce a myriad of adverse effects, ranging from nausea and fatigue to pain and emotional distress, the integration of herbal therapies has gained attention as a potential complementary approach. **Objective:** The review synthesizes existing literature, drawing upon both preclinical and clinical studies, to evaluate the efficacy and safety of various herbs in alleviating common side effects associated with cancer therapies. **Methods:** This review article employs a narrative review approach, systematically collecting and analyzing findings from preclinical and clinical studies. **Results:** Special emphasis is placed on the potential benefits of herbal interventions in addressing physical symptoms, such as nausea and pain, as well as psychological and emotional challenges faced by cancer patients. Furthermore, the review explores the mechanisms of action behind these herbal interventions and potential synergies with conventional treatments. **Conclusion:** By providing a critical analysis of the current state of knowledge, this review aims to guide healthcare professionals, researchers, and patients in making informed decisions regarding the integration of herbal therapies into cancer care, ultimately improving the supportive care and quality of life for individuals undergoing cancer treatment.

Keywords: cancer, herbs, phytochemicals, signalling, tumors

1. Introduction

Cancer, a complex and pervasive group of diseases, poses significant challenges to patients and healthcare providers alike. Conventional cancer treatments, while instrumental in targeting and eliminating malignant cells, often come at the cost of debilitating side effects that can profoundly impact patients' quality of life. As the pursuit of comprehensive cancer care continues, there is a growing interest in exploring complementary approaches, including the integration of herbal therapies. The history of utilizing herbs in healthcare dates back centuries, with diverse cultures incorporating botanical remedies into traditional healing practices [1].

In the context of cancer care, this historical foundation becomes particularly intriguing, as many herbal interventions have been traditionally employed to address symptoms and support overall well-being. However, the integration of herbal therapies into modern cancer care requires a rigorous examination of their efficacy, safety, and potential interactions with conventional treatments [2]. The rationale for exploring herbal therapies in the context of cancer primarily stems from the desire to mitigate the adverse effects of traditional cancer treatments. Chemotherapy, radiation, and other interventions, while essential in combating cancer cells, often lead to nausea, fatigue, pain, and psychological distress [3]. Herbal therapies present a promising avenue for managing these side effects, offering a holistic approach that addresses the multidimensional challenges faced by cancer patients [4].

This review adopts a comprehensive scope, encompassing an in-depth analysis of the existing literature on herbal therapies in the context of cancer care. It explores a range of herbs with purported benefits in managing side effects commonly associated with cancer treatments. The scope extends to both preclinical and clinical

studies, aiming to synthesize evidence from diverse sources and provide a nuanced understanding of the potential benefits and limitations of herbal interventions. The review delves into various aspects of herbal therapies, including their historical use, physiological mechanisms of action, and potential synergies with conventional treatments. Specific attention is given to herbs addressing nausea, pain, fatigue, and emotional well-being [1,2]. Additionally, the safety of herbal interventions and their possible interactions with standard cancer treatments are critically examined, ensuring a balanced evaluation of their role in cancer care.

2. Methods

The primary objectives of this review are to:

- a. **Evaluate the Efficacy of Herbal Therapies:** Systematically assess the scientific evidence supporting the efficacy of herbal interventions in managing the side effects of cancer treatments.
- b. **Examine Safety Profiles:** Investigate the safety of herbal therapies, considering potential adverse effects and interactions with conventional cancer treatments.
- c. **Explore Patient Perspectives:** Incorporate qualitative insights from cancer patients to provide a holistic understanding of the impact of herbal therapies on their quality of life and overall well-being.
- d. The significance of this review lies in its potential to inform healthcare professionals, researchers, and cancer patients about the role of herbal therapies in cancer care. By synthesizing current knowledge, the review aims to guide clinical decision-making, promote patient-centered care, and stimulate further research in an emerging and dynamic field. Ultimately, a nuanced exploration of herbal therapies in cancer care contributes to the ongoing dialogue surrounding integrative approaches and strives to enhance the supportive care provided to individuals facing the challenges of cancer and its treatment.

3. Discussion

3.1 Common Side Effects of Cancer Treatments: Managing the Impact on Quality of Life

Cancer treatments, while instrumental in targeting and eradicating cancerous cells, often give rise to a spectrum of side effects that can significantly impact the well-being and daily lives of patients. This section provides an in-depth exploration of the common side effects associated with cancer treatments, their profound impact on the quality of life, and the current approaches to managing these symptoms [5].

- i. **Overview of Adverse Effects:** Chemotherapy, radiation therapy, immunotherapy, and surgery—cornerstones of cancer treatment—can elicit a range of adverse effects that vary depending on the type of cancer, the stage of treatment, and individual patient factors. Nausea and vomiting are prevalent side effects, stemming from the impact of treatments on the gastrointestinal system. Fatigue, often described as an overwhelming sense of tiredness, is another ubiquitous symptom that can persist long after treatment completion. Pain, both acute and chronic, may result from the cancer itself, the treatment process, or surgery. Emotional and psychological challenges further compound the physical burden, with many cancer patients experiencing anxiety, depression, and changes in mood. Additionally, the immune-suppressing nature of certain treatments can make patients more susceptible to infections, further compromising their overall health [5].
- ii. **Impact on Quality of Life:** The cumulative impact of these side effects on the quality of life of cancer patients is profound. Nausea and vomiting can lead to a decreased appetite and malnutrition, hindering the body's ability to recover. Fatigue may limit the ability to engage in daily activities, eroding both physical and emotional reserves. Chronic pain can impede mobility and diminish the joy derived from simple pleasures [6]. The emotional toll, often underestimated, can manifest as heightened stress, feelings of isolation, and a diminished sense of well-being. Maintaining or improving the quality of life is a critical goal in cancer care, recognizing that the impact of treatment extends beyond mere survival. Addressing the common side effects becomes imperative not only for the physical health of patients but also for their ability to navigate the emotional and psychological challenges associated with a cancer diagnosis and its treatment [4].
- iii. **Current Approaches to Symptom Management:** In response to the multifaceted challenges posed by cancer treatment side effects, healthcare professionals employ a variety of approaches to symptom management [5]. Which were:
 - a. **Pharmacological Interventions:** Medications such as ondansetron and metoclopramide are commonly used to alleviate nausea and prevent vomiting associated with chemotherapy. Pain management involves the use of analgesic medications, ranging from over-the-counter options like acetaminophen to more potent opioids for severe pain [3].

- b. Nutritional Support: Dietary interventions, including small, frequent meals and the use of nutritional supplements, are employed to address malnutrition and weight loss associated with nausea and appetite suppression [5].
- c. Physical and Rehabilitative Therapies: Physical therapy interventions aim to manage fatigue and enhance physical function through tailored exercise programs. Complementary approaches, such as acupuncture and massage therapy, may also contribute to pain management and overall well-being.
- d. Psychosocial Support: Psychosocial interventions, including counseling and support groups, play a crucial role in addressing emotional challenges and promoting mental well-being.
- e. Immunization and Infection Prevention: Proactive measures, such as immunizations and vigilant infection control practices, are implemented to reduce the risk of infections in patients with compromised immune systems.
- f. Patient Education and Empowerment: Equipping patients with knowledge about potential side effects and self-management strategies empowers them to actively participate in their care and enhances their ability to cope with treatment-related challenges.

While these approaches contribute significantly to symptom management, there is a growing interest in exploring complementary and integrative therapies, including herbal interventions, to further enhance the supportive care provided to cancer patients. The subsequent sections of this review will delve into the potential benefits and considerations of incorporating herbal therapies into the comprehensive management of common side effects associated with cancer treatments.

3.2 Herbs in Cancer Care: Historical Context and Current Trends

Cancer, a complex and formidable adversary, has been a scourge of humanity throughout history. While modern medicine has made significant strides in cancer treatment, the use of herbs in cancer care has deep historical roots and continues to be a subject of contemporary interest and exploration. Herbal remedies have been employed in various cultures for centuries, forming an integral part of traditional medicinal practices. In ancient China, Greece, and India, herbal concoctions were utilized to alleviate symptoms and promote well-being. Ayurveda, the traditional Indian system of medicine, documented the use of herbs in cancer-like conditions, emphasizing holistic approaches to balance the body. In medieval Europe, herbalists and wise women crafted potions from plants, often handed down through generations, to address ailments including cancers. Plants like foxglove and mistletoe found their way into concoctions believed to possess healing properties. The historical context of herbs in cancer care reflects a diverse array of cultural perspectives, each contributing unique knowledge and approaches to address the complexities of this disease [7].

The term "allspice," originating in the 1600s, was coined by the English who believed the herb combined the flavors of cinnamon, nutmeg, and cloves. Also known as "Jamaica pepper," "kurundu," "myrtle pepper," "pimenta," and "newspice," allspice, contrary to popular belief, is not a spice blend but comes from the dried unripe berries of the *Pimenta dioica* tree. Indigenous to the Greater Antilles, southern Mexico, and Central America, this tree is now cultivated in warm regions worldwide and is commercially available as an essential oil. Allspice is purported to possess diverse properties, including antimicrobial, antioxidant, anti-inflammatory, analgesic, antipyretic, anticancer, and antitumorigenic effects. Its composition includes flavonoids, phenolic acids, catechins, and phenylpropanoids, with essential oils comprising eugenol, eugenol methyl ether, cineole, phellandrene, and caryophyllenes. The antioxidant and antimicrobial activities are thought to be associated with eugenol [8-9].

Studies have shown that allspice is as effective as garlic and onions in inhibiting microbial growth, with evidence suggesting its effectiveness in reducing the virulence of *Escherichia coli* O157:H7. However, caution is advised as excessive consumption of allspice oil may lead to toxicity and promote inflammation, nausea, and vomiting. Allspice's potential anticancer properties may be linked to its influence on cytochrome P450 (CYP) activity, impacting carcinogen bioactivation. Experimental studies on human liver carcinoma and colon adenocarcinoma cells demonstrated the activation of the CYP3A4 promoter by allspice extract, suggesting a plausible mechanism. Allspice's specificity in response was observed, with no influence on gastrointestinal glutathione peroxidase [8].

Inflammation, a cancer risk factor, appears to be influenced by allspice consumption, as indicated by rodent studies showing significant inhibition of various inflammatory markers. Additionally, allspice demonstrated antiulcer and cytoprotective activity in rats, suggesting a potential impact on cyclooxygenase (COX) activity. Allspice has shown the ability to alter the proliferation of cultured cancer cells, particularly in prostate cancer cells, where cell viability was reduced. The mechanism behind this effect remains unclear, but studies suggest that epigenetic factors, including a decrease in histone acetyltransferase (HAT) activity, may be involved.

Further controlled interventions in animal models are needed to explore the potential benefits of allspice as a dietary antitumorigenic agent [9].

3.3 Current Trends

In the contemporary landscape, the interest in herbs for cancer care has been rekindled, fueled by a combination of traditional wisdom, scientific inquiry, and a growing preference for complementary and alternative medicine. Several herbs have gained attention for their potential anti-cancer properties, both in prevention and as adjuncts to conventional treatments. Numerous herbs and plant compounds are subjects of ongoing research for their potential anti-cancer properties. It's important to note that while some studies suggest promising results, the effectiveness and safety of these herbs for cancer treatment are still being explored, and more rigorous clinical trials are needed. Here are a few examples:

- a. [Turmeric (*Curcuma longa*)]: Curcumin, the active compound in turmeric, has demonstrated anti-inflammatory and antioxidant properties. Studies suggest its potential in inhibiting cancer cell growth and enhancing the effectiveness of chemotherapy [1].
- b. [Green Tea (*Camellia sinensis*)]: Rich in polyphenols, green tea has been linked to cancer prevention. Epigallocatechin gallate (EGCG), a compound in green tea, exhibits anti-cancer properties by modulating signaling pathways involved in cell proliferation. [10-11] Tea represents another significant source of numerous natural compounds with the capacity for chemoprevention. Green tea, among the various tea variants, stands out as the most extensively studied for its potential in preventing and treating cancer. Scientific evidence has both approved and demonstrated that green tea plays a role in reducing the risk of breast, prostate, thyroid, colorectal, stomach, esophageal, and prostate cancers. The chemopreventive effects of green tea are attributed to catechins, specifically (flavan-3-ols). The primary bioactive constituents in green tea extracts include (–)-epicatechin (EC), (–)-epigallocatechin (EGC), (–)-epicatechin-3-gallate (ECG), and (–)-epigallocatechin-3-gallate (EGCG), with EGCG being the most abundant and biologically active among them [10].
- c. [Mistletoe (*Viscum album*)]: Used historically in European herbal traditions, mistletoe extracts have been explored for their potential immunomodulatory effects and anti-cancer properties. Some studies indicate positive outcomes in cancer patients, although more research is needed. Preparations of pharmaceuticals derived from plants exhibit diverse anti-malignant effects, as they are known to exert cytotoxic and immunomodulatory activities. Additionally, they contribute to enhancing patient tolerance to chemotherapy and improving overall quality of life. These effects can be attributed to various bioactive molecules found in mistletoe tissues, including proteins, phenolic acids, flavonoids, phytosterols, triterpene acids, and oligo- and polysaccharides. Among the mistletoe compounds, two protein groups, mistletoe lectins and viscotoxins, have been extensively studied for their cytotoxic and immunomodulatory properties. Mistletoe lectins, consisting of three glycoproteins categorized as type II ribosome-inactivating proteins, are formed by two polypeptide chains connected by a disulfide link. These isoforms differ in molecular mass and carbohydrate specificity, exhibiting variant biological properties. Mistletoe lectin B chains selectively recognize and bind to receptors on cell membranes, thereby altering endocellular signaling pathways, while the A chain enters the cytosol and inhibits protein synthesis by catalyzing the cleavage of 28S ribosomal RNA. Viscotoxins, on the other hand, are a group of low molecular weight proteins, approximately 5 kDa, classified as type III thionins. These toxic proteins demonstrate anticancer properties by exerting both cytotoxic effects and eliciting immunogenic responses [11].
- d. [Ginseng (*Panax ginseng*)]: *Panax ginseng* (PG), a widely utilized herbal medicine in Asia, is renowned for its diverse pharmacological activities. The unique components of ginseng species, known as ginsenosides or steroid-like saponins, have demonstrated efficacy in various conditions, including neurodegenerative diseases and cardiovascular ailments. In the realm of cancer, studies have reported the treatment and prevention effects against breast, lung, and colon cancer. Notably, a clinical trial indicated that ginsenoside improved the quality of life post-chemotherapy in epithelial uterine cancer patients. Among the numerous ginsenosides in PG, ginsenoside Rb1, Rb2, Rc, Rd, Re, Rf, and Rg1 constitute the majority. These ginsenosides can be categorized into protopanaxadiol (PPD) groups, including ginsenosides Ra3, Rb1, Rc, Rd, Rg3, and Rh2, and protopanaxatriol (PPT) groups, encompassing ginsenosides Rg1, Re, Rh1, and R1. Despite their diverse pharmacological effects, intact ginsenosides exhibit remarkably low oral bioavailability when passing through the large intestine without undergoing decomposition by gastric juices or liver enzymes. Human fecal microflora plays a pivotal role in metabolizing ginsenosides, predominantly converting them into compound K. In the PPD group, bacteria such as *Bacteroides* sp., *Bifidobacterium* sp., *Eubacterium* sp., and *Fusobacterium* sp. transform

ginsenosides Rb1, Rb2, Rb3, Rc, and Rd into compound K after oral administration. Similarly, ginsenoside Rg1 and Re from the PPT group undergo metabolism into ginsenoside F1 and Rh1, facilitated by *Bacteroides* sp., *Bifidobacterium* sp., *Eubacterium* sp., and *Fusobacterium* sp. Additionally, ginsenoside Rg3 is converted into Rh2 by intestinal bacteria such as *Bacteroides* sp., *Bifidobacterium* sp., and *Eubacterium* sp. [12].

- e. [Artemisinin (*Artemisia annua*)]: *Artemisia annua*, a traditional Chinese medicinal plant with a rich history, has been employed in the treatment of jaundice and hepatitis. It is also recognized for its effectiveness in alleviating symptoms such as fever, nausea, headaches, and excessive sweating induced by factors like summer heat, parasitic infections, and malaria. The roots of this plant extend back to 168 B.C. as documented in ancient Chinese herbalist texts, where dried leaves of *Artemisia annua* were combined with other botanicals to create an infusion. This infusion was utilized in the treatment of conditions like haemorrhoids and was even acknowledged for its potential as a libido enhancer. Originally known for its antimalarial properties, artemisinin and its derivatives have garnered interest in cancer research. Some studies suggest their potential to selectively target cancer cells [13].
- f. [Ashwagandha (*Withania somnifera*)]: *Withania Somnifera* Dunal, commonly known as Ashwagandha, holds significant usage in numerous Indian herbal pharmaceuticals and nutraceuticals. This annual herb thrives in dry and arid soil, often growing as a wild plant, and is extensively detailed in Ayurveda—the ancient Indian system of herbal medicine—for its immunomodulatory and anti-aging properties. Alongside its anti-inflammatory attributes, *Withania Somnifera* exhibits actions such as antitumor and radiosensitizing effects, as well as analgesic activity. Despite these known characteristics, there is a lack of reported research on in vitro studies of *Withania Somnifera* cultivated in soil amended with varying concentrations of fly ash. This study aims to assess the antiproliferative potential of the 50% ethanol extract derived from the root, stem, and leaves of *Withania Somnifera* against various human cancer cell lines. Commonly used in Ayurvedic medicine, ashwagandha has adaptogenic properties. Some studies propose its potential in inhibiting the growth of certain cancer cells and enhancing the efficacy of chemotherapy [14].
- g. [Ginger (*Zingiber officinale*)]: Ginger contains bioactive compounds with anti-inflammatory and antioxidant effects. Research indicates that ginger extracts might have anti-cancer properties, particularly in relation to gastrointestinal cancers [14].
- h. [Garlic (*Allium sativum*)]: Garlic has been studied for its potential in reducing the risk of certain cancers, particularly those of the digestive system. Its active compound, allicin, exhibits anti-cancer properties in preclinical studies. Ginger (*Zingiber officinale*) stands out as a widely utilized natural product with applications both as a spice and a remedy for various ailments, including nausea, dysentery, heartburn, flatulence, diarrhea, loss of appetite, infections, cough, and bronchitis. Experimental studies have unveiled that ginger and its active constituents, notably 6-gingerol and 6-shogaol, demonstrate anticancer properties, particularly against gastrointestinal (GI) cancers [14]. The anticancer mechanisms of ginger involve the modulation of several signaling molecules, encompassing NF- κ B, STAT3, MAPK, PI3K, ERK1/2, Akt, TNF- α , COX-2, cyclin D1, cdk, MMP-9, survivin, cIAP-1, XIAP, Bcl-2, caspases, and other regulatory proteins governing cell growth. This review comprehensively explores the evidence supporting the chemopreventive and chemotherapeutic potential of ginger extract and its active components, drawing from in vitro studies, animal models, and observations in human patients [14].
- i. [Astragalus (*Astragalus membranaceus*)]: Used in traditional Chinese medicine, astragalus has immune-modulating effects. Some studies suggest that it might enhance the immune response and quality of life in cancer patients. *Astragalus membranaceus* (Fisch.) Bunge, a perennial herb belonging to the Leguminosae family, holds significant value and widespread distribution in temperate and arid regions across Asia, Europe, and North America. In Traditional Chinese Medicine (TCM), its roots are esteemed as a premier adaptogenic herb and recognized for their "Qi tonifying" properties, aiding in preventing harmful pathogens from penetrating deep into the body and supporting detoxification. Referred to as *Astragali Radix* or Huang qi (meaning yellow) in China, its medicinal use dates back to 200 AD, recorded in the Shen Nong's Classic of Materia Medica and featured in pharmacopoeias globally [15].

Huang qi has been traditionally employed to address various oxidative stress-related conditions affecting the eyes, brain, intestine, lung, heart, kidneys, as well as wound healing, liver cirrhosis, diabetes, hypertension, and certain cancers like leukemia and uterine cancer. Its applications extend to treating common ailments such as the common cold, numbness, diarrhea, fatigue, edema, sores, chronic ulcerations, night sweats, paralysis of limbs, wasting disorder, anorexia, dyspepsia, and anemia. Recent attention has been drawn to the plant's anti-

cancer properties, with all its parts demonstrating potential efficacy against colorectal, ovarian, stomach, liver, lung, cervical, lymphomas, breast, and nasopharyngeal cancers.

In Western herbalism, *Astragalus membranaceus* has gained popularity for immune support, particularly in enhancing the response to various viruses and bacteria. Its immune-modulatory effects involve stimulating white blood cell activity, including macrophages, T-cells, and natural killer cells, which actively participate in the body's defense against tumors and microbial infections [15].

While these herbs show promise, it's crucial to approach their use with caution. The field of herbal medicine lacks standardization, and the efficacy of herbs can vary. Additionally, potential herb-drug interactions should be considered, especially for cancer patients undergoing conventional treatments.

3.4 Challenges and Future Directions

Despite the growing interest in herbs for cancer care, challenges persist. The lack of rigorous clinical trials, standardization of herbal preparations, and integration into mainstream medical practices pose hurdles [1-4]. Bridging the gap between traditional knowledge and evidence-based medicine remains a key objective. Future directions in herbal cancer care should involve collaborative efforts between traditional healers, herbalists, and modern medical practitioners. Research initiatives must focus on identifying bioactive compounds, understanding mechanisms of action, and conducting well-designed clinical trials to establish safety and efficacy. In conclusion, the use of herbs in cancer care spans a rich tapestry of historical practices and contemporary trends. Integrating the wisdom of traditional herbalism with modern scientific rigor offers a holistic approach to cancer care. While challenges persist, the potential benefits of herbs in cancer prevention and treatment warrant continued exploration and research.

Future prospects for herbal therapies in cancer management

The future prospects for herbal therapies in cancer management are promising, with growing interest and research in this field. Herbal therapies, often derived from plants and traditional medicinal practices, have gained attention for their potential role in preventing, treating, and managing cancer [10]. Several factors contribute to the positive outlook for herbal therapies in cancer management:

- a. **Diverse Bioactive Compounds:** Herbs contain a vast array of bioactive compounds, including polyphenols, alkaloids, flavonoids, and terpenoids. These compounds have demonstrated various pharmacological activities, such as antioxidant, anti-inflammatory, and anti-cancer properties.
- b. **Targeted Therapeutic Effects:** Many herbal compounds exhibit selective cytotoxicity towards cancer cells while sparing normal cells. This selectivity is advantageous in minimizing side effects commonly associated with conventional cancer treatments.
- c. **Immunomodulation:** Herbal therapies often exert immunomodulatory effects, enhancing the body's immune response against cancer cells. This can contribute to a holistic approach in cancer management by supporting the immune system.
- d. **Anti-Angiogenic Properties:** Some herbal compounds possess anti-angiogenic properties, inhibiting the formation of new blood vessels that supply nutrients to tumors. This can potentially restrict tumor growth and metastasis.
- e. **Combination Therapies:** The future may see an increased focus on combining herbal therapies with conventional cancer treatments. Synergistic effects between herbal compounds and standard therapies could enhance treatment outcomes and reduce adverse effects.
- f. **Personalized Medicine:** Advances in molecular biology and personalized medicine may lead to the identification of specific herbal formulations tailored to individual genetic profiles and cancer types. This personalized approach could optimize treatment efficacy.
- g. **Clinical Research and Validation:** Ongoing and future clinical trials will provide scientific validation of the efficacy and safety of herbal therapies in cancer management. Rigorous research is essential to establish evidence-based guidelines for incorporating herbal treatments into mainstream oncology.
- h. **Patient-Centered Care:** Herbal therapies offer a patient-centered approach, considering not only the physical aspects of cancer but also the overall well-being of individuals. Integrating herbal treatments into cancer care may address the holistic needs of patients.

Despite the promising outlook, challenges such as standardization of herbal formulations, understanding mechanisms of action, and collaboration between traditional and modern medicine need to be addressed. The integration of herbal therapies into mainstream cancer management will likely involve a multidisciplinary approach, combining the knowledge of traditional medicine practitioners with modern scientific methodologies.

4. Conclusion

Increasingly, it is becoming evident that aging does not inevitably lead to the development of cancers; rather, cancers appear to be preventable conditions. The information presented in this chapter proposes that spices could be significant elements in one's diet, potentially reducing the risk of cancer and influencing the behavior of tumors. Spices, serving various purposes such as flavoring, coloring, and preserving, have been integral to human consumption for centuries. It's essential to recognize that this chapter provides only a glimpse into the broader impact of herbs and spices, considering the existence of around 180 spices commonly utilized in culinary practices. Undoubtedly, evidence suggests that numerous biological processes, including cell proliferation, programmed cell death (apoptosis), formation of new blood vessels (angiogenesis), and immune response, may be modulated by the consumption of one or more spices. While the existing data are captivating, a substantial amount of additional information is required to ascertain which individuals would derive the greatest benefits from an increased intake of specific spices, the optimal levels of exposure necessary to achieve desired outcomes, and the potential interactions, both positive and negative, with other components of the diet or medications regularly taken by an individual.

5. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

6. Ethical Statement

Sumatera Medical Journal (SUMEJ) is a peer-reviewed electronic international journal. This statement clarifies ethical behavior of all parties involved in the act of publishing an article in Sumatera Medical Journal (SUMEJ), including the authors, the chief editor, the Editorial Board, the peer-reviewer and the publisher (TALENTA Publisher Universitas Sumatera Utara). This statement is based on COPE's Best Practice Guidelines for Journal Editors.

7. Author Contributions

All authors contributed to the design and implementation of this case report, data analysis, and finalizing the manuscript.

8. Funding

No funding.

9. Acknowledgement

The authors thank to the staff and member for their valuable assistance during data collection and analysis.

10. Conflict of Interest

Authors declares no conflict of interest.

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