

A Perspective review on role of various nutraceuticals in management of Cancer

Rajashekar Perusomula¹, Vikrant Abbot², Gourab Saha³, Mrinal⁴, Pooja Khanpara⁵, Tanmay Ghosh⁶, Saiyed Musaratafrin Sabirali⁷, Sharma Kruti Bharat⁸, Soma Das^{*9}

¹Department of Pharmacology, Cognitive Science Research Initiative Lab, Vishnu Institute of Pharmaceutical Education & Research, Narsapur, Telangana, India.

²Department of Pharmacy, Chandigarh Group of Colleges, Jhanjeri, Mohali, Punjab, India.

³Department of Pharmaceutics, College of Pharmaceutical Sciences, Berhampur, Odisha, India.

⁴Department of Pharmacy, a) Research scholar Chandigarh University, Gharuan Mohali, Punjab, b) Assistant professor, Saraswati institute of Pharmaceutical Sciences and Research, Gharuan Mohali, Punjab, India.

⁵Department of Pharmacognosy, Smt. R. D. Gardi B.Pharmacy College, Nyara, Rajkot, Gujarat, India.

⁶Department of Microbiology, Dinabandhu Andrews College, Baishnabghata, South 24 Parganas, Kolkata, West Bengal, India.

⁷Department of Pharmacology, A. R. College of Pharmacy and G. H. Patel Institute of Pharmacy, Vallabh Vidyanagar, Anand, Gujarat, India

⁸Central Research Service, Shree Krishna Hospital and Medical Research Centre, Karamsad, Anand, Gujarat, India

^{*9}Department of Pharmaceutical Technology, School of Health and Medical Sciences :Adamas University, Kolkata, West Bengal, India

*Corresponding Author: Dr Soma Das,

ABSTRACT

Depending on the form and location, cancer is a dangerous medical condition that is seldom treatable. Many therapies, such as hormone therapy, radiation therapy, and chemotherapy, are used to treat cancer; however, a significant drawback of these treatments is their multitude of side effects, which can include gastrointestinal issues, skin abnormalities, and hair loss. Nutraceuticals are useful strategy for managing cancer. A food or component of a diet that has physiological and medicinal benefits and is used to prevent disease is called a nutraceutical. Research indicates that combination treatment is far more effective than a single nutraceutical in preventing cancer. Combination approaches for chemoprevention can involve two or more phytochemicals, a phytochemical that has been chemically synthesized and an effective medication, or a phytochemical that has been chemically produced and a natural nutrient. This review study aims to elucidate the relevance of nutraceuticals as chemopreventive agents.

KEY-WORDS

Nutraceuticals, Cancer, Chemotherapy, Radiotherapy, Prevention

INTRODUCTION

The most deadly illness where unregulated and undesired cell proliferation takes place is cancer. Human cells typically divide to create new cells by growing and multiplying. New cells replace old ones as they age or sustain injury. However, on sometimes, this system malfunctions, allowing aberrant or damaged cells to proliferate. Furthermore, these cells have the potential to develop benign (noncancerous) or malignant (cancerous) tumors.[1] Cancer frequently manifests as fatigue, lumps, abrupt changes in weight and skin tone, breathing difficulties, difficulty swallowing, unexplained fevers, and other symptoms.[2] The leading causes of cancer are smoking, eating too much red, processed meat, having a high body weight, and sun exposure.[3] Cancer is treated with surgery, immunotherapy, hormone treatment, chemotherapy, radiation, and bone marrow transplantation.[4] Reducing your risk of cancer involves eating a healthy weight, abstaining from alcohol and tobacco, and limiting your exposure to the sun.[5] Nutraceuticals are one of the major variables that can aid in the prevention of cancer among the many other factors that can do so.

Nutraceuticals

A nutraceutical is any substance that is contemplated as a food or part of food and is used in treatment or prevention of any disease. The word Nutraceutical is the combine of two words “nutrition” and “pharmaceutical“ and was coined by Stephen DeFelice in 1989.[6] According to Stephen, “Nutraceutical is a food, food ingredients or any dietary supplement that have a specific health and medical benefits.”[7] Basically, a nutraceutical is a food or component of a food that has the potential to offer medical or health advantages, including the prevention and/or treatment of a disease or condition [8]. Formerly, this concept applied to functional foods. Nevertheless, more recent classifications made by many institutions and groups attempt to distinguish between functional and nutraceutical foods. Any isolated herbal product, dietary supplement, particular diet, processed food (such as cereals, soups, and drinks), or dietary supplement that is utilized both as a food and a medicine is referred to as a nutraceutical [9]. Both non-food goods (such as medications and dietetics) and food products containing bioactive chemicals have seen a surge in demand over the last few years. These items cannot be categorized as "food" since they include extracts

that have been enhanced with phytochemicals to exploit positive physiological benefits. In order to distinguish between nutrients and medications, a new word called nutraceuticals was created. Natural bioactive supplements known as nutraceuticals provide nutritional benefit and show promise as treatments for a number of ailments. Chemotherapy, radiation, and surgery are some of the current cancer therapies that have unwanted side effects that endanger the patients' health and wellbeing. Recent research indicates that several plant based substances could affect the cellular and molecular mechanisms underpinning tumour growth. Some of these molecules may, however, also have antagonistic effects on conventional therapeutics. This article's goal is to summarize the most recent scientific research supporting the use of dietary supplements for both cancer treatment and prevention [10].

A substantial source of nutraceutical components includes bioactive phytochemicals such alkaloids, different terpenoids, and polyphenols (anthocyanins, flavones, flavanols, isoflavones, stilbenes, ellagic acid, etc.) [11]. In terms of human health, phytochemicals, which are primarily produced by plants, are non-essential nutrients that have either defensive or disease-protective properties [12]. Therapeutic substances known as nutraceuticals have drug-like qualities and can be used to treat illnesses with a high risk of death, including cancer, diabetes, atherosclerosis, and neurological and haematological problems. According to research findings, health food items include polyphenols, terpenoids, tannins, alkaloids, and flavonoids, all of which have a strong potential to combat these fatal diseases.

Different nutraceuticals and their role in chemo-prevention

Nutraceuticals are extremely effective at preventing cancer because of their capacity to slow down cell development and stop cell division. [13] Cancer can be prevented in part by using nutraceuticals made from soy beans, garlic, ginger, tea, propolis, honey, and many other ingredients.[14] Nutraceuticals also aid in improving cancer patients' frailty and lessening the toxicity brought on by radiation and chemotherapy.[15]

1. Lycopene

One of the components of ripe tomatoes is lycopene. It may also be found in a variety of red fruits and vegetables, such as papaya, watermelon, and red carrots. It possesses chemopreventive and anti-inflammatory qualities. Lycopene scavenges free radical damage, absorbs oxidative stress, and shields DNA from oxidative damage. It

prevents healthy cells from turning into malignant ones as a result. It also affects cytotoxicity, cancer enzymes, genetic alterations, and defense mechanisms.[16]

2. Epigallocatechin-3-gallate

Green tea's active ingredient is called epigallocatechin-3-gallate (EGCG). The anti-cancer potential of this green tea component has been recognized in many cancer types and is now under investigation. It has been demonstrated that EGCG possesses chemopreventive qualities by impeding the initiation, development, and progression of carcinogenesis. Additionally, this catechin has shown its value in the treatment of cancer by modifying a number of cell signaling pathways, including as those that regulate angiogenesis, programmed cell death, proliferation control, and the elimination of malignant cells.(17)

3. Curcumin

Turmeric contains a component called curcumin. Due to its antioxidant properties, curcumin may lessen inflammation and edema. As inflammation seems to have a role in cancer, it is being studied as a potential cancer treatment. Curcumin may stop cancer from developing, lessen its spread, improve the effectiveness of chemotherapy, and shield healthy tissue from the damaging effects of radiation therapy.[18]

4. Capsaicin

It is an active ingredient in chili peppers, a plant of the capsicum genus.[19] It has a strong anti-cancer effect and can cause cell-cycle arrest, caspase-mediated cell death, or inhibition of proliferation in a range of cancer cells.[20]

5. Enterolactone

A mammalian lignan produced from diet lignans is called enterolactone. Multiple studies have shown that it has strong anti-cancer and/or preventive capabilities against many malignancies, including liver cell malignancy, breast, prostatic, colo-rectal, lung, ovarian, endometrium, and cervical malignancies. The anti-proliferative, pro-apoptotic, anti-inflammatory, anti-angiogenic, and anti-metastatic properties of enterolactone have been primarily linked to these actions.[21]

6 . Ajoene

Ajoene is one of the active constituents generated when crushed garlic is heated. Ajoene has a wide range of biological actions, including anticancer properties. Its cytotoxicity against cancer cells is thought to be caused by

an apoptotic mediated pathway that involve activation of the mitochondrial-dependent signaling cascade. [22]

7. Gingerol

Gingerol is an active constituent of ginger. It is obtained as pungent yellow oil from the rhizome of ginger. It is present in all plants belonging to family Zingiberaceae. [23] It has the potential to reduce tumour necrosis factor alpha (TNF-alpha) expression by inhibiting I-kappaB alpha (IkappaBalph) phosphorylation and nuclear factor kappaB nuclear translocation. Additional antiproliferative effects of gingerol involve Cytochrome c release, Caspases activation, and a rise in proteolytic protease-activating factor-1 (Apaf-1) as such an apoptosis induction process. [24]

Table 1: Health benefits of certain nutraceuticals and herbals during cancer treatment

Nutraceuticals/herbals	Health benefits during cancer treatment
Vitamin C	Chemoprotective in the treatment of esophageal and breast cancer
Fish oil	Improved tumor inhibition by altering cancer cell membranes
Selenium	Antitumor genetic effect
Ginseng	Nutrition therapy enables anticancer drug's (like mitomycin) potency
Avemar	Dietary food for cancer patients specifically for high-risk skin cancer patients
Ellagic acid (found in many nuts and fruits such as black raspberry, pomegranates, walnuts, strawberries, and almond)	Chemoprotective, anti-apoptotic, anticarcinogenic
Vinca rosea	Antitumor herb, effective in the treatment of lungs, breast, and cervix cancer
<i>Curcuma longa</i>	Antitumor, anti-inflammatory, antioxidant, antimutagenic, antifungal, antiviral, antibacteria, and hepatoprotective
<i>Nigella sativa</i>	Inhibit cancer cell proliferation, immune-modulating, and immune-potentiating
Cannabis (marijuana)	Herb that relieves from pain, depression, nausea caused during chemotherapeutic treatment of cancer
<i>Allium sativum</i>	Antiproliferative effects and act as anticancer for intestinal cancer chemotherapy
<i>Carica papaya</i>	Anticancer activity
<i>Ganoderma lucidum</i>	Anticancer agent due to its role as an activator of the immune system response
<i>Mangifera indica</i>	Chemoprotective properties and as nutrition therapy enables anticancer drug's potency
<i>Solanum torvum</i>	Act as a natural antibiotic, antimicrobial, antibacterial, and hepatoprotective activity
<i>Crateva magna</i>	Antitumor activity
<i>Azadirachta indica</i>	Enables anticancer drug's potency

Advantages of nutraceutical use over conventional cancer therapy

Chemotherapy agents are not particular to tumors, and they frequently induce considerable toxic effects on non-cancerous cells. These effects might result in severe conditions such cardiovascular disorders, which are the primary cause of mortality for cancer survivors [25].

Many tumor forms are resistant to radiation therapy either intrinsically or by acquired resistance, which causes recurrence soon after treatment. The maximal radiation dosage to nearby normal tissues that may be tolerated also places restrictions on cancer treatment. Therefore, the goal of efficient radiotherapy is to kill as many

cancer cells as possible while staying within the permissible dose range that won't cause radiation damage to nearby healthy tissues [26].

Surgery as such is limited to noninvasive tumors that are in situ. It is not applicable to malignancies that have spread. Additionally, adjuvant and neoadjuvant medicines are typically used in its execution [27].

There is a need for a more focused and targeted therapy since conventional chemotherapy and radiation have the drawbacks of multi-drug resistance, non-specificity to tumors, and negative side consequences to non-cancerous cells and the rest of the body. Nutraceuticals and their semi-synthetic equivalents have demonstrated encouraging outcomes against several cancer types when used as cancer treatments, both in vitro and in vivo. Sesquiterpenes, flavonoids, alkaloids, diterpenoids, saponins, and polyphenolic chemicals are examples of natural substances that can be used in place of or in addition to already prescribed medications. When used with traditional therapy, they have demonstrated to be non-toxic, more selective, and chemoradiation sensitizer [28–31].

Since there have been no reports of dosage toxicity to the body, nutraceuticals have also been determined to be dosage friendly. In general, they are less dangerous than radiation and chemotherapy medications. Additionally, they are less expensive than traditional techniques. [33–31].

Limitations of nutraceutical oncology

There are several restrictions on the effectiveness and efficient use of nutraceuticals, despite their many beneficial potentials in the therapy of cancer. Nutraceuticals have the potential to adversely impact traditional cancer treatments. For example, it has been demonstrated that cancer patients—particularly those who smoke—who are undergoing radiation and chemotherapy suffer injury from antioxidants [34–35]. High doses of β -carotene and vitamin E dramatically increase the risk of lung and prostate cancer. The exact method by which these dangers arise is unknown, but [30]. When thinking about some plant-based supplements, exercise extreme caution since some of them have the potential to counteract the effects of therapeutic medicines or change their metabolism from effective forms, which can lead to a counteractivity and the advancement of the pathophysiology [31].

The proper application of nutraceuticals in cancer care is currently the subject of limited clinical study findings. The majority of studies focus

mostly on epidemiology and in vitro or animal model studies. Vigorous research is desperately needed in the field of nutraceutical oncology in order to validate the many claims that are now accessible and, in turn, recommend the proper use of these physiologically significant compounds.

Another issue with several nutraceuticals is their poor bioavailability. On the other hand, certain others help the poorly absorbed ones to be absorbed. For example, piperine, a bioactive component of pepper (*Piper nigrum*), has been shown to modulate drug metabolism isoforms in the liver, hence facilitating the absorption and bioavailability of curcumin and other tea polyphenols [36].

CONCLUSION

Despite the most fatal diseases, cancer exists in a variety of forms. Many of them, such as cancers of the breast, prostate, thyroid, and other organs, are treatable, while cancers of the liver, lungs, pancreas, and gallbladder are not. A healthy diet, staying away from alcohol and tobacco, keeping a healthy weight, and limiting sun exposure are some of the many things that lower the risk of cancer. Nutraceuticals are a revolutionary approach to cancer prevention since they are often affordable and have minimal adverse effects. Numerous nutraceuticals have demonstrated their effectiveness in preventing cancer, but further study is still needed to understand how they work as chemo-preventives.

CONFLICT OF INTEREST

The authors declare that the review was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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