



Potentiality of Nutraceuticals in Management of Cancer

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Abstract

Introduction: Present urbanization and westernization phase, though has improved the economic, technological and cultural parameters but has created several health challenges among population and cancer is one of the leading health challenges which has become extremely pervasive in world and especially in India. Cancer is recognised by its characteristic uncontrolled cell proliferation and has become leading cause of increased morbidity and mortality rates.

Objectives: Analysing the severity of this medical complication, present review study has been conducted to determine the importance of nutraceuticals in prevention and management of cancer.

Methodology: Secondary data like books, journals, e-resources have been used in collecting scientific information for this study.

Results and Discussion: Several studies have depicted and derived that nutraceuticals have an essential role in nutritional prevention and management of cancer. Nutraceuticals have the nutritional properties of drugs which are present in natural occurring food items. They are non-toxic and non-nutritive dietary supplements which have an eminent role in decaying the free radicals and decreasing the oxidative stress. Nutraceuticals like phytochemicals, probiotics, vitamins, minerals, amino acids, bioflavonoids present in food products like spinach, broccoli, ginger, cucumber, garlic, etc. have a beneficial medicinal, anti-oxidant and anti-inflammatory properties which are extremely indispensable in the management of cancer. Regular and recommended intake of these nutraceuticals will help in increasing the anti-oxidant and anti-inflammatory activities which in turn help in controlling the complications of cancer. Keeping this in view, the present review has been conducted to determine the effective role of nutraceuticals in treatment of cancer.

Keywords: cancer, nutraceuticals, phytochemicals, flavonoids, anti-oxidant, anti-inflammatory activities

Introduction

As we know that industrialization and urbanisation have created several health challenges among our population, and cancer is one of the leading health challenges which has become extremely pervasive in world and especially in India. According to American Cancer Society's Facts and Figures of 2018, there were an estimated 18.1 million new cancer cases diagnosed around the world and 9.6 million cancer deaths. In the

society's report of 2022, it is estimated that the number of new cancer cases and deaths are 1.9 million with 609,360 cancer deaths in the United States. According to National Cancer Institute report on Cancer Statistics of 2018, 57 per cent of new cancer cases reported in 2012 occurred in developing regions of the world that includes Central America.

The word 'nutraceuticals' was coined by Stephen DeFelice in 1989. It can also be inferred that the word 'nutraceuticals' is derived from the two words: nutrition and pharmatics. Nutraceutical is defined as a food or part of a food that can be used to provide medical or health benefits; including the prevention and management of cancer. In other words, the nutraceutical are any products that are isolated from herbal products, dietary supplements, specific diets, and processed foods such as cereals, soups, and beverages which in addition to provide nutrition can also use as medicine. Nutraceuticals are also defined as pharmaceutically blended products that possess both nutritional as well as the medicinal value which are intended to improve the physical health, fight against day-to-day challenges such as stress, slow down aging process and so on.

Health Canada defines nutraceuticals as those products which are made from foods, but are vend in the form of pills, powder and other medicinal forms, not usually associated with foods. Many researchers have shown that about 64 per cent to 81 per cent of cancer patients take various nutraceutical supplements such as vitamins, minerals, herbal supplements. Research evidences have also proven that they do not produce negative side effects on the patients as are obtainable with chemotherapy and other forms of conventional cancer therapy. There is also no dosage problem associated with the use of nutraceuticals. Nutraceuticals can also be used in combination with other forms of cancer therapy. Foods low in simple carbohydrates with moderate amounts of high-quality protein, fiber and fat (especially fats of the omega-3 fatty acid series) are beneficial for cancer patients. Also, certain supplemental micronutrients, nutraceuticals and functional foods have potential to reduce the risk of developing cancer. Nutraceuticals also play a key role in decreasing toxicity related with chemotherapy and radiation therapy and cell proliferation.

Objectives

- To analyse the severity of medical complication of cancer
- To emphasize on the anti – cancer effects of daily routine different food items having nutraceutical properties
- To determining the mechanism action of nutraceuticals in decreasing the risk of cancer
- To give a reflection on the beneficiary role of herbals in treatment of different diseases

Methodology

Secondary data like books, journals, e-resources have been used in collecting scientific information for this study.

Data sources

Population data of cancer incidence have been collected by the National Cancer Institute's Surveillance of United States.

Pie chart data is taken from Globocon 2020.

The number of new cases in 2020 of both sex statistical have been obtained from World Health Organization.

Literature Review

Pasquale Marino et al. (2023) focussed on potential role of natural antioxidant products in oncological disease. Vivek Puri et al. (2022) reviewed an article in which they showed the latest findings on therapeutic action of nutraceuticals as bioactive molecules on various diseases. Hitesh Kumar et al. (2022) highlighted the prostate cancer and importance of nutraceutical for the control and management of prostate cancer and the significance of nutraceutical to cancer patients during chemotherapy. Jessica Maivolo et al. (2021) defined the potential role

of natural polyphenols in cancer: Harsha H. Nair and Vijay Alex (2021) overviewed on the relevance of various phytochemicals in cancer treatment together with their usefulness as chemopreventives and chemosensitizers.

Kha Alwan, Dhalga, Nabaha (2020) reviewed on the nutraceutical and herbs as adjuvants in the chemotherapy of cancer. Mohammed Iman Qadi and Saba Ibrahim (2018) describe the Curcumin Therapy for the treatment of cancer. Vikas Arora and Manoj Kumar Mishra (2016) had provided the information regarding the nutraceuticals role in various acute and chronic diseases.

Kirubai Kumar and Saravathi Kumar (2013) had scientifically proved by various researches that nutraceutical is effective in prevention and paves in various disease conditions which is also in accordance with the finding by Rama et al. (2006). The Ramamo et al. (2014) reviewed their knowledge towards the use of nutraceuticals role in the prevention of cancer. Angel Navarro et al. (2017) reviewed on the different roles of nutraceuticals and their mechanism of prevention and treatment of cancer. Lipp Day et al. (2011) focused on the health promoting effects of several nutraceuticals that have the potential of being incorporated into daily diets.

Rakesh Sharma (2000) had conducted study on nutraceuticals and nutraceutical supplementation criteria. A literature survey and found that the use of nutraceuticals in prevention and disease control has been extended further as preventive nutrition supplementation policy of center of disease control under its independent supervisor. Naman B. Tripathi et al. (2003) determined the role of different vitamins, minerals, dietary fat in the management of cancer.

Outcomes

Current status of Global cases and Deaths:

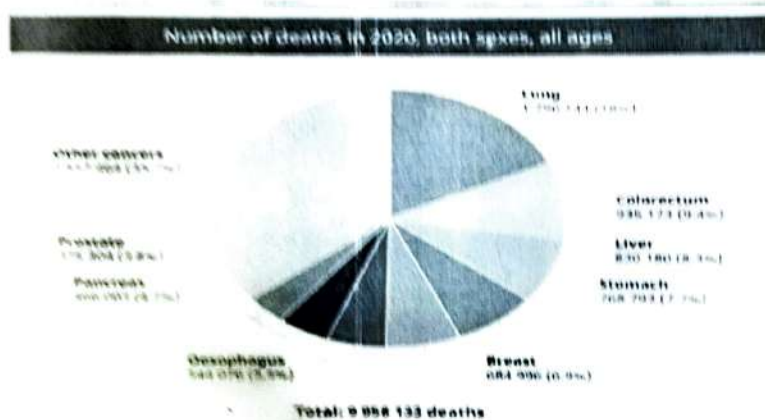


Fig. 1: Global Cancer Observatory 2020

According to Global Cancer Observatory, the breast cancer in females is higher in all cancers which are 11.7% as compared to other cancer such as lung (11.4%), colorectum (10%), prostate (7.7%), liver (4.7%) while as compare with male, the cancer of lung is more than other (18%), colorectum (9.4%), liver (8.3%) as shown in fig.1. Near about 1,92,92,789 million cases were observed in 2020 and 99,58,133 deaths were happened due to cancer.

Current status of Global Incidence and Mortality of Cancer:

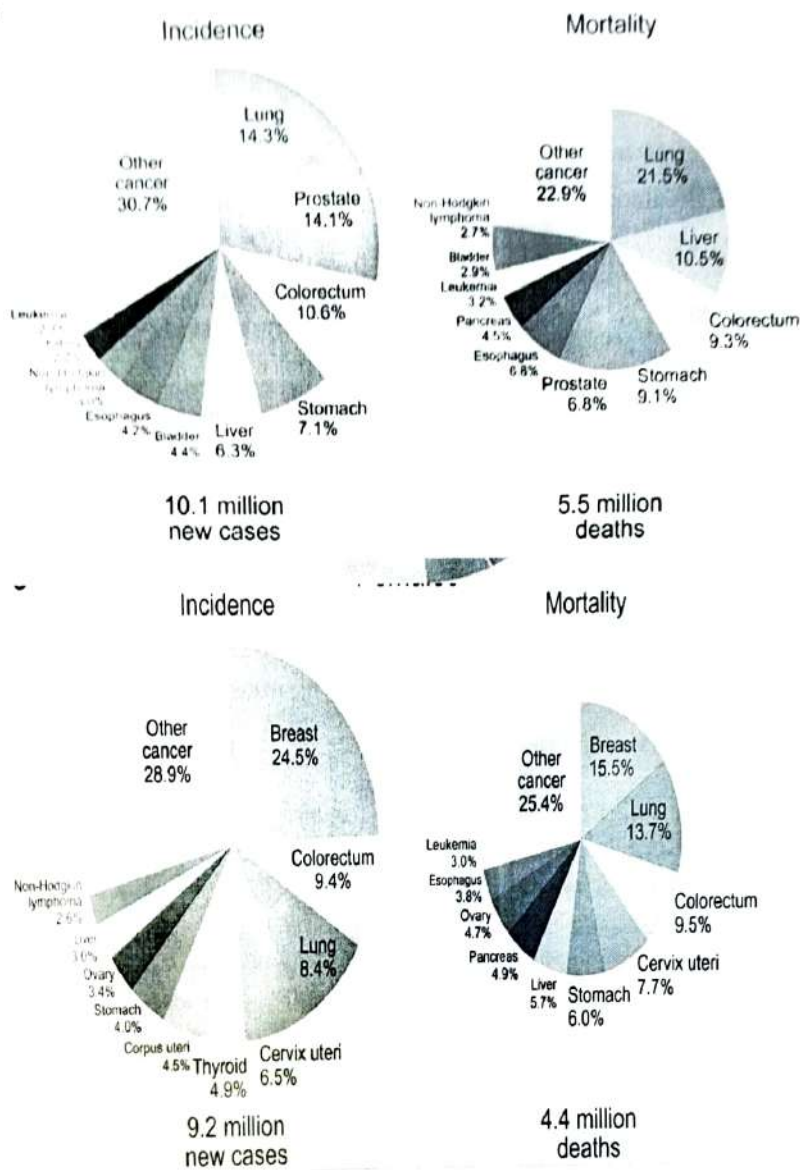


Fig.2: Global Cancer Statistics 2020

Using the Globocon 2020 data, the incidence and mortality produced by cancer was estimated by the International Agency for Research of Cancer. According to this data, the worldwide estimation of cancer new cases in 2020 were 19.3 million excluding non-melanoma skin cancer and almost 10.0 million cancer deaths (9.9 million excluding non-melanoma skin cancer) occurred in 2020. The lung cancer were the most commonly diagnosed and prevalent cancer in females. The estimated new cancer cases were 2.3 million (11.7%), followed by lung (11.4 per cent), colorectal (10.0per cent), prostate (7.3per cent) and stomach (5.6per cent) cancers. Lung

cancer remained the leading cause of cancer death, with an estimated 1.8 million deaths (9.4 per cent) deaths, liver (8.3 per cent), stomach (7.7 per cent) and female breast (6.9 per cent) cancers. The death rates for female breast and cervical cancers were considerably higher in transitioned countries as shown in fig. 2. Due to demographic changes, it is expected that about 28.4 million cases will rise in 2040.

Classification of Nutraceuticals

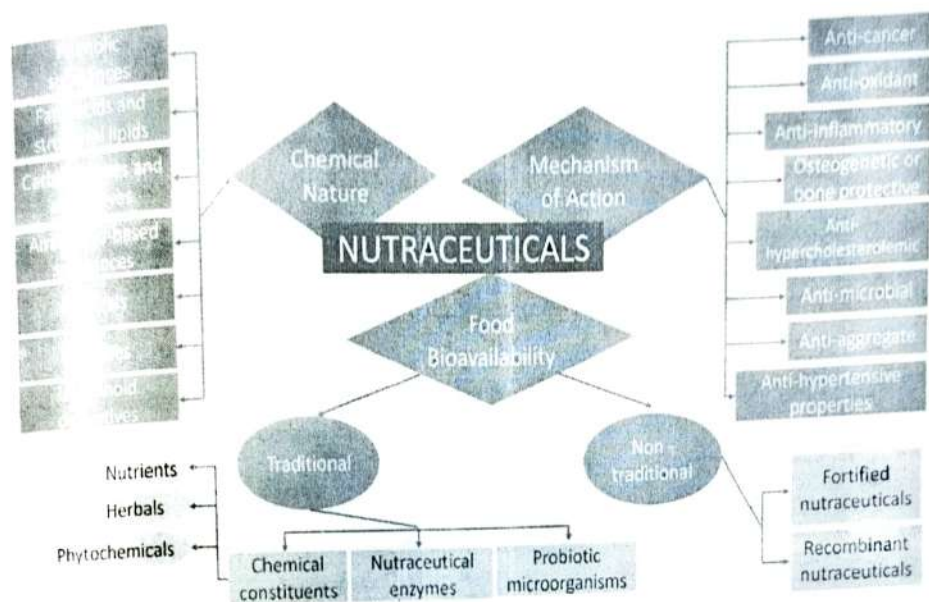


Fig.3: Classification of Nutraceuticals (Adapted from Pandey et al. (2010))

Nutraceuticals Based on Food Availability

(A) Traditional Nutraceuticals

These are generally obtained from nature, without any changes in their natural form. Various constituents such as lycopene in tomatoes, omega-3 fatty acids in salmon, or saponins in soy are available and consumed for different health benefits (Fig.3). Various types of traditional nutraceuticals and non – traditional are as follows:

- i) **Chemical constituents**
 - (a) Nutrients
 - (b) Herbals
 - (c) Phytochemicals
 - (d) Lipids and polyunsaturated Fatty Acids
 - (e) Spices
 - (f) Dietary fiber
- (ii) **Probiotic microorganisms**
- (iii) **Nutraceutical enzymes**

i) Chemical Constituents:

(a) Nutrients

Various macro and micronutrients play different role in the metabolic process. Plant and animal products along with vitamins have many health benefits and are helpful in curing cancer. Natural products obtained from plants are beneficial in treating various disorders such as brittle bones and low haemoglobin count, and they

provide strength to bones and muscles, help in neuron transmission, and maintain rhythm of heart muscles. The essential fatty acids such as omega-3 and omega-6 play a well-defined function in the development of brain and also decrease the level of cholesterol in the arteries.

(b) Herbals

Nutraceuticals and herbs play an important role in acute and chronic diseases such as cancer, flu, cold. Both have the properties of anti-inflammatory, anti-diuretic and anti-pyretic.

There are various herbs such as coriander, peppermint which contains various bio-active components that cures the diseases.

(c) Phytochemicals

Carotenoids (isoprenoids) are present in vegetables, enhancing immune system, mainly killer cells accounting for an anti-cancer response. Various legumes, grains, have the capability in reducing the cholesterol level and act as anti-carcinogenic.

Flavonoids, a class of secondary metabolites, which are present in most of the plants, help in preventing various diseases such as cancer, diabetes, heart diseases, and kidney problem through its antioxidant properties and their bio-active components. Phenolic acids are the largest class of secondary metabolites, mainly found in citrus fruits and red wine, and have the antioxidant activity of scavenging the free radicals produced as a result of various metabolic pathways such as protein, carbohydrate and fat. They also have anti-cancer and anti-tumour activity. One of the classical examples is *Curcumin* (turmeric), used as phytochemicals in most of the kitchen.

(d) Lipids and polyunsaturated fatty acids

The various subgroups include fats, waxes, glycolipids, phospholipids, steroids, fat – soluble vitamins, etc are all polyphenol compounds. Isoprenoids enhance antioxidative power by improving receptor functionality. The omega-3, omega-6 are essential fatty acids which play an important role in human body. Cell membrane phospholipid bi-layers are protected from free radicals by isoprenoids. Omega-3-PUFAs help in immune boosting, platelet aggregating, anti-inflammatory agents.

(e) Spices

Spices are substances, which are used as condiments because of their flavour, taste and color. Many of them have been used as medicinal plants in folk medicine for the treatment of various diseases because they contain many bioactive compounds and possess a lot of beneficial health effects. Scientific studies have shown the antioxidant, anti-inflammatory and immune-modulatory effects of these spices, which are utilized in prevention and treatment of several cancers, including lung, liver, breast, stomach, colorectum, cervix, and prostate cancers.

(f) Dietary Fiber

Dietary fibers are endogenous components of plant materials. Fibers can be broadly classified into soluble and insoluble fibers. Soluble fiber is mainly derived from oat bran and fruit pectin, wheat, rye, rice and most other grains are main sources of insoluble fibers. Legumes, beans, peas, certain fruits and vegetables are excellent sources of both soluble and insoluble fibers. Dietary fibers have shown substantial evidence of positive effect. Insoluble fiber reduces rate of colon cancer and diverticulitis, an inflammatory condition of the colon. Fibrous polysaccharides also bind carcinogens and lower the bile acids.

(ii) Probiotics and Prebiotics

Probiotic defined as microbial supplement that helpfully influence the host through its effects in the intestinal tract. Probiotics are beneficial bacteria or other microorganisms that are added in foods, which add to the friendly microbial flora in the intestinal tract. Examples of common strains include *Lactobacillus* and *Bifidobacterium* families of bacteria. Some are naturally found in fermented foods like sauerkraut and yogurt while some are added as nutraceutical ingredients in some foods usually displayed on the food's label.

They are non-digestible foods in human digestive system (onions, garlic, bananas, beans, skin of apples, or other fiber that have the capability to stimulate the favourable growth and activities of indigenous probiotic bacteria. It has been proved by various scientific evidences that probiotics and prebiotics act as an anti-cancer agent and also helps in prevention of various gut diseases. Probiotics and prebiotics function through various mechanisms such as modulating the gut microbiota, eliminating pathogens, reducing mutagenesis and geno toxicity of dietary carcinogens, preventing the release and reabsorption of pro-carcinogenic substances, producing metabolites with anticancer properties.

(iii) Nutraceutical Enzymes

Enzymes are proteinous in structure and are produced by the cell, act as a biocatalyst. Medical problems mainly related to the GIT whether GERD (gastroesophageal reflux disease) or constipation or diarrhoea or ulcerative colitis could be treated with enzyme supplements, enzyme could be a better option for diabetic patients.

(B) Non – Traditional Nutraceuticals

They are the foods enriched with supplements or biotechnologically designed crops to boost the nutrients. There are many natural bioactive containing foods that helps in the human wellness. The non – traditional nutraceuticals are given as follows:

1. Fortified Nutraceuticals

This type of nutraceutical includes breeding at the agriculture level or addition of compatible nutrients to the main ingredients such as minerals added to cereals, flour fortified with calcium, iron and folic acid, and milk fortified with cholecalciferol. These can be utilized to combat various associated micronutrient deficiencies.

2. Recombinant Nutraceuticals

Biotechnology tools have been well applied through a fermentation process in various food materials such as cheese and bread to extract the enzyme useful for providing necessary nutrients at an optimum level.

Potentiality of Nutraceuticals in Cancer Treatment

Nutraceuticals oncology is the use of nutraceuticals and functional foods which helps in the cancer prevention and management of cancer. In recent times, researches have shown that about 64 per cent to 81 per cent of human cancer patients take various nutraceutical supplements such as vitamins and minerals, or herbal supplements. However, 68 per cent of their physicians are unaware of their usage. It has also been proved that there is no negative side effect of nutraceuticals on the patients. Foods low in simple carbohydrates with moderate amounts of high-quality protein, fiber, and fat (especially fats of the omega-3 fatty acid series) are beneficial for cancer patients.

Also, there are certain nutraceuticals that potential to reduce the risk of developing cancer, or retarding the rate of growth and metastasis of established malignant disease, capability in decreasing toxicity and also reducing the risk of side effects associated from various therapies. It also improves the condition of life.

Important Nutraceuticals in Prevention and Management of Cancer:

1. Polyphenol

The polyphenols are naturally occurring compounds which are found in various fruits, vegetables, cereals and beverages. In human diet, there are various foods that are rich in polyphenols such as wine, tea, coffee, etc. The food product that are manufactured from these foods have significant amount of polyphenol.

2. Antioxidant vitamins

Antioxidants protect the body against the effects of free radicals and other substances which produce toxic effects, such as xenobiotics. The role of antioxidant vitamins such as ascorbic acid, lycopene, beta-carotene, alpha tocopherol, retinol and non-vitamin natural antioxidants in the prevention of cancer disease has been highlighted in various research studies.

Table 1: Nutraceuticals rich Foods and their Anti-cancer Properties

Sites	Food Component	Constituent	Anti-cancer Agents
	Garlic	Thiocremonone	Inhibiting tumor growth
Liver	Black cumin	Thymoquinone	Inhibiting cell proliferation
	Clove	Eugenol	Improving the xenobiotic metabolizing systems
Cervix	Black cumin	Thymoquinone, methanolic extract	Inducing apoptosis and inhibiting proliferation
Prostate	Ginger	Ginger extract	Inducing inhibiting prostate cancer cell proliferation and growth
	Saffron	Saffron extract	Anti-proliferative properties, inhibiting cell invasion and migration
	Tomatoes, Guava, Papaya	Lycopene	Anti-oxidant activity, protect against formation of cancer mainly prostate, bladder.
	Corn, Egg yolk, Spinach	Lutin	Anti-cancer activity, protects the eyes from age related muscular degeneration.
	Carrots, Orange, Papaya, various fruits and vegetables	Beta - carotene	Anti-oxidant properties, neutralizes free radicals, protect cornea against UV light, Anti-carcinogenic.
	Onion	Allyl sulphur compounds	Anti-oxidant and anti-inflammatory properties
	Fish oil, Egg	EPA and DHA	Can induce apoptosis and inhibit growth of cancer cells.

Source: Potential Role of Nutraceuticals (Adapted from Kalra Ek (2003))

3. Lipids and polyunsaturated fatty acids

The various sub-groups include fats, waxes, glycolipids, phospholipids, and polyprenyl compounds. The essential fatty acids are omega-3, omega-6 which play well defined functions. Isoprenoids enhance anti-oxidative power by improving receptor functionality. Omega-3-PUFAs are immune boosting, platelet aggregating, anti-inflammatory agents.

4. Spices

Spices are substances which are used as condiments because of their flavour, taste and color. Many of them have been used as medicinal plants in folk medicine for the treatment of various diseases because they contain many bioactive compounds and possess a lot of beneficial health effects. Scientific studies have shown the antioxidant, anti-inflammatory and immune modulatory effects of these spices, which are utilized in prevention and treatment of several cancers.

Conclusion

The incidence of cancer is continuously rising day-by day. To decrease the risk of various diseases, nutraceutical products have been researched. These products are extremely active and also have a profound effect on cell metabolism. As nutraceutical act as powerful instrument in maintaining health, destroy free radicals, act as nutritionally induced acute and chronic diseases. They are also important in reducing toxicity associated with chemotherapy and radiation therapy, and may lead to better life conditions by reducing cancer cachexia. They inhibit cell proliferation and induce apoptosis in cancer cells.

Nutraceuticals provide an active source of compounds with chemo-preventive effects because they have antioxidant properties which minimize the risk of cancer as well as various diseases. They are harmless and natural food constituents. This article aims to give a reflection on the beneficial role of nutraceuticals in the prevention and managements of cancer. Therefore, daily intake of nutraceutical supplements will reduce the risk of diseases and increase the longevity and quality of life.

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