



Cancer Chemoprevention and Healthy Lifestyle (A Review of Functional Foods in Cancer)

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Mini Review

It has been estimated that among all cancers, approximately 5% to 10% are caused by genetic factors (i.e., inherited/hereditary cancers), brain cancers are accounting for 1% to 2%, and about 2% are pediatric cancers wherein genetic aberrations perhaps play a key role [1-3]. Unlike hereditary and pediatric cancers, primary brain cancers are probably associated with both genetic and environmental factors such as exposure to aromatic hydrocarbons, ionizing radiation, and pesticides [2,4]. Similarly, both genetic susceptibility and environmental risk factors could impact the development of sarcomas, which originate from mesenchymal tissues (mesoderm) and account for less than 1% of adult solid malignant tumors [5]. In contrast, the majority of cancers (i.e., carcinomas) are linked with environmental or lifestyle-related factors, e.g., use of tobacco, chronic alcohol consumption, infections, and obesity – many of these risk factors could be preventable. Alternatively, intake of a healthy balanced diet with appropriate quantities of fruits and vegetables may lower cancer risk [6]. According to the World Health Organization (WHO), nearly 40% of cancers can be prevented, especially alcohol and tobacco-related cancers. Roughly 11% of all cancer cases are connected to alcohol, and tobacco use accounts for 25% of all cancer mortality worldwide. It may be worth mentioning that globally about 19.3 million new cancer cases and 10 million deaths occurred due to cancer in 2020 [7].

Considering the above-mentioned cancer problem and possibility of its control, strategies have been developing from a multitude of different directions since the initial cancer chemoprevention approaches by prominent scientists like Lee Wattenberg (1921-2014) and Michael Sporn (1933-). The ideas of cancer prevention by dietary components are primarily based on two key issues – inhibition of oxidative stress and inflammation. However, there are other relevant aspects such as inhibition of cell proliferation or cell cycle arrest, induction of apoptosis (programmed cell death), DNA repair, alteration in gene expression or epigenetic changes [8]. Interestingly, a book from the Academic Press ‘Functional Foods in Cancer Prevention and therapy’ edited by Dr. Y. Kabir (2020) has discussed all the above-mentioned biological mechanisms and how they are modulated by different dietary or herbal components. Of note, functional foods are believed to possess ingredients that have several health benefits.

It is thought that persistent oxidative stress can generate a state of chronic inflammation, which in turn could lead to a number of chronic health conditions such as type-2 diabetes, cardiovascular disorders, and cancer [9]. The majority of chapters in this book discussed these two important biological events, i.e., oxidative stress and chronic inflammation, at different levels and varied perspectives. It is notable that particularly five chapters (10-14) explained these two phenomena in great detail. In chapter-10, the authors elaborated how cancer preventive effects of phytochemicals from various plant-based products function mainly through anti-inflammatory and antioxidant activity. Conversely, they also showed that phytochemicals are able to enhance the secretion of reactive oxygen species that can kill cancer cells. In addition, the authors mentioned the application of nanotechnology such as nanoparticles for the phytochemical delivery. Both chapters 11 and 13 elucidated the antioxidant properties of various phytochemicals and their effects on tumors. On the other hand, Khan et al. in chapter-12 revealed that plant polyphenols possess both antioxidant and pro-oxidant properties. They also proposed that copper-dependent pro-oxidant cytotoxic action of various polyphenols against cancer cells perhaps is a common mechanism. In chapter-14, the authors described the beneficial role of probiotics in a number of health problems including

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oxidative stress, inflammation, diabetes, and cancers. Overall, this chapter did a good job of introducing probiotics, different strains and human health benefits of each, and their potential use in cancers of different systems.

Angiogenesis (new blood vessels formation) and inhibition of apoptosis are two important phenomena for continued neoplastic growths. A tumor cannot grow beyond a diameter of 1 mm to 2 mm without angiogenesis due to nutrient deficiency [10]. Consequently, malignant tumors produce angiogenic factors including vascular endothelial growth factor. Several authors in this book mentioned these two key tumor-related phenomena. However, in chapter-1, Varol discussed in great detail the topic of angiogenesis, and its modulation by natural remedies and functional foods. In chapter-2, Gupta also narrated anticancer bioactive foods and their categorizations, e.g., sources such as plant, animal, and microbial origin, chemical nature, and methods of action such as anti-proliferative/apoptotic, and antiangiogenic.

The book is written and organized, so that certain chapters in this book focused on specific issues. For example, chapter-5 pinpointed the dietary components that can increase the body concentrations of adiponectin. Of note, adipose tissue secretes various hormone-like cytokines/adipokines; and in obesity, the majority of these adipokines have pro-inflammatory functions. Contrarily, anti-inflammatory adipokine adiponectin possibly has a preventive role against cancer. In chapter-6, the authors described different constituents of lentils, e.g., polyphenols, bioactive peptides (like lectins, and defensin), and phytosterols, which have demonstrated to possess anticancer effects. Similarly, in chapter-7, the authors showed the evidence for anticancer properties of honey. Interestingly, honey has been suggested to have immune-improving, antioxidant and anti-inflammatory properties, as well as anti-proliferative, pro-apoptotic, and anti-mutagenic effects. Nevertheless, an elaborated report has been presented in chapter-9 on grape seed polyphenols such as resveratrol, catechin, quercetin, and proanthocyanidin, and their effectiveness in preventing UV-induced skin carcinogenesis.

Phytochemicals such as epigallocatechin-3-gallate, curcumin, flavonoids, and resveratrol are frequently discussed throughout the book, particularly in chapters 3, 8-10, 17, 18, and 20. Chapter-8 exclusively concentrated on the mechanisms of anti-cancer effects of curcumin. On the other hand, a few chapters solely addressed the plausible chemopreventive strategies of specific cancers such as breast cancer (chapter-15) and head & neck cancer (chapter-16). At the latter part of the book, three articles are thought-provoking. In chapter-17, it is shown how phytochemicals can target the cell signaling pathways, which are necessary for self-renewal of cancer stem cells. In chapter-18, Gottlieb et al. described the effects of different food components on specific genes, associated enzymes or epigenetic events in order to modulate a number of malignancy-

related phenomena. The authors in chapter-19 revealed the interplay between genetic/epigenetic and environmental factors, and how dietary factors interact with certain metabolic enzymes to modulate the cancer risk. In this connection, a detailed account on the status of glucose metabolism in cancer cells has been provided in chapter-4, along with metabolic reprogramming in these cells by functional foods.

Finally, the last chapter (i.e., 21) by Sharma et al. primarily focused on cancer survivors to prevent or reduce the risk of cancer recurrence, secondary cancers, second primary cancers, and other chronic diseases. In general, they recommended that a diet rich in vegetables, fruits, and whole grains and low in fats, red meats, and alcohol along with exercise enhances cancer patients' survival. Overall, the book has covered a diverse range of cancer chemoprevention-related issues. Informative discussion on the role of food in cancer prevention together with explanations on biochemical and genetic concepts, which are supported by experimental evidence and clinical studies, has much to offer to readers at various levels.

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