Chapter 3

# The Effect of Antioxidant Foods on Cancer Prevention

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**Abstract**

Cancer is the second-most common cause of death worldwide, after cardiovascular diseases. With the development of cancer, significant changes occur within the cell. Due to the increase in diagnostic possibilities and the provision of more widespread health services to societies, it is possible to diagnose more and more patients with cancer every day. The development of technology increases people's exposure to cancer-causing substances, impacting the frequency of cancer. This study examined the effects of nutrition, one of the environmental factors, on cancer. The high mortality rate in cancer increases the importance of the subject even more. It is accepted that environmental factors play a role between 80 and 90% in the development of all cancers. It is recommended to consume vegetables and fruits. Processed red meat consumption should be limited. Avoid using frying oils for an extended period of time. Dietary recommendations are important for cancer prevention. Many factors, such as carotenoids, vitamins, phenolic compounds, terpenoids, and steroids in plants, have been shown to be effective in reducing the risk of disease. Antioxidants are still widely used to prevent or reduce the effects of cancer. However, an increasing number of studies suggest that antioxidant use may accelerate the spread of cancer, highlighting the need for further research on nutrition and cancer.

## 1.INTRODUCTION

Cancer is a general term used for various disease groups defined by uncontrolled and abnormal cell proliferation in which cells lose control of

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division (Todd and Wong, 1999). It has been the most common health problem in our country in recent years. Abnormal cell proliferation forms a tumor mass. A tumor is the uncontrolled proliferation of some cells in the body. The tumor disrupts normal functions in the area where it occurs. A tumor that grows in the area where it started and does not spread to other tissues is called a benign tumor, while a tumor that spreads to other tissues and grows is called a malignant tumor (Ünsal, 2018). The process of cancer development, called carcinogenesis, consists of three phases: initiation, promotion, and progression. The initiation phase is characterized by epigenome, chromosome, and DNA damage that regulates gene expression. The initial phase is followed by a long process. With inflammation, genomically unstable cells grow. In the progression phase, as the cells proliferate, they further damage their genome and transform into malignant tumors (Poirier, 1987). The main types of cancer are stomach cancer, cervical cancer, prostate cancer, pancreatic cancer, esophageal cancer, skin cancer, blood cancer, liver cancer, small intestine cancer, colon cancer, breast cancer, uterine cancer, kidney cancer, and lung cancer (Ministry of Health, 2021).

Although the reasons for the occurrence of cancer in a body are not fully known, the external and internal factors that may be factors in cancer formation are listed as follows:

- Genetic predisposition
- Poor eating habits
- Smoking and alcohol use
- Additives in food
- Radiation exposure
- Some chemical substances
- Some viruses and bacteria
- Prolonged exposure to sunlight
- Air pollution
- Exposure to an overdose of x-rays (Ministry of Health, 2021).

One of the most important requirements for a quality life is a healthy diet. Nutrients provide the necessary substances for the metabolic requirements of the organism, and in addition, they contain components that have positive effects on our health (Coşkun, 2005). Balanced and adequate nutrition during cancer treatment reduces the risk of infection, heals quickly, tolerates treatment-related side effects better, maintains energy and strength, preserves the body's nutritional stores and weight, and makes it feel better (Mandar, 2012).

Healthy nutrition is very important for preventing diseases. Antioxidant nutrition is especially important to get rid of the effects of free radicals. Food antioxidants are defined as substances that can neutralize some or all of the negative effects of free radicals in humans (Yılmaz, 2010). Cancer may develop for different reasons. Unhealthy diets, wrong lifestyles, sedentary lifestyles, and obesity increase the risk of cancer. Unhealthy diets and harmful foods have been observed to cause cancer. Improper nutrition, consuming cancer-causing foods, or not getting enough nutrition can cause cancer. Especially in obese individuals, the risk of kidney, breast, uterine, and colon cancer increases (Çevik & Pirinççi, 2017). Approximately 1/3 of all cancer cases are caused by the food consumed, and 1/3 of all cancer deaths are related to nutrition. Therefore, healthy nutrition, abstaining from alcohol and smoking, and physical activity are very important in cancer prevention (Özcan & Demir, 2004).

Epidemiologic studies show that obese people are more likely to develop certain types of cancer, such as breast, prostate, lung, ovarian, colon, rectum, and kidney cancer. It is estimated that a significant portion of these cancers are related to nutrition. Research has found that an increase in body mass index increases the risk of death from breast and prostate cancers at later ages (Okasha et al., 2002).

### 1.1.Cancer and the Antioxidant System

Antioxidant nutrients are nutrients that reduce free radicals and reactive compounds that occur during the normal physiological activities of humans or that are ingested through the environment and nutrition by giving electrons or hydrogen to them and thus significantly reduce the negative effects that may occur (Astley, 2003; Benzie, 2003; Erbaş, 2006). The antioxidant content of foods may vary according to the preparation, type, harvest time, harvest methods, climate, temperature, humidity, and light of the storage environment. Although the use of natural antioxidants reduces the risk of developing cancer and many other diseases, excessive use may cause toxic effects (Cornelli, 2009).

A good antioxidant eliminates free radicals, retains redox metals, and has a positive effect on gene expression. There are two types of antioxidants: enzymatic and non-enzymatic. Enzymatic antioxidants include Superoxide Dismutase, Catalase, Glutathione Peroxidase, Glutathione Reductase and Glucose 6-Phosphate Dehydrogenase. Nonenzymatic antioxidants are Mineral (Se, Zn), Vitamin (A, C, K and E), Carotenoids (B-carotene, Lycopene, Lutein, Zeaxanthin), Organosulfur Compounds (Allium, Allyl Sulfite, Indoles), Low Molecular Weight Antioxidants (GSH-Px, Uric

Acid), Antioxidant Cofactors (Coenzyme Q10) and Polyphenols (Moure et al., 2009).

The foods containing the most powerful antioxidants are Anthocyanins (Damson Plum, Blackberry, Blackberry, Black Mulberry, Cherry, Blueberry, Blueberry, Cherry), Catechins (Black tea and Green tea), Lycopene (Tomato, Pink Grapefruit, Watermelon, Apricot), Beta Carotene (Carrot, Melon, Mango, Apricot), Resveratrol (Grape, Blueberry, Cranberry), Elajic Acid (Pomegranate, Grape, Cherry, Strawberry), Capsaicin (Red Hot Pepper), Quercetin (Red Onion and Apple), Vitamin C (Grapefruit, Orange, Pepper, Broccoli, Kiwi, Rosehip), Vitamin E (Almonds, Sunflower Seeds, Wheat), Selenium (Potatoes, Sunflower Seeds, Eggs), Polyphenols (Green Tea, Raspberry, Soy, Strawberry, Plum, Apple, Blueberry), Glucosinolates (Broccoli, Brussels Sprouts, Watercress, Cauliflower), Lutein (Broccoli, Spinach, Kale, Red Grape, Kiwi) (Ratnam et al. , 2006). Some studies have found that patients who eat more fruits and vegetables (rich sources of antioxidants) are less likely to develop certain types of cancer (Willett, 1994).

Apple is superior at eliminating mutagens in the intestinal cavity due to its fibrous structure and pectin content, and it dilutes mutagens by being water-retentive. In this way, it reduces the activity of oxidative stress, indicating that it is an important herbal intestinal protector. In studies, it has been determined that apples and apple juice can prevent the formation of colon and lung cancer in humans due to the antioxidants, pectin, and vitamins they contain and may be protective against liver and breast cancer (Yılmaz, 2010; Gerhauser, 2008).

In a study, the relationship between dietary fat and distal colon cancer was examined. In countries with a high prevalence of distal colon cancer, 40–45% of daily calories were found to consist of saturated and unsaturated fats. In Japan, where the incidence of distal colon cancer is low, it was found that 10–15% of daily calories were provided from fats, and most of them were provided from unsaturated fats, especially from fish (Weisburger, 1992). Studies have shown that omega-3 fatty acids reduce the risk of cancer, and it has also been shown that the ratio of omega-6 and omega-3 in the diet is important. Studies have found that this ratio in the diet is important in reducing the risk of more than one type of cancer, especially breast cancer (Aksoy, 1984). Omega-3 fatty acids reduce the risk of cancer formation. They also slow down the growth of lung, colon, breast, prostate, and many other types of cancer. At the same time, omega-3 fatty acids increase the effectiveness of chemotherapy and radiotherapy and the response to

treatment. Omega-3 fatty acids also reduce and prevent weight loss, muscle loss, and cachexia seen in cancer (Muhsiroğlu, 2007).

Many studies have shown an association between salted foods and gastric cancer. In Hong Kong and South China, the incidence of nasopharyngeal cancer is also high due to high nitrosamine intake due to the high consumption of salted fish. Foods cooked using various cooking methods, such as smoking, high temperatures, and charcoal grilling, show high carcinogenic properties due to polycyclic hydrocarbons and heterocyclic aromatic amines (Yıldız and Demir, 2004).

A high animal protein intake will also increase saturated fat consumption. This has been associated with breast, uterine, gastrointestinal, colorectal, and pancreatic cancers and increases the risk of these cancers (Muhsiroğlu, 2007). Studies have shown that lean animal protein consumption is not associated with cancer. It has been reported that processed meats such as salami, sausage, and pepperoni have a high effect on the relationship between pancreatic cancer and meat consumption (Baysal and Criss, 2004). Nitrates and nitrites are frequently used in processed meat products such as sausage, salami, bacon, and fish as preservatives, colorants, flavor enhancers, and to maintain an antimicrobial environment. In addition, nitrites converted to nitrosamines have been reported to cause bladder cancer in animal models (Dönmez et al., 2010). It has been shown that women who were fed diets containing high amounts of vegetables, fruits, whole grains, fish, and poultry after breast cancer diagnosis had lower mortality rates than women fed diets containing processed foods, red meat, sweets, high-fat daily products, and French fries (Kroenke et al., 2005).

Vitamin A is a fat-soluble vitamin that plays a primary role in the normal growth and development of epithelial tissues. It is found as retinol and its esters in milk and offal and as provitamin A carotenoids in yellow and green leafy vegetables. Carotenoids are the pigments that give these fruits and vegetables their yellow, orange, and red colors. Carotenoids are divided into two groups: hydrocarbons and xanthophylls. Their antioxidant effects are due to their conjugated double bonds, which function both as free radical scavengers and single oxygen suppressors (Podselek, 2005). As the number of double bonds in carotenoids increases, antioxidant activity increases in parallel. The most effective antioxidant among carotenoids is lycopene; xanthophylls have the lowest antioxidant effect (Koca and Karadeniz, 2005).

Vitamin C, known as ascorbic acid, is a water-soluble vitamin with antioxidant properties and is involved in many enzymatic reactions (Moser and Benich, 1991). Its antioxidant properties are versatile. It acts both intracellularly and extracellularly as a water-soluble antioxidant. It prevents

lipid oxidation by different cellular mechanisms (Proteggente et al., 2002). Vitamin C is considered a free radical scavenger, and a high intake of vitamin C-rich foods (e.g., citrus fruits) may play a role in reducing the incidence of gastric cancer (Boyle and Levin, 2008). The most important sources of vitamin C are citrus fruits, tomatoes, potatoes, peppers, pumpkin, strawberries, fibrous green vegetables, and sprouts. High doses of ascorbic acid intake may cause diarrhea and crystal formation in the urine, leading to the risk of kidney stones in the renal tract and predisposing to gout by affecting uric acid excretion (Auer et al., 1998).

Vitamin E is one of the major fat-soluble vitamins and one of the eight substances called tocopherols. Vegetable oils, eggs, and cereals are rich food sources of vitamin E. Excessive intake of vitamin E may cause stomach upset, diarrhea, and dizziness, rather than the usual toxic effects (Sherwin, 1990). In addition, some randomized trials have shown that vitamin E intake may increase the risk of fragility and hemorrhagic stroke, so its use should be avoided, especially in cancer patients with uncontrolled hypertension and thrombocytopenia (Hartman et al., 1998).

Studies have shown that certain carotenoids, such as alpha-carotene, beta-carotene, lycopene, lutein, cryptoxanthin, and zeaxanthin, which are found in many foods, complete their formation and act as anticarcinogens in the organs where they are stored. Therefore, in addition to carotenoids with provitamin A activity such as beta-carotene, carotenoids without provitamin A activity such as canthaxanthin, lycopene, and lutein have antioxidant properties and prevent cancer formation in this way (Gerster, 1993; Le et al., 1993). Beta-carotene has been shown to inhibit cell growth in a cell cycle-dependent manner and trigger apoptosis in cancer cells (Kotake-Nara et al., 2001).

Due to thermal and oxidative reactions occurring in frying oils, the use of the same oil for a long period of time adversely affects the acceptability and nutritional value of products fried in that oil. Volatile spoilage compounds such as aldehydes, ketones, hydrocarbons, alcohols, acids, esters, and aromatic compounds are formed in oils by oxidation (Fujisaki et al., 2002). Using frying oils more than three times causes the oil to burn. Burnt oil contains carcinogens (Koçak, 2012). Studies have reported that cooking methods such as barbecue, grilling, and pan-frying are more effective in heterocyclicamine formation compared to cooking methods such as microwave cooking and boiling or steaming (Ferguson, 2010). In addition, it has been determined in many studies that the use of spices and plant extracts rich in components with antioxidant effects prevents the formation of heterocyclicamine. Spices used in the preparation of mixtures such as meatballs are added not only

in Turkey but also all over the world to give color, flavor, and aroma to the product. In their study, in which they examined the inhibitory effect of black pepper on heterocyclicamine formation in meatballs made from minced meat, they reported that black pepper inhibited heterocyclicamine formation between 48.8 and 65.8% (Öz and Kaya, 2011).

**1.2.Foods that Increase Cancer Growth**

- Salted foods,
- Smoked foods,
- Hamburger,
- Meat cooked over direct fire,
- Foods with added nitrites and nitrates, such as sausage, salami,
- A diet poor in vegetables and fruits,
- Butter, suet, and fried foods (Coulston et al., 2001).

**1.3.Foods that Reduce Cancer Formation**

- Dried legumes: lentils, chickpeas, beans, kidney beans, peas, and soybeans

- Fruits: Orange, grapefruit, lemon, rosehip, blackberry, cranberry, apple, pear, quince, plum, cherry, sour cherry, strawberry, melon, watermelon, grape, fig, pomegranate, mulberry, banana, date

- Nuts: Chickpeas, chestnuts, almonds, hazelnuts, pistachios, walnuts

- Cereals: Whole wheat bread, wholemeal bread, rye bread, oat bread, bulgur

- Animal Products: Eggs, skimmed or low-fat milk, yogurt, cheese, cottage cheese, cottage cheese, yogurt, and kefir (Coulston et al., 2001).

**1.4.Ways to Prevent Cancer and Nutrition Recommendations**

- Achieving and maintaining a healthy body weight (maintaining a body mass index between 21-23)

- Ensuring that 15-30% of daily energy is obtained from fats

- Limiting red meat protein energy to 10% per day (avoiding over-salted foods such as pickles and pickled meats, paying attention to low-heat cooking)

- Storing food in conditions that prevent mold and fungus (refrigerating and freezing perishable foods)

- Paying attention to identifying and monitoring whether various chemical contaminants, pesticides, wastes, and additives in food are within safe limits

- Regular physical activity (brisk walking for 1 hour a day, more vigorous exercise for 1 hour a week) (Yıldız and Demir, 2004; Baysal and Criss, 2004).

It should be noted that cancer is a very general term. Since the development of tumors is a multi-stage process, it distinguishes patients with cancer from each other. Although cancer varies according to its origin, the organ in which it is located, and the cell type, success in treatment can be achieved if it is treated in the light of specific, accurate information, not general information from hearsay. Furthermore, it is important to avoid the uncontrolled and unsupervised use of antioxidants since they have been found to trigger cancer instead of preventing its development (Çiftçi, 2017). There are many factors that increase the risk of cancer. Studies have shown that nutrition is important in creating cancer risk. Medical nutrition therapy is always an effective method for treating cancer. The idea of eliminating cancer with medical nutrition therapy is a fictitious idea, while the idea of affecting the speed of cancer is a real approach. Dietary advice is important for cancer prevention. Healthcare providers should offer individuals preventive nutrition recommendations before cancer develops. However, researchers need to conduct more studies on nutrition and cancer.

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