Oncology Nutrition Connection

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The Oncology Nutrition Dietetic Practice Group (ON DPG) is pleased to distribute a unique issue of *Oncology Nutrition Connection (ONC)*. Devoted to Cancer Victory Gardens, it provides:

Chair, ON DPG: Maureen Huhmann, DCN, RD, CSO

Cancer Victory Gardens

Introduction

Immigrants who settled America sustained themselves with home gardens and farms. Thomas Jefferson, Abraham Lincoln, Woodrow Wilson, and FDR are among U.S. Presidents who planted "kitchen" gardens on the grounds of the White House. But as early America's agrarian society evolved into an industrial economy, family farms were gradually replaced with large farming businesses, and diets included greater amounts of processed foods. By the early 1900s public health officials recognized the relationship between processed diets and emerging nutrient deficiency diseases, and pursued national food fortification and enrichment programs. This coincided with the discovery of vitamins and minerals, and the recognition that whole foods provide a mix of nutrients required for good health. But at the time few appreciated the array of bioactive substances such as phytochemicals that are also present in whole plant foods.

Phytochemicals entered researchers' radar screens in the 20th century, but interest has heated up over the past several decades. Mark Messina, PhD and soyfoods expert, has stated "Phytochemicals are, in a sense, the vitamins and minerals of the 21st Century" (1). He believes "we now stand at the threshold of a Second Golden Age of Nutrition", the first taking place in the first half of the 20th century when vitamin and mineral research predominated, and the second at this time, when "we're piecing together practical, useable information, like the bioavailability of certain phytochemicals ... and how much cells need for an anti-cancer benefit ... ." (1). As evidence accumulated that approximately 30% of cancers could be attributed to lifestyle choices, research also suggested that phytochemicals play an important role in

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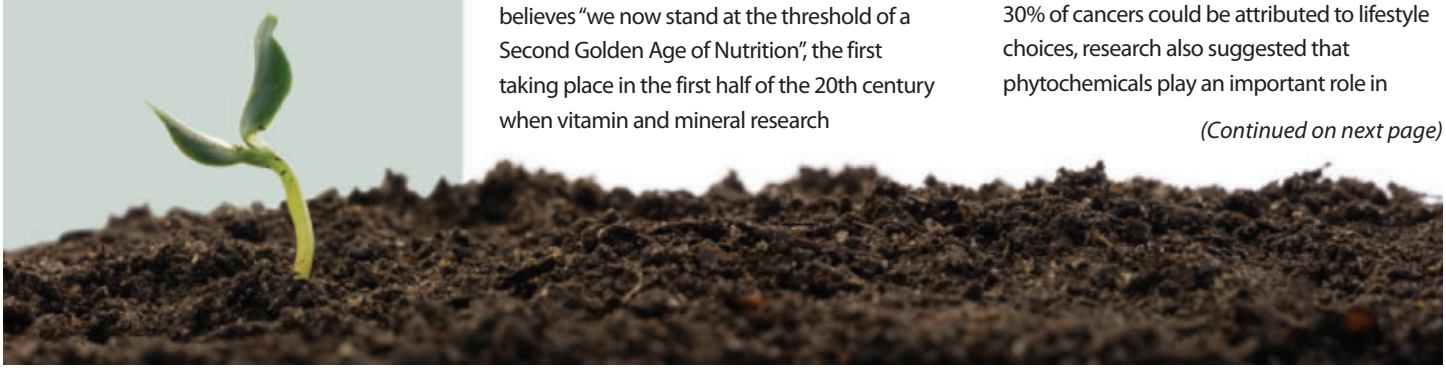

cancer prevention, and could perhaps be targeted for new treatments. Surveys suggest that a majority of Americans now believe that food provides benefits beyond basic nutrition, and want to know how food components can improve or maintain their health (2).

Today's gardeners believe that homegrown food provides one of the keys to good health. Gardening trends are covered by all media, and few Americans missed the news about our First Lady's White House garden. Michelle Obama used her platform to publicize the health and environmental benefits of homegrown food, and produce harvested from the White House garden were even used as the secret ingredient at an Iron Chef competition!

Many oncology RDs are working to educate, motivate, and demonstrate firsthand the value of gardening to cancer survivors. They are bringing this message to the cancer care community, and through their leadership health care facilities are beginning to plant healing gardens.

This issue of *Oncology Nutrition Connection* is devoted to cancer survivors who will benefit from healthful substances found in vegetables and fruits grown in Cancer Victory Gardens.

References:

1. Nutrition and Cancer Prevention: New insights into the role of phytochemicals. American Institute for Cancer Research, July 30, 1999 AICR Interview with Mark Messina.
2. 2009 *Food & Health Survey: Consumer Attitudes toward Food, Nutrition, & Health*, International Food Information Council Foundation.

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Professional Insight

Diana Dyer, MS, RD

As a cancer survivor, I feel deeply connected to the sense of hope and sense of purpose conveyed by this Chinese proverb. A garden begins with dreams, but comes to life with the pleasant work of planning, seed ordering or plant purchasing, sowing, watering, weeding, nurturing the baby plants to fruition, composting, working outside in the summer sunshine and rains, and finally harvesting, cooking, savoring, preserving, and sharing the delicious eating many many months after those first thoughts about this year's garden. All that sounds like the best of life to me.

Being a long-term and multiple-time cancer survivor, I have found that planning for (and thus anticipating) future activities has been one of my most effective coping strategies to transcend the rigors and uncertainties associated with cancer treatments and recovery, both of which are frequently accompanied by anxiety and multiple fears. I have found that planning each year's garden along with the step, step, step of implementation takes my mind off troubles and fears, allowing me to focus on pleasant thoughts of the future instead, i.e., to begin living again with both hope and purpose.

What exactly is a Cancer Victory Garden?

With inspiration from the Victory Gardens promoted during WWII, the home gardens planted to help with the war effort, my vision of a Cancer Victory Garden is simply a personal effort by anyone with a cancer diagnosis (including cancer caregivers) to grow fruits and vegetables for health and to increase length and quality of life after a cancer diagnosis.

Many years ago a friend (who is also a cancer survivor) "confessed" to me that she stopped doing her daily meditation and yoga during the summer, hoping that the time she spent in her garden was "good enough" to substitute for the benefits she felt those practices provided to her cancer recovery. My friend's comment has stayed with me all these years, and was the starting point for my realization that gardening itself provides an activity that engages and enhances the body-mind-spirit connection.

Although dozens of complementary and alternative medicine (CAM) therapies from acupuncture to yoga are often recommended as beneficial for cancer patients, gardening per se is only rarely recommended as a complementary therapy. Perhaps this is a classic example of "everything old is new again." Over the past several years, I have actually come to think of gardening as potentially the most accessible, low-cost, and effective complementary therapy available for cancer patients in order to optimize the hoped for outcomes from conventional cancer care. Indeed the benefits from gardening are available right out the backdoor, on a windowsill, patio or deck, balcony, front yard, even a rooftop.

I love both the positive energy and play on words that the phrase "Cancer Victory Garden" creates. From my own experience, I would briefly summarize the benefits of growing a Cancer Victory Garden as follows:

1. ***My body*** - Gardening helps keep me cancer-free plus optimizes my overall health from the increased consumption of a wide variety of organically grown, fresh, lower-cost fruits and vegetables, daily exercise while planting, tending, and harvesting (stretching, aerobic, strength-building), and sun exposure for increased vitamin D.
2. ***My mind*** - Gardening helps keep my mind occupied with planning, learning something new, providing multiple sensory experiences, creating beauty and appreciating nature, creating lasting memories, making new friends, community-building, quality family time, finding solace, relaxation, and slowing down. In other words, gardening is a "stress-buster"!
3. ***My soul*** - While having my hands in the soil and my face in the sun and rain, gardening helps me develop a spiritual practice where focusing my care and attention on ideals such as love, renewal, forgiveness, patience, and balance promotes a deep connection with the circle of life and the future of life.

"Life begins the day you plant a garden"

– Chinese Proverb

It is my hope that members of ON DPG will use the information in this edition of ONC to advocate for and promote the benefits of planting fruit and vegetable gardens at their own homes, in their communities, on the grounds of their health care institutions, and anywhere cancer patients may receive additional supportive services. Lastly, I hope ON DPG members will promote gardening to their patients as an effective and enjoyable complementary therapy for fighting cancer.

Whole Food, Phytochemicals, and Cancer

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Whole foods provide an assortment of bioactive compounds that promote and support good health. Vitamins and minerals are among the best known, and are found in both plant and animal foods. Phytochemicals are bioactive compounds unique to plant foods. Their primary purpose is to protect plants from bacteria, viruses, and DNA damage, in essence being an integral part of a plant's survival system. Many evolved as toxic substances that would discourage insects from eating the plant and organisms from killing the plant, but their value also extends to health promotion in humans. Of approximately 25,000 bioactive substances in food, thousands of them are phytochemicals.

Phytochemicals and Cancer

The National Cancer Institute (NCI) estimated that 1,479,350 men and women in the U.S. would be diagnosed with cancer and 562,340 men and women would die of cancer [of all sites] in 2009 (1). Cancer is the second leading cause of death in the U.S., and is gaining ground on the leading cause of death, heart disease (2). While the NCI is committed to understanding "genetic, epigenetic, environmental, behavioral, and sociocultural determinants of cancer", NCI also recognizes that prevention is the first line of defense against cancer (3). A recent report published by the American Institute for Cancer Research (AICR), *Policy and Action for Cancer Prevention*, contains new estimates suggesting that " about a third of the most common cancers in high income countries, and about a quarter in low- and middle-income countries, can be prevented by eating a healthy plant-based diet, being physically active, and maintaining a healthy weight" (4).

Population studies suggest that consuming recommended levels of vegetables and fruits, specifically 5 to 9 daily servings, is associated with lower incidence of cancer, and cell studies consistently demonstrate that phytochemicals can help prevent the growth of cancer cells. It has been more difficult to demonstrate cancer fighting effectiveness of nutrients and phytochemicals in clinical trials. Researchers have frequently utilized bioactive compounds in single dietary supplements for prospective studies, but such work has failed to demonstrate health benefits. This has led researchers to speculate that bioactive components in whole fruits and vegetables work synergistically and on multiple biochemical pathways to modulate carcinogenesis.

Carcinogenesis

Cancer is a highly complex disease that arises from seemingly endless genetic and epigenetic changes, but common to all cancers is the transformation of a normal cell to an abnormal cell (initiation), cancer promotion, and cancer progression. In addition, all cancers depend on an abnormal cell's ability to multiply, evade apoptosis (cell death), develop an adequate blood supply (angiogenesis), and spread (metastasize) to distant sites. To pinpoint the best dietary practices for preventing and possibly treating cancer, researchers are examining the role of nutrients, and bioactive compounds such as phytochemicals, on these processes.

- ***DNA Mutations***
  DNA routinely undergoes a variety of changes, but most are quickly repaired. DNA mutations that are not repaired may cause cells to lose the ability to replicate, grow, and function normally. Research suggests that phytochemicals and other bioactive compounds in food help repair DNA mutations, preventing formation of abnormal cells that can potentially lead to cancers.

- ***Oxidation Reactions Involving Reactive Oxygen Species (ROS)***
  Reactive Oxygen Species (ROS) are partially reduced forms of oxygen that trigger inflammation. They play important roles in life, such as promoting inflammation following trauma or injury that helps limit bacterial infection and repairs tissue. However, excess levels of ROS can stress and damage tissue by promoting chronic inflammation. In turn, chronic inflammation can contribute to a biochemical environment that favors DNA mutations and the formation of abnormal cells (5,6). Phytochemicals with anti-oxidant properties quench

ROS, modulating the biochemical environment so it is less conducive to cancer initiation.

- ***Cytochrome P450 Enzymes***
  Cytochrome P450 enzymes (CYPs) detoxify foreign chemicals, including drugs. CYPs are also involved in cancer formation and treatment, having the potential to either activate or inactivate carcinogens and chemotherapy drugs (7). For example, NNK (4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone) is a carcinogenic compound found in tobacco. Cytochrome P450 enzymes, such as CYP2A13, activate NNK, resulting in DNA adducts that can lead to mutations (8). Cruciferous vegetables supply phytochemicals that may inhibit theses CYPs, making them uniquely protective against these DNA mutations.

- ***Phase II Enzymes***
  Phase II enzymes such as glutathione transferase detoxify potentially harmful molecules that can initiate cancer. The cruciferous and allium families of vegetables provide glucosinolates that may increase the expression of Phase II genes. For example, rat studies suggest that sulforaphane, an isothiocyanate in broccoli, is a very potent Phase II enzyme inducer and has the potential to help block mammary tumor formation (9). Evidence also suggests that dietary Phase II inducers may protect against cancer by promoting apoptosis of abnormal cells (10).

- ***Cell Cycling***
  A cell cycle involves a series of coordinated events that result in cell division. Phases of cell cycling replicate chromosomes (DNA synthesis or S-phase) and create two genetically identical daughter cells (mitosis or M-phase). Gaps between these phases give a cell time to respond to a variety of cell signals that review the work that has been done. If a cell recognizes any problems, such as a DNA mutation, the cell cycle is delayed so the problem can be repaired. Unregulated cell cycles may allow mutations to remain uncorrected, which can contribute to cancer initiation (11). Lycopene, a phytochemical found in tomato products, is one of several phytochemicals that may influence cell gaps, helping to keep cell cycling on a normal track (12).

- ***Apoptosis***
  Normal cells replicate DNA a limited number of times. As normal cells age and die, a process referred to as apoptosis, they are replaced by new cells. This results in routine renewal of body tissues. Cancer cells resist normal cell aging and death, evading signals that promote apoptosis. Cell studies suggest that phenethyl isothiocyanate, which is found in cruciferous vegetables, is one of many phytochemicals that may induce apoptosis of cancer cells (13).

- ***Angiogenesis***
  To grow beyond 1 or 2 millimeters, tumors rely on expansion of the circulatory system for an adequate supply of oxygen and nutrients. The growth of circulatory vessels, referred to as angiogenesis, also provides a route for cancer cells to metastasize into surrounding tissues and beyond (14). Anti-angiogenic treatments cut off the supply of blood, and therefore nutrients, to the tumor, shrinking it, and perhaps killing it. Several phytochemicals are purported to have anti-angiogenic properties by inhibiting vasculature formation in tumors. Evidence from cell studies suggests that Indole-3-Carbinol (13C) and diindoylmethane (DIM) are two phytochemicals that inhibit angiogenesis and metastasis, though in vivo studies are needed to confirm this benefit (15).

Phytochemical Reviews

The following briefs address the roles of some phytochemicals found in cancer-fighting foods.

Allyl Sulfides

Allyl Sulfides are a group of sulfur compounds found in onions, garlic, and leeks. They are best known for their anticarcinogenic properties (16). The total sulfur content of garlic is known to reach 1% of its dry weight; however, sulfur content of the allium family varies among species, and can be influenced by the vegetation phase of the plant (17). Different types of allyl sulfide compounds promote different levels of toxicity to cells. Water soluble allyl sulfide compounds such as the S-allylcysteine found in deodorized garlic preparations is far less toxic to cells than the

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lipid soluble compounds, but both compounds have anticancer properties (17).

Allyl sulfides are thought to reduce tumor incidence in breast, skin, colon, uterine, esophageal and lung cancers (16). The American Institute for Cancer Research (AICR) states that the strongest evidence suggests they protect against stomach and colorectal cancer (18). This protection is associated with the ability of allyl sulfides to block N-nitroso compound formation, suppress the bio-activation of several carcinogens, enhance DNA repair, reduce cell proliferation, and induce apoptosis (16). It also appears that benefits are derived from several of these mechanisms working together.

Biological activities of allyl sulfides are influenced by several dietary components, including total fat, selenium, methionine and vitamin A (19). Diets lower in protein and higher in selenium may reduce incidence of chemically induced tumors in mice fed diets enhanced with garlic powder (20). At this point, ways in which dietary fat intake alters the effects of garlic are unclear. Processing of garlic may reduce levels of allyl sulfur compounds, and crushed raw garlic is highest in these components (21). AICR reports that peeling and chopping garlic releases the enzyme, alliinase, which is thought to promote development of health promoting sulphur compounds (18).

Concentration and duration of exposure can increase antiproliferative effects of allyl sulfides. In other words, the more you eat, the more of an effect this substance will have (19). There are no recommended intakes for allyl sulfides; various doses have been used in clinical trials.

Our bodies' response to specific foods such as garlic, or their active compounds such as allyl sulfides, is also influenced by genetics. While garlic influences enzymes involved in the regulation of ROS, individual polymorphisms in enzymes may influence individual response to garlic. As the field of nutrigenomics progresses, clinicians may be better able to determine who may benefit the most from consuming garlic, and perhaps other food sources of allyl sulfides (17). In the meantime, emerging evidence suggests that incorporating garlic and onion in the diet may have significant health benefits.

Anthocyanins

Anthocyanins are a sub-group of flavonoids that give fruits and vegetables their bright red, blue and purple colors (22,23). They are abundant in red grapes, raspberries, blueberries, cranberries, purple cabbage, corn and sweet potatoes. Anthocyanin levels are measured in milligrams (mg) per 100 grams (g). Fruits with low levels of color such as pears contain approximately 0.25mg/100g while colorful fruits such as blueberries contain 500mg/100g.

Anthocyanins occur naturally as glycosides, which are sugars bound to the non-carbohydrate portion of a molecule (24). The six most common anthocyanidins are cyanidin, delphinidin, petunidin, peonidin, pelargonidin, and malvidin. Cyanidin is the most common form, and is present in 90% of fruits (25). Anthocyanins can be absorbed as intact glycosides. Absorption occurs in the colon as well as the stomach and small intestines. Absorption and metabolism is rapid; very little is detected six hours after ingestion. The chemical structure of anthocyanins alters absorption. A high fat or carbohydrate-rich diet may delay transit time through the gastrointestinal (GI) tract, but has little impact on absorption.

Epidemiologic studies suggest that consuming anthocyanins reduces cancer risk. These compounds have anti-oxidant and anti-inflammatory activity, which can limit circulation of ROS that can damage DNA and promote inflammation (24). The de-glycosylated or aglycone forms, called anthocyanidins, have been shown to be potent inhibitors of malignant cell survival and oncogenic signaling. In vitro studies suggest they can modulate expression of multiple genes associated with free radical scavenging, stimulate phase II detoxifying enzymes, reduce inflammation and angiogenesis (26), and induce apoptosis (27). Taken together, these processes inhibit cancer initiation and promotion.

Much more research is needed to fully elucidate the biochemical role of anthocyanins in cancer biology, but current knowledge supports their reputation as cancer fighters. Berries, red cabbage and lettuce, corn, and sweet potatoes not only are rich sources of anthocyanins; they are commonly consumed foods that enhance any diet. Incorporating these foods into the diet, whether in salads, entrees, deserts, or as snacks, enhances variety while promoting health.

Genistein

Genistein is one of the primary isoflavones found in soy products, and to a lesser extent in other legumes. Traditional soy foods, including edamame, tofu, tempeh and soy milk, contain about 1.5-40 mg genistein/100g whole food, while American style and more highly processed soy foods such as soy burgers, soy nuts and protein bars provide from 5-75 mg genistein/100g (28).

Genistein is chemically similar to 17 , ß-estradiol, and binds most readily to estrogen receptor ß, but at a much lower affinity than estrogen. Its anti-cancer actions include slowing the growth of cancer cells through protein-tyrosine kinsase inhibition, inhibiting HER-2 protein phosphorylation, and promoting apoptosis through various pathways (29). Genistein also has antioxidant activity (29). Concern has been raised about its potential estrogenic action and whether it may promote tumor growth. While a mouse model of postmenopausal breast cancer has suggested that genistein may promote tumor development (30), inhibition of cancer has also been shown in animal studies (29). Blood levels achieved through diet, generally < 5 uM, have showed few harmful effects in cell cultures (31-33). A recent meta-analysis found phytoestrogens to be safe for human consumption, and suggests they do not increase risk of endometrial or breast cancer (34).

Epidemiological and case control studies have shown that genistein may be protective against breast cancer in women with no previous breast cancer diagnosis (35-37), and that it may benefit women who have already been diagnosed with breast cancer (38,39). Contrary to previous research on genistein's interaction with tamoxifen, in two recent studies of women with breast cancer, soy foods did not alter the effect of tamoxifen but rather mimicked its effect (38,39). By increasing the number of terminal end buds in mammary tissue, similar to breast development during a first pregnancy, genistein may have the greatest effect in preventing breast cancer when consumed by girls before and during puberty (40). Genistein, along with other isoflavones, is also a promising agent for preventing prostate cancer (41).

Indole-3-Carbinol (I3C)

Indole-3-Carbinol (I3C) has been extensively studied over the past decade, and is being investigated for its potential value as a chemopreventive agent. I3C is produced from glucosinolates found in plants, particularly cruciferous vegetables. More specifically, it is derived from the breakdown of glucobrassicin, a chemical found in these same plants (42). Cruciferous vegetables such as cabbage, broccoli, cauliflower, Brussel sprouts and kale are particularly high in glucosinolates, and contain sulfur and nitrogen, which gives these foods their bitter or sharp taste (43). The glucosinolate content of cruciferous vegetables ranges from 35-65 grams per ½ cup raw vegetable (43).

Gluocosinolates such as I3C are water-soluble and can therefore leach into water during cooking; steaming or microwaving reduces these losses. Enzymatic activity of glucosinolates increases with cooking and crushing, and yields I3C. The acidic environment of the stomach converts I3C to diindoylmethane (DIM), another potential cancer-fighting compound (44).

Glucosinolates in vegetables enhances conjugation and excretion of potentially toxic and carcinogenic compounds.

Epidemiologic, laboratory, and animal studies suggest that I3C may decrease risk of estrogen-enhanced cancers such as breast and cervical cancer, possibly by increasing the ratio of 2-hydroxyestrone to 16-alpha-hydroxyestrone (45). This change increases levels of weaker estrogen and promotes estrogen ratios that depress tumor activity. I3C also may have a synergistic effect when used in conjunction with tamoxifen and genistein. In addition, I3C has potential therapeutic value because it may be able to sensitize prostate cancer cells to chemotherapy drugs (46).

I3C may promote apoptosis and cell cycle arrest (47) while DIM has been shown to up-regulate the expression of the tumor suppressor protein BRCA 1, thus protecting cells against oxidative stress (48). However, research results are conflicting. Some studies suggest I3C exhibits inhibitory and preventive effects on tumors, while other studies suggest enhanced cancer development. For example, one study concluded that in preclinical data, I3C was a potentially useful chemotherapeutic agent in patients with Adult T-cell leukemia/lymphoma (49). Another animal study suggested that dietary I3C inhibits endometrial adenocarcinoma (50). However, several animal studies suggest it may promote cancer, including one that suggested I3C may promote hepatocarcinogenesis in animal models (51).

Health professionals should be cautious about recommending supplemental I3C. In rats exposed to a cancer initiator, I3C increased the incidence of uterine adenocarcinoma. Also, oral use of I3C in animals and humans has been shown to increase the amount of 4-hydroxyestrone, which is a risk factor for the development of breast and prostate cancer (52).

Lutein

Lutein is a phytochemical belonging to the xanthophyll family of carotenoids. Food sources of lutein include dark leafy green vegetables, broccoli, corn, green beans and green peas (53), all readily available in the market and easily included in home gardens. As a carotenoid, lutein is best absorbed with small amounts (3-5 grams) of fat. Chopping, pureeing or cooking with oil increase bioavailability. Lutein may be provided as a supplement, but bioavailability in supplements varies widely among subjects (54). No Dietary Reference Intake or Adequate Intake has been established for lutein.

The protective role of fruits and vegetables in decreasing cancer risk is well supported.

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However, with thousands of phytochemicals identified, it has been difficult to establish individual cause and effect relationships (55). Many carotenoids, including lutein, have antioxidant activity. In vivo studies have suggested that low doses of ß-carotene and lutein inhibit azoxymethane and aberrant crypt foci formation associated with early neoplastic colon lesions (56). In studies of serum levels prior to diagnosis, low levels of carotenoids were associated with a twofold increase in risk for breast cancer (57). Conversely, lutein intake had no statistically significant effect on the incidence of gastric cancer in a European prospective investigation (58). With multiple variables of different neoplasms and investigation modes, and the complexity of numerous phytochemicals and nutrients within individual foods, much more research is needed to determine the relationship of lutein to cancer. Meanwhile, follow mom's advice and eat more fruits and vegetables, especially those dark leafy greens!

Lycopene

Lycopene is a lipid soluble carotenoid that is responsible for the red color of several foods such as tomatoes, watermelons, pink guava, papaya and apricots. Over 85% of dietary lycopene consumed in North America is provided by tomatoes and tomato products (59). Lycopene content in most foods ranges from 0.9–4.2 mg/100g, however processed tomato sauce and ketchup can provide from 33 to 68 mg/100g (60). Variety and ripeness are key determinants of lycopene content in tomatoes (61).

Only about 10-30% of consumed lycopene is absorbed (59). Factors affecting absorption include presence of other carotenoids and dietary lipids, food processing, and isomeric form (cis configuration is more bioavailable than trans) (59). Cooking or processing frees lycopene from protein complexes and increases its bioavailability (59). Lycopene has a half life of 2-3 days, and reaches maximum serum concentration within 15-48 hours of consumption (62). After absorption, lycopene is selectively deposited in the liver, prostate, testes, and adrenal glands.

Lycopene has no pro-vitamin A activity, but has antioxidant potential. Lycopene quenches ROS and free radicals, eliminating unpaired electrons characteristic of these molecules and thereby disarming their ability to damage cells. In addition, lycopene influences biological processes that regulate cell cycle progression, gap junction communication, and cytokine and growth factor signaling. Some of the other mechanisms of action include induction of phase II enzymes, inhibition of insulin-like growth factor 1, signal transduction, apoptosis induction, inhibition of androgen activation and signaling, and modulation of the cyclo-oxygenase pathway (63). Epidemiological studies such as the Health Professionals Follow-Up Study found that men who consumed more lycopene had a lower risk of developing prostate cancer (64). A similar association was seen in a cohort of 14,000 Seventh Day Adventist men (65). Lycopene may be protective against developing breast cancer (60); low serum lycopene levels have also been associated with higher mortality in some cancer patients (67).

While lycopene is generally regarded as safe (59), it is still not recognized as an essential nutrient, and so no Dietary Reference Intake recommendations exist. Mean per capita intake of lycopene in the U.S. ranges from 8.2 (68) to 10.9 mg/day (69). Clinical trials have investigated effects of doses ranging from 5 to 120 mg lycopene/day, but a consensus is yet to be reached on the optimal daily dose.

Quercetin

Quercetin is the main flavonol in our diet. Found in many fruits, vegetables and beverages, it is particularly abundant in onions and apples, but also found in black tea, green tea and red wine (70). The phenolic group attached to quercetin has anti-cancer benefits associated with its ability to react with free radicals to form a more stable phenoxy radical. In addition, studies suggest that quercetin has anti-inflammatory, anti-viral, and anti-allergy properties (71).

A population-based case-control study of 264 cases of colorectal cancer and 408 controls concluded that flavonols, specifically quercetin obtained from non-tea components of the diet, may reduce the risk of developing colon cancer (72). Another study involving 582 lung cancer and 582 control subjects, using in-person diet recall interviews, found a statistically significant inverse association between lung cancer risk and intake of major food sources of quercetin (onions and apples) and naringin (white grapefruit) (73). A cohort consisting of 27,100 male smokers aged 50-69, without history of cancer, also concluded that intake of flavonols and flavones was inversely associated with lung cancer risk (74).

Quercetin glycosides are absorbed from the gut and undergo hydrolysis in the enterocyte via b-glucosidases before draining into the portal vein. In vitro incubation of quercetin in normal human plasma showed it is extensively bound to plasma proteins, primarily albumin. Daily intake of flavonols has been estimated at 20-25mg/d in the United States. Intake of quercetin is thought to be 15.4mg/d (72). With a reported half-life of 11-28 hours, higher intakes favor accumulation in plasma (75,76).

Storage, cooking, and processing influence quercetin content in food. For example, onions lose between 75%-80% of their initial quercetin content after boiling for 15 minutes, and 30% after frying, suggesting that cooking reduces quercetin content in food (75). Further clinical studies will provide insight into the absorption, accumulation, elimination, and health benefits of quercetin. However, frequent intake of vegetables and fruits continues to be recommended. In the words of Hippocrates nearly 2500 years ago "Let food be thy medicine and medicine be thy food."

Zeaxanthin

Zeaxanthin is one of the most commonly found dietary carotenoids, and is further classified as a xanthophyll. It is responsible for providing plants with the rich colors of yellow, orange, and red. Zeaxanthin is

lipophyllic, so fat improves absorption. Bioavailability is improved by chopping and homogenizing (76). Zeaxanthin is not converted to retinol, therefore has no vitamin A activity.

Lutein and zeaxanthin content in food is generally reported together because methods used to quantify these carotenoids do not separate the two compounds (71). Select foods may be reported as rich in lutein and zeaxanthin, however may contain mostly lutein. For example, green leafy vegetables are rich sources of lutein, but contain little or no zeaxanthin. In one analysis, corn and corn products were found to be major contributors of dietary zeaxanthin. Rich dietary sources of zeaxanthin, which range from 16 to 20 mg/100g, include egg yolks, corn, orange pepper, honeydew, orange juice, and mango (77). There is a strong association between incidence of age-related macular degeneration (AMD) and intake of lutein and zeaxanthin (78). In 2007 the Age-Related Eye Disease Study (AREDS) Research Group reported on diet and AMD in 4,519 AREDS participants aged 60 to 80 years. Participants who reported the highest dietary intake of lutein/zeaxanthin were less likely to have advanced AMD. When divided into lowest to highest quintiles, the absolute median intake values for daily lutein/zeaxanthin were 686 micrograms (µg) for quintile 1, 1056 µg for quintile 2, 1426 µg for quintile 3, 1942 µg for quintile 4, and 3544 µg for quintile 5 (79).

The association between greater lutein/zeaxanthin intake and decreased risk of AMD is attributed to their antioxidant potential. In vitro, in vivo, and animal studies suggest zeaxanthin's potential anti-cancer activity occurs through modulation of apoptosis and the immune system, inhibition of angiogenesis, induction of cell differentiation, and prevention of oxidative damage (79).

Observational studies suggest that zeaxanthin may reduce the risk of breast and lung cancer. A pooled analysis of 13

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Nutrition Practice Tips:

1. Whole foods provide an assortment of bioactive substances that promote health, including thousands of phytochemicals.
2. AICR's report, *Policy and Action for Cancer Prevention*, suggests that " about a third of the most common cancers in high income countries, and about a quarter in low- and middle-income countries, can be prevented by eating a healthy plant-based diet, being physically active, and maintaining a healthy weight" (4).
3. Phytochemicals influence many biochemical actions involved in carcinogenesis. For example, they may help prevent DNA mutations that may initiate cancers; promote apoptosis of cancer cells; inhibit angiogenesis; control inflammation by neutralizing Reactive Oxygen Species; promote phase I and phase II detoxification reactions; and encourage normal cell cycles.
4. Evidence suggests that many phytochemicals work synergistically, therefore use of supplements with only one component/ingredient may not be as beneficial as consuming whole foods.
5. Anthocyanins are a sub-group of flavonoids that give fruits and vegetables their bright red, blue and purple colors. Research suggests these phytochemicals may stimulate phase II detoxifying enzymes and reduce inflammation and angiogenesis, among other cancer-fighting effects.
6. Indole-3-Carbinol (I3C) is found in cruciferous vegetables. Research suggests it may act on several anti-cancer mechanisms. For example, it may sensitize prostate cancer cells to chemotherapy drugs and increase levels of weaker estrogen while promoting estrogen ratios that depress tumor activity.
7. Lycopene is the most abundant carotenoid in tomatoes. The Health Professionals Follow-Up Study found that men who consumed more lycopene had a lower risk of developing prostate cancer.
8. Lutein is found in dark leafy green vegetables, broccoli, corn, green beans and green peas. Studies suggest it helps delay Age-Related Macular Degeneration. Its antioxidant potential may provide anti-cancer benefits, but studies examining lutein's effect on cancers have been inconclusive.
9. Quercetin, the main flavonol in the diet, is particularly abundant in onions, apples and tea. The phenolic group attached to Quercetin has anti-cancer benefits associated with its ability to react with free radicals to form a more stable phenoxy radical.
10. Zeaxanthin is responsible for providing plants with the rich colors of yellow, orange, and red. Egg yolks, corn, orange pepper, honeydew, orange juice, and mango are rich dietary sources of zeaxanthin. Zeaxanthin's potential anti-cancer activity includes modulation of apoptosis and inhibition of angiogenesis.

prospective studies found that increasing fruit and vegetable consumption is associated with decreasing risk of renal cell cancer; this protection may partly be due to the zeaxanthin content in fruits and vegetables (80). One of the most well-known large prospective studies involving zeaxanthin is the Alpha-Tocopherol, Beta-Carotene Cancer Prevention (ATBC) Study. It reported that men with the highest intake of lutein plus zeaxanthin at baseline had a 17% lower risk of lung cancer compared to men with the lowest intake (81). Research about zeaxanthin and cancer continues to evolve, but experts agree that consuming foods rich in zeaxanthin is consistent with current dietary guidelines.

Nutrigenomics, Epigenetics, Phytochemicals, and Cancer

Nutrigenomics is a hot topic in health care and nutrition. It applies diet and lifestyle modifications to an individual genetic profile, with the goal of promoting good health (82). Site-specific changes to the nucleotide sequence of DNA, called single nucleotide polymorphisms (SNPs), may modify absorption, metabolism, and functional response of dietary factors (83) and potentially result in health problems. Nutrition scientists are actively searching for dietary factors that directly influence DNA or gene expression through SNPs. In oncology, this means determining which bioactive dietary compounds influence the conversion of normal to abnormal cells; the transition to cancer cells; and processes such as apoptosis, angiogenesis, and inflammation, all of which play pivotal roles in carcinogenesis.

A common SNP associated with health risk encodes the enzyme methylenetetrahydrofolate reductase (MTHFR). Because a polymorphism exists at residue 677, individuals may carry one of three genotypes of this enzyme. Anyone carrying the 677 TT genotype will poorly convert homocysteine to methionine, resulting in mild hyperhomocysteinemia. This effect can be offset by increasing folate intake, a practice that may decrease risk of colon cancer in carriers (83).

DNA methylation patterns influence complex biochemical reactions. Hypomethylation is seen in some tumor cells, but in some instances hypermethylation can inhibit tumor suppressor genes and contribute to carcinogenesis (84). Some nutrients, including folate, influence methylation patterns. Phytochemicals are also being studied for their affect on DNA methylation, and genistein, a phytochemical in soy products, may suppress the development of prostate and mammary cancers by maintaining a protective DNA methylation pattern (84).

This brief discussion only hints at the complexities of nutrigenomics. Scientists continue to actively pursue a variety of research avenues in this field, including the potential roles of phytochemicals.

Summary:

Carcinogenesis is a relatively slow process, providing a large window of opportunity for phytochemicals and other bioactive compounds to influence carcinogenesis. Research has failed to support benefits of phytochemicals from dietary supplements, and both the American Cancer Society (ACS) and AICR advise against using dietary supplements for cancer prevention (85). Conversely, many studies support health benefits of whole fruits and vegetables, and research has suggested that for most cancers, people in the lower quartile of the population, who eat the lowest amount of fruits and vegetables, have a greater risk of developing cancer than those in the highest quartile (86). Such research has led many public health organizations to recommend consuming at least 5 to 9 servings of vegetables and fruits daily for their health benefits. Homegrown produce provides a steady supply of bioactive compounds such as phytochemicals that may work singly or synergistically to prevent or slow carcinogenesis.

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Organic Foods

One of the most challenging decisions that shoppers face is whether to spend extra money on organic foods. Cancer survivors may be willing to pay extra if organic foods are indeed more nutritious, but research is equivocal. Christine McCullum-Gomez, PhD, RD and Anne-Marie Scott, PhD, RD, of the Hunger and Environmental Nutrition Dietetic Practice Group have written an evidence-based review of this topic that helps consumers navigate the current research. Originally written as a **Hot Topic** for the American Dietetic Association, it is being reprinted for our readers' benefit.

DISCUSSION OF TOPIC:

Consumers report cost, health and environmental concerns as factors in considering their decision to purchase foods labeled organic (1, 11). In juxtaposition to conventional foods, there are a variety of reasons why organic foods can be considered as facilitating the creation of a healthful, sustainable food system.

1. Some organic fruits, vegetables and juices may contain more phytochemicals (e.g., antioxidants and polyphenols) compared to their conventionally grown counterparts (9, 12-17). However, researchers are still debating from both sides (pro and con) of any potential nutritional advantages of consuming organic versus conventional fruits and vegetables and other plant products (9, 10, 12-18). As with all research, it is important to understand and question the methodology of any study and not draw broad conclusions from limited or incomparable data.
2. Organic meat may reduce the development of human antibiotic resistance and lessen air and water pollution (19).
3. In an ongoing cohort study, consumption of organic dairy products was associated with a lower risk of eczema during the first two years of life (20). The authors hypothesize "a high intake of omega-3 fatty acids and/or conjugated linoleic acids from organic dairy products by the child is protective against eczema (independent of atopy) and that also the mother's intake of these fatty acids during pregnancy and lactation contributes to this protection" (20). One proposed mechanism to explain this association is the production of biologically active compounds and processes of intra-cellular signaling, since it is typical for molecules participating in processes of intra-cellular signaling to be present in very small amounts (21). Additional research is needed in this area (20, 21).
4. Organic agriculture offers numerous opportunities to reduce exposure to agricultural pesticides through the food and water supply (3), which may be detrimental to human health, particularly for high-risk groups such as pregnant women, infants, young children and farm worker households (22-27).
5. Organically cultivated foods can promote a more sustainable food system by reducing soil erosion and rehabilitating poor soils (7, 28). Many components of organic agriculture can be implemented within other sustainable farming systems (7).
6. Organic agriculture can integrate small- to medium-size farmers into high-value food chains/markets (7). Increasingly, larger farms and international producers have entered the organic marketplace; even so, the smallest organic farms have been able to maintain a stable share of the organic foods sector (3).
7. Organic agriculture has other documented heightened economic values of environmental services than conventional agriculture, including services provided by shelterbelts on farmland. These shelterbelts provide shelter and pollen/nectar resources to pollinators (29). Many agricultural food crops are dependent on pollination services provided by insects and other animals including birds. In contrast, synthetic pesticides used in agricultural production may negatively affect insects and other animals that are pollinators of food plants (28).
8. Organic agricultural systems offer multiple opportunities to help reduce greenhouse gas emissions and counteract global warming (7). Organic agriculture significantly lowers energy requirements for agricultural production systems compared to industrial agriculture (3, 7, 8). Long-term field experiments document that organic matter is higher in organically managed soil than in conventionally managed soil (7, 30). Humus (the well-decomposed part of soil organic matter) helps mitigate climate change by sequestering carbon and acting as a sink (e.g., by removing carbon dioxide from the atmosphere and fixing it in the soil) (7).
9. Biodiversity is enhanced in organic agricultural systems (3, 7, 28), which makes these farms more resilient to unpredictable weather patterns and pest outbreaks (7), as is predicted with climate change (31).

BOTTOM LINE:

As shown above, the decision to choose organic products is influenced by many issues, including cost, health and environmental concerns. How to make sense of all the research and help consumers should be one of the roles of the RD and DTR. While there is still more work to be done, current research indicates there can be initial and long-term positive impacts on the health of individuals and the environment from the adoption of large-scale organic

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farming and food consumption. However, the potential of organic agriculture to improve the environmental performance of United States agriculture is having only a modest impact on the environment because the current organic adoption rate is low (3). Such that, the 2008 Food, Conservation and Energy Act (2008 Farm Bill) included increased "funding to help producers and handlers with organic certification costs, to enhance data collection on organic agriculture and to support Federal organic regulatory activities."

The USDA's Agricultural Marketing Service also administers several different grant programs, which have assisted a number of different local, organic initiatives across the U.S. (3). "Public investment in organic agriculture facilitates wider access to organic food for consumers and helps farmers capture high-value markets and boost farm income, as well as conserve nonrenewable natural resources and protect U.S. soil and water." (3).

There is an ongoing debate over the federal USDA National Organic Program (NOP) which certifies food products as "organic" as some manufacturers are looking to broaden and thereby weaken the label by allowing these food products to include trace ingredients or additives that may not be organic. The challenge for our field is to understand exactly how foods and food products are grown and manufactured and the effects these methods may have on our personal health and the health of the global environment. For instance, local foods are not always organic (and vice versa) and not all organic food products being marketed and sold at retail outlets are nutrient-dense foods (e.g., organic potato chips). Hence, when making food choices as part of a healthful diet, moderation and variety are important, regardless of whether or not food is produced organically or conventionally.

OPPORTUNITIES FOR THE RD/DTR:

Organic farming methods, organic foods and their associated products are increasing in agriculture and the marketplace. RDs and DTRs who understand the issues related to purchasing organic foods can help consumers make informed decisions that are best for their needs. ADA's Position Paper on Practices to Conserve Natural Resources and Support Ecological Sustainability encourages "consumption of food produced with fewer agricultural inputs (e.g., certified organic, grass-fed or range-fed meats, pastured poultry)." "In health care, Kaiser Permanente has shown innovative leadership by opening organic farmers' markets in its hospitals and medical office buildings throughout the nation as part of a comprehensive food policy" (28). Seasonally available, locally produced organic produce is usually comparable in price to conventional produce (4). Consumers and families on a tight budget can also purchase organically produced foods through a community supported agriculture program (5). To further contain a family's monthly food costs, seasonally

available, locally produced organic foods can be frozen, dehydrated or preserved (canned) for later use. Food and nutrition professionals are well-positioned to provide the public with both knowledge and skills in these areas.

Written by Christine McCullum-Gomez, PhD, RD and Anne-Marie Scott, PhD, RD of the Hunger and Environmental Nutrition Dietetic Practice Group. © 2010 Hot Topics, American Dietetic Association. Used with permission.

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Growing a Victory Garden

By taking advantage of containers, rooftops, yards, and even windows, anyone can grow health-promoting foods. The next section of this newsletter will help gardeners get started, beginning with the selection of foods and continuing with guidelines for preparing soil and planting, harvesting, and storing foods grown in a Cancer Victory Garden. Tips were primarily obtained from state extension services and the master gardener program, resources sponsored by the United States Department of Agriculture (USDA).

State Extension Services and Master Gardener Programs

The United States has a long history of helping the country meet its agricultural needs. In addition, the concept of "Extension" or "reaching out," has been a linchpin of the Land-Grant University system as a means to "extend" their resources to citizens. The Victory Garden Program developed during World War II is an example of these efforts. Extension agents provided seeds, fertilizer, and simple gardening tools to citizens, resulting in 15 million families planting victory gardens in 1942. In 1943 the USDA estimated that 20 million victory gardens produced more than 40 percent of the vegetables grown for that year's fresh consumption. Today there are almost 3,000 extension offices nationwide, and extension agents continue to assist Americans with their gardening efforts.

As interest in the environment and home gardening increased, extension agents found they were unable to meet everyone's needs. The Master Gardener program evolved from this demand. Extension agents determined that some questions could be answered by well-trained volunteers, and the term "Master Gardener" was coined in the 1970s. It applies to volunteers who successfully complete training programs developed by extension agents. Master Gardeners volunteer their time to answer phone and e-mail questions and conduct educational gardening programs.

Step 1: Select Foods to Grow and a Site to Grow Them

Planning a Cancer Victory Garden starts with determining which foods will promote your unique health goals and can be grown in a home or community garden. Because whole plant foods provide a variety of vitamins, minerals, and phytochemicals associated with cancer prevention, there are many vegetables and fruits to choose from. The decision may come down to space and taste preferences. Most importantly, grow what you like!

Then determine where to locate your garden. Most vegetables require 6 to 8 hours of sunlight every day, so a sunny site is essential. However, you do not need to limit your garden to one site. Grow tomatoes in containers; grow peas on a trellis; you can even grow vegetables within a flower garden!

This newsletter provides tips on growing blueberries, broccoli, garlic, tomatoes, and spinach. All provide a wealth of health-promoting bioactive substances and can be consumed in a variety of ways. They can be grown in traditional gardens, in containers, as shrubs in a corner of a yard, or in raised beds. So select one space, or several within your garden with enough sun exposure, and get ready to plant.

Step 2: Prepare the Soil

A productive garden depends on high quality soil that nourishes growing plants. Texture and pH are among the factors that influence soil quality, but as Angie Tagtow, MS, RD, LD, discusses below, soil is much more than that. Angie is managing editor of the *Journal of Hunger & Environmental Nutrition*, and consults with a variety of organizations about the connections between natural resources, specifically soil, and health. We thank Angie for sharing her knowledge of soil with readers of *Oncology Nutrition Connection*.

1. ***How important is soil to the quality of produce, and in turn to our health?***
   The relationship between soil and a plant is no different than the relationship

between the food on our plates and our health. Well-nourished soils will provide the nutrients needed for that plant to grow. If the soil is not well-nourished, and is not rich with humus, the plant is not able to grow to its optimal potential, and the food produced will not contain the maximum amount of nutrients.

Soil is a living ecosystem. One teaspoon of soil from undisturbed prairie may contain 400 to 600 million bacteria, thousands of protozoa, miles of fungi, nematodes, etc. – many of these organisms have yet to be identified. Soil is a community of organisms. However, when these components of the soil are stressed, damaged or no longer exist, then this soil-to-food relationship begins to fail because it is out of balance. And, when the system is out of balance, our food and our health are out of balance.

Food is the common denominator in the "soil to health" system, as it connects soil to plants to animals and humans. Soil is the cornerstone, or foundation of the entire food system – it is the earth's life support system. Everything we eat has it origins in soil. Healthy soil grows healthy food ... healthy food nourishes healthy people ... healthy people live in healthy communities. Preserving our natural resources and building soil is key to a food system that nourishes all living things.

What I think is critical to the link between soil and health is the fact that soil is eroding at unprecedented rates. In 2009, about two-thirds of Iowa's counties had farmland that lost between 24 and 56 tons of soil per acre due to erosion. I have heard that Iowa has lost more than 50% of its topsoil in the last 100 years. Once soil is gone ... it's gone. According to the Soil Science Society, it takes about 500 years to build one inch of soil. When the top soil is gone, there will be no farms. Without farms, there will be no food. As Franklin Roosevelt said, "A nation that destroys its soil, destroys itself."

Resources:

Rodale Institute -
http://www.rodaleinstitute.org/nutrition.
Soil Food Web -
http://www.blm.gov/nstc/soil/foodweb/index.html and http://www.blm.gov/nstc/soil/foodweb/images/FOOD%20WEB.jpg
Iowa Daily Erosion Project -
http://wepp.mesonet.agron.iastate.edu/GIS/erosion.phtml
Victory Grower -
http://groups.ucanr.org/victorygrower/index.cfm

2. How important is soil texture (e.g., sand, silt, and clay) to plant growth?

The goal in any garden is to build rich humus. As Sir Albert Howard said, "Proper soil fertility, which builds appropriate levels of humus in the soil, is the basis of the public health system of the future" (Howard, A. An Agricultural Testament, 1939). Kitchen Gardeners International has a great diagram on knowing your soil type. Once you have your soil analyzed, you can then make appropriate amendments in an effort to achieve an equal mix of clay, sand and silt – often referred to as loamy soil. Compost is a great amendment to any soil.

Resource:

Kitchen Gardeners International -
http://kitchengardeners.org/questions/why-it-important-know-my-soil-type).

3. Is a soil test kit an economical and essential tool for home gardeners?

Yes, testing soil is essential to building a healthy foundation for gardening. Soil test kits can be found in most home improvement and garden centers. In addition, check out the soil resources available through your local Extension office. I would strongly recommend those in urban settings who are considering a

(Continued on next page)

backyard or community garden test soil not only for nutrients and pH, but also for heavy metals such as lead and toxins such as arsenic.

Resources:

Soil Testing -
http://www.extension.org/pages/Soils_and_Composting:_Soil_Testing and Soil testing
Sustainable Urban Gardening -
www.sacgardens.org
American Community Gardening
Association - http://communitygarden.org

4. Many cancer survivors prefer organic gardening methods. Is fertilizer acceptable in organic gardening? Are soil amendment recommendations different for organic gardening?

Oftentimes we think of adding "fertilizer" to our soil when we plant our gardens and when plants are growing. But I contend we need to be thinking about feeding and nourishing our soil year-round. Regularly adding organic matter to the soil allows us to recycle the nutrients in leaves, grass clippings, and other commonly available materials. Soil invertebrates and microorganisms break down organic matter, resulting in the release of plant-available nutrients. Composting is a great way to continually feed the soil and build humus. My recipe for healthy soil is simple: brown material + green material + water. I often use chopped leaves, grass clippings and kitchen scraps (especially coffee grounds) for compost. Add them to a small pile or bin, add some water, turn them every few days, and in a couple of months you will have rich compost. I not only mix this into the soil, but also use it as mulch to suppress weeds in garden beds. Check your local coffee shop to see if they will give you their coffee grounds to add to your mulch. I would caution against using grass clippings or leaves that may have been sprayed with a fertilizer, herbicide, fungicide or pesticide.

Using cow, horse or chicken manure is also a great natural way to fertilize the soil. You can buy bagged manure at a home and garden store or connect with a farmer who may have animals. I would highly encourage those who are using manure from a farm to ask the farmer questions about the animals' feed, and whether antibiotics or hormones are used. Ideally, you will want manure from animals that are raised in a pasture, are grass-fed, and are not treated with antibiotics or hormones. Farms that are certified organic are the ideal sources of rich manure. Manure from farms should "cure" at least 120 days before being added to gardens to eliminate risk of contamination.

There are a plethora of wonderful organic gardening resources available if you are seeking a natural, chemical-free way of growing food. The recently held Midwest Organic and Sustainable Education Service conference in LaCrosse, Wisconsin displayed a wonderful variety of tools available to gardeners and farmers. In addition, connecting with a local Master Gardener program or gardening club is a wonderful way to learn about gardening techniques, local species, growing conditions, and soil types. Growing food organically contributes to the health of eaters and the environment.

Resources:

Mike McGrath's Book of Compost -
http://www.amazon.com/Mike-McGraths-Book-Compost-McGrath/dp/1402733984
Midwest Organic and Sustainable Education Services -
www.mosesorganic.org
Organic Gardening -
www.organicgardening.com

John Traunfeld, Extension Specialist with the University of Maryland Extension Service, adds a few more tips about manure:

Manure can sometimes sit in a pile for 120 days or more and still not be safe to apply to a food garden. Because of pathogen concerns, gardeners using farm animal manure should incorporate it into soil in the fall only. Guidelines from the National Organic Program (NOP) state that crops that touch the ground (e.g. leafy greens) cannot be harvested less than 120 days from an application of un-composted manure. The problem is that most gardeners cannot evaluate composted manures to determine their safety. An exception are manure products dried at high temperatures (dried steer manure).

The NOP has not established specific restrictions regarding when farmers can apply composted manure to crops; however, NOP is very specific about manure composting procedures. According to the NOP regulations, (1) An initial carbon : nitrogen ratio of between 25:1 and 40:1 must exist for the blend of materials in the compost "pile"; (2) Temperatures between 131° F and 170° F must be sustained for three days using an in-vessel or static aerated pile system; or (3) Temperatures between 131° F and 170° F must be sustained for 15 days using a window composting system, during which period the materials must be turned a minimum of five times ***(U.S. Department of Agriculture. 2000. Section 205.203(c)(2). National Organic Program Standards. www.ams.usda.gov/nop/NOP/standards.html).***

5. Do container gardens have different soil needs than gardens planted in yards?

They do, and it is important to consult with appropriate resources. Container gardening is a great way to get started and is ideal for those who do not have access to bare ground.

Resources:

http://www.gardenguides.com/685-guide-container-gardening.html

The University of Maryland Extension service has published a comprehensive brochure on Container Vegetable Gardening: Healthy Harvests from Small Spaces (The Home & Garden Mimeo # HG 600) HG 600. The Ohio State University also publishes a fact sheet on Container Vegetable Gardening @ http://ohioline.osu.edu/hyg-fact/1000/1647.html. Do you love the idea of eating home-grown salads from April through November? The Grow It Eat It campaign (www.growit.umd.edu) created by the University of Maryland Extension includes guidelines for building a "salad table" @ HG - 601 Print Instructions for Building a Salad Table or Salad Box

RD Gardening Spotlights:

Cece Ohmart, RD, LD, Director of Clinical Nutrition Services at Maine Coast Memoral Hospital in Ellsworth, Maine *developed National Nutrition Month® activities based on ADA's theme "From the Ground Up". She states, "Our gardening "extravaganza" was based in the hospital cafeteria, and provided seed catalogs, daily prizes, kiosks packed with gardening information, and gardening education programs.*

Participants could review or take seed catalogs home. Throughout the month nutrition merchandise was given away, including water bottles, vegetable seed packets donated by Johnny's seeds, starting kits for herb gardens, gardening tools for adults and children, kneeling pads, watering globes for container gardens, and garden stepping stones. Every person who completed a nutrition crossword puzzle was entered into the prize drawings; prizes were also given away at a "Lunch and Learn" lecture.

Gardening brochures were made available to patients, visitors, and employees. They addressed how to plant a garden, gardening with children, container gardening, raised bed gardening, organic/green gardening, common gardening mistakes, and growing herbs. We also provided recipes so everyone could enjoy the bounty from their gardens!

The month long program was capped with a "Lunch and Learn" presentation from the Maine Cooperative Extension and a master gardener, which included a gardening discussion and a question and answer period. Overall, the response to this program was overwhelming. Rather than telling people to "eat your veggies", we showed them how they could grow their own, and people responded!

Elena Schumacher, RD, CSO, LDN, is an oncology dietitian at the Helen F. Graham Cancer Center with Christiana Care Health System in Newark, Delaware. *She is working on a raised bed herb garden on the rooftop garden space of the cancer center. Elena and other health professionals at the site are planning an educational session led by a Master Gardener from the New Castle County, Delaware Cooperative Extension in late May. This session will address recommendations for planting herbs. Later in the summer an additional education session is planned on the rooftop garden; participants will learn about health benefits of including herbs in the diet.*

Cheryl Wachtel, RD, is the oncology dietitian at Trinitas Comprehensive Cancer Center in Elizabeth, New Jersey. *To celebrate and promote the 2010 National Nutrition Month® theme, Nutrition from the Ground Up!, Cheryl started a small Cancer Victory Garden for her cancer center.*

Cheryl reports ... "Dietitians are always encouraging a heartier consumption of fruits, veggies, and herbs, which are loaded with vitamins, minerals, phytochemicals, antioxidants and fiber. And of course, produce is low in calories while it packs in all those impressive nutrients. Just about any which way dietitians promote health-care (or disease-care for that matter) involves a push towards eating more fruits and vegetables. So, let's use from the ground up as a tool for improving our nutritional intake." Starting with a little "Jiffy Greenhouse" of 72 peat pods, and with staff help, Cheryl planted parsley, cilantro, dill and oregano seeds from the ground up. Once they sprout, Cheryl will distribute seedlings to patients and staff so they can continue the growth at home, and enjoy the bounty.

Debra DeMille, MS, RD, CSO, is a nutrition counselor with the Joan Karnell Cancer Center at Pennsylvania Hospital in Philadelphia, Pennsylvania. *Along with a group of health care professionals at this center, and a landscape architect with a specialty in healing gardens, Debra is working on obtaining approval and funding for a healing garden. Her hope is that eventually this will include organically grown herbs and vegetables. This group has identified space and is collaborating with hospital Administration, Engineering, and the Garden Club, as an historic herb garden is already on site. They hope to include a sitting area with shade where small groups can meet; a water feature; stones with inspirational sayings; and of course shrubbery, herbs, flowers, and other greenery. Debra shared that the team has learned much from this experience, such as the need to consider security and access as well as the artistic aspects of a healing garden.*

Plant, Grow, Harvest, Store, Enjoy!

Here are tips for planting, harvesting, and storing a fews fruits and vegetables that are rich sources of phytochemicals. It is important to grow what you like, so consult with suggested resources for growing your personal favorites. Fertilizer may be needed to supply adequate nutrients for growing vegetables and fruits, and it is best to check with a local Extension Service about fertilizing needs for each product as well as for natural methods of improving soil quality.

Blueberries

Blueberries are a nutritional powerhouse and are on most lists of 'top cancer-fighting foods'. A 1/2 cup serving provides about 40 calories with 1.8 grams of dietary fiber and negligible amounts of fat. They are also packed full of phytochemicals, especially anthocyanins that give blueberries their vivid color.

Native to North America, where 90% of the world's blueberries are grown, their history in the U.S. dates back to Native Americans, who taught the pilgrims how to dry blueberries in the summer sun to preserve them for winter. In the U.S., rabbiteye blueberries grow best in the south while highbush varieties are better suited for northern regions. In colder states in the north, mid-west, and New England, half-high blueberries grow well. Once established, plants can produce up to 10 pounds of blueberries in a growing season.

Soil Tips: Blueberries grow best in well-drained, weed-free soil, with pH between 4.5 and 5.5. Dark, crumbly soil is usually ideal. Incorporate organic material if soil is hard, tough, and rocky.

Planting Tips: Blueberries can be grown in a hedge, in groups of three, in raised beds, or in containers. Yield is better when several bushes are grown near each other. Plant in the spring or early fall, or even in late winter in moderate climates. For optimum yield, plant blueberry bushes in full sun and four to six feet apart from other plants.

To plant blueberries, fill an 18 X 18 inches (deep and wide) hole with peat moss and top soil to 4 inches from the top; then place the plant in the ground. Alternately, plant in raised beds (12 to 18 inches high) or in containers (10-gallon or larger). It usually takes three years to establish healthy blueberry plants. When established, blueberry plants need to be pruned each winter, between January and March. Some extension services recommend limiting the number of branches on a blueberry bush to the age of the plant, with a maximum of 8 branches per bush. They suggest removing 1-2 branches per year so that no branches are older than 4 to 6 years. Here is a link http://extension.oregonstate.edu/catalog/html/ec/ec1304/ to a brochure about growing blueberries.

Harvesting Tips: Blueberries should be left on the plant for a few days after they first turn blue. During this time they will become more flavorful, sweeter, and larger.

Storage Tips: Blueberries can be stored in the refrigerator for about a week after being picked. They can be frozen and canned. Before freezing, wash and drain berries. Quality may be better if berries are spread out on a cookie sheet, frozen, then placed in a plastic bag.

Tomatoes

Technically a fruit, tomatoes are still considered a vegetable by most consumers. A medium tomato provides about 20 calories and negligible fat, but plenty of vitamins A and C, and potassium. Tomatoes are a rich source of lycopene, a carotenoid associated with prostate health.

Now the most popular vegetable grown in home gardens, until the early 1800s tomatoes were thought to be poisonous. There are endless varieties of tomatoes to choose from. Developed generations ago, heirloom varieties are becoming popular again, and are commonly sold at Farmer's Markets. Home gardeners often save seeds of heirloom tomatoes from one season to another because they are prized for their robust flavor. Hybrids are most often sold in supermarkets, and are often developed for unique properties, such as disease resistance and higher yields.

Most home gardeners prefer to work with small seedlings because they are easy to transplant. Tomatoes can grow in bushes or vines; patio tomatoes are suited to small spaces or containers. A strong plant can produce 10 to 15 pounds of tomatoes in a season, so plan to share them if you don't want to freeze or can this produce. Here is a link http://extension.missouri.edu/publications/DisplayPub.aspx?P=G6461 to a brochure about growing tomatoes.

Soil Tips: Tomatoes grow best in a slightly acidic soil with pH between 6.2 and 6.8. Soil should be dark, crumbly, and moist. Incorporate organic material to improve tough and rocky soil.

Planting Tips: Transplant small, strong plants (6 to 10 inches tall) after all danger of frost is past. Leave about 2 feet between plants so there is room for a cage or stakes; letting them grow along the ground takes more room. Growing tomatoes need 7 hours of direct sunlight each day. Water is also essential for growing tomatoes. If the soil around a tomato plant dries out, calcium may not be absorbed and dry, leathery spots may

form on the bottom of each fruit.

Harvesting Tips: Harvest after the fruit color begins to change but before it is fully ripe.

Storage Tips: For best quality and taste, allow fruit to completely ripen at room temperature, then store ripe tomatoes at room temperature until you are ready to eat them. When the first severe frost appears, green tomatoes can be picked and stored in cool (50°- 70°F), humid conditions for 1 to 3 weeks, but need to be ripened at room temperature.

Spinach

It turns out that Popeye had an instinct for good nutrition. Spinach is a poster child for nutrient density. One cup of raw spinach provides only 7 calories, negligible fat, but a wide range of nutrients including vitamins A, C, and K, calcium, iron, and magnesium, though oxalic acid in spinach can inhibit iron and calcium absorption. Lutein and zeanthin are the primary phytochemicals found in spinach. They are the only carotenoids found in the lens of the eye, and like other carotenoids are best absorbed with a small amount of fat.

Spinach is a cool weather vegetable that grows quickly. It can be grown from seeds or small plants, and planted as soon as the soil can be worked. In the U.S. cultivation of spinach began in the early 1800s. There are three main varieties of spinach. Savoy spinach has curly, dark green leaves. Semi-savoy spinach is less curly. Flat or smooth-leaved spinach is the type used in processed foods such as frozen spinach. Baby spinach is a form of flat spinach.

Two cups of raw spinach cook down to 1/2 cup. The University of Arkansas conducted a unique study, substituting spinach leaves for lettuce on hamburgers. Students were unable to tell the difference, and thought the burgers with spinach leaves were just as tasty! Here is a link http://www.ces.ncsu.edu/depts/hort/hil/hil-17.html to an article about growing spinach.

Soil Tips: Spinach prefers soil that drains well and has a pH between 6.4 and 6.8. Dark, crumbly soil is usually ideal. Incorporate organic material into hard, rocky soil.

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Planting Tips: Sow spinach seeds in rows spaced about 1 -1½ feet. apart, or scatter the seeds in a square of soil. Cover seeds lightly with soil, pat firm, and water. Keep soil moist until germination. Once the plants have grown their true leaves, thin the plants to 6 inches apart. Plant spinach from the spring thaw through June, and again in the fall. To extend your harvest, reseed every few weeks.

Harvesting Tips: Spinach can be harvested approximately 4 to 6 weeks after seeds are planted, when the largest leaves are 6 to 8 inches long. Some people harvest outer leaves, which are usually larger, and leave the inner leaves to mature for later harvest. Others prefer the taste of smaller spinach leaves. The best spinach leaves are tender and bright green.

Storage Tips: For fresh spinach, pick leaves shortly before eating them. Wash each leaf to remove soil before eating fresh spinach, but don't wash fresh spinach before storing in the refrigerator. Spinach can be stored in a plastic bag in the refrigerator for 3 - 7 days.

Broccoli

Broccoli is a member of the cruciferae family. It provides about 30 calories, no fat, and 2 grams dietary fiber per one cup (chopped) serving. Broccoli is usually rated high on nutrient quality indexes because it supplies such a wide variety of nutrients, including vitamins A, C, and E, calcium, iron, thiamine, and riboflavin. In addition to vitamins and minerals, broccoli also contains many phytochemicals including isothiocyanates, Indole-3-carbinol, glucosinolates, Dithiolthiones, Indoles, Glucoraphanin, and S-Methyl Cysteine Sulfoxide. Here is a link http://urbanext.illinois.edu/veggies/broccoli1.html to an article about growing broccoli.

Soil Tips: Broccoli prefers well-drained, moist soil with plenty of organic matter and a pH between 6.0 and 7.0. Dark, crumbly soil is ideal; incorporate organic material into hard, rocky soil.

Planting Tips: Plant broccoli in a sunny location. The planting bed should be thoroughly watered before setting out seedlings (transplants). Broccoli needs approximately 1 to 1.5 inches of water per week. Transplants can be set out in the garden in early April. If growing in rows, space transplants 18 inches apart, with about 24 inches between rows.

Harvesting Tips: Broccoli should be harvested when the center green flower bud cluster is still tight, and before any yellow petals begin to show.

Storage Tips: After harvesting, stems should be cut at an angle, and refrigerated immediately. Quality can be improved by steam-blanching broccoli before freezing.

Garlic

Garlic has received attention in recent years for its reported health benefits, in particular its potential to lower cholesterol and help prevent cancer. One garlic clove provides 4 calories and minimal amounts of fat. It also provides small amounts of calcium, phosphorus, potassium, and magnesium. Phytochemicals in garlic have received much media attention, especially organosulfur compounds.

Individual garlic cloves act as seeds. Each clove produces one plant with a single bulb, which may in turn contain up to twenty cloves. It is traditional to plant garlic on the shortest day of the year, but in warmer Southern areas gardeners see good results when it is planted in late February or March. In the North it is more common to plant garlic towards the end of the year or soon after the first major frost of the year. Garlic is generally winter hardy, but can be damaged if the temperatures are very cold and the snow cover thin. Covering garlic with (weed-free)straw helps protect it from extreme winter weather.

Good drainage is important to growing garlic, making it a great choice for raised beds, where water levels can be more easily controlled. Wherever it is planted, the bulb itself should be up out of the water level while the roots receive adequate moisture. Here is a link http://ohioline.osu.edu/hyg-fact/1000/1627.html to a fact sheet about growing garlic in a home garden.

Soil Tips: Garlic grows best in soil enriched with organic matter and with a pH between 6 and 7. Soil that is dark and crumbly is of good quality.

Planting Tips: Garlic cloves should be planted individually, upright, about an inch under the surface, root end down, and 4

inches apart. Individual cloves should be separated from the bulb the day of or up to two days before planting. Cloves separated for longer than two days tend to dry out. Several weeks after planting garlic, cover them with mulch such as weed free straw.

Harvesting Tips: Garlic can be harvested when the leaves brown and die away. It is important to gently dig up the bulbs, then hang them in a cool, dry place for 1 to 4 weeks. After drying, brush off the dirt, cut the tops to one-half inch above the main bulb, and trim roots close to the base of the bulb.

Storage Tips: Garlic is ideally stored in a cool place away from direct sunlight, but can also be stored at room temperature.

Enjoy!

The fresh flavors of homegrown vegetables and fruits, especially when harvested close to their peak, create a natural desire for these foods. Because of this, Americans are incorporating homegrown produce into their diets. The Center for Disease Control and Prevention (CDC) has assembled a wealth of ideas for increasing fruit and vegetable intake at http://www.fruitsandveggiesmatter.gov/. CDC features a different fruit and vegetable each month, providing budget tips and recipes, and offering an interactive tool that provides nutritional analyses. USDA's My Pyramid also offers ideas at http://www.mypyramid.gov/pyramid/vegetables_why.html.

Summary:

This issue of *Oncology Nutrition Connection* provides guidelines for starting a home garden, but there is much to learn about gardening that is beyond the scope of this issue. State extension services and master gardener programs provide free resources for all gardeners. So... select a gardening site, make a plan, test and amend the soil, plant, harvest, and ENJOY!!!

Readers who would like to contribute to a gardening blog can check out Diana Dyer's, which shares her thoughts, experiences, and research findings about the benefits of gardening for cancer survivors. It can be accessed at www.cancervictorygardens.com. Diana welcomes short stories and photos from ON DPG members and their patients for her Cancer Victory Gardens blog. Our hope is that this publication, along with other gardening resources and blogs like Diana's, will inspire cancer survivors to incorporate gardening into their pathway to recovery and a healthy life after a cancer diagnosis.

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