Nutrition & Breast Cancer

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Good nutrition may reduce the incidence of breast cancer and the risk of breast cancer progression or recurrence. There are many studies in progress to help further understand how diet and cancer are related. We do know, however, that improved nutrition reduces risk of chronic diseases, such as diabetes, obesity, hypertension and heart disease, and also enhances overall quality of life. It is estimated that one third of cancer deaths in the U.S. can be attributed to diet in adulthood [1].

Guidelines for a Healthy Diet

- Plant-based diet
    - o Plenty of fruits and vegetables
    - o High fiber – whole grains and beans/legumes
- Low fat diet with emphasis on healthy fats
- Limit processed and refined grains/flours/sugars
- Drink plenty of fluids
- Be physically active to help achieve and maintain a healthy weight

Plant based diet

A lifelong commitment to a plant based diet may lower a woman's risk of developing breast cancer and may also reduce the risk of recurrent breast cancer. A plant based diet consists primarily of fruits, vegetables, whole grains, beans/legumes, and other plant protein sources.

* All words noted with an asterisk (*) are defined in the glossary on pages 33-34.

FRUITS AND VEGETABLES

- Contain vitamins, minerals, fiber, and various cancer-fighting phytonutrients* (for example: carotenoids, lycopene, indoles, isoflavones, flavonols).
- Vibrant, intense **COLOR** is one indicator of phytonutrient* content.
- There is extensive and consistent evidence that diets high in fruits and vegetables are associated with decreased risks of many cancers, and while results for breast cancer risk are not yet conclusive, they are promising [2-9].
- In a study of about 3000 postmenopausal women, a protective effect for vegetables was observed [2].
    - o Women who consumed 25 or more servings of vegetables weekly had a 37% lower risk of breast cancer compared with women who consumed fewer than 9 vegetable servings weekly.
- An epidemiological study reported a significant protective effect of vegetables against breast cancer when case-control* and cohort* studies were considered together [4].
- A meta-analysis* – looking at the data from 17 studies [10] revealed that high vs. low vegetable consumption was associated with a 25% reduction in breast cancer risk, but these findings were not confirmed by collected data from 8 studies [11].
- A recent case-control* study reported women who consumed more than 3.8 servings of fruits and vegetables daily had a lower risk of breast cancer when compared with women who consumed fewer than 2.3 daily servings [12].
- A study assessing plasma or blood carotenoids as a marker for fruit and vegetable intake reported that individuals in the top 1/4 had a 43% lower risk of breast cancer recurrence when compared to those in the lowest 1/4 [13].

Beta-Carotene

- Beta-carotene is one of the 600 carotenoids that can be partially converted into vitamin A in the body.
- Carotenoids have a protective role for certain sites of cancer, including breast cancer [7,14,15].
- In various studies, serum beta-carotene levels were lower among breast cancer patients compared to women without cancer [14,16-20].
    - o One of these studies reported the risk of breast cancer to be 221% greater for women in the lowest quartile of serum beta-carotene compared to women in the highest quartile [20].
- A case-control* study reported that increased plasma levels of beta-carotene, retinol, and total antioxidant* status were associated with about a 50% reduced risk of breast cancer [19].
- In vitro research indicates that carotenoids may inhibit the production of breast cancer cells [21,22].
    - o Beta-carotene may inhibit estrogen-receptor positive (ER+) and estrogen-receptor negative (ER-) breast tumor development [15].
- Beta-carotene may hinder the development of breast cancer cells by inducing apoptosis*, or programmed cell death [23].
- **Dietary sources include carrots, winter squash, sweet potatoes, cantaloupe, and mangoes.**
- Research indicates that dietary sources of beta-carotene are likely much more protective than supplemental sources against the risk of cancer [24-28].

Cruciferous Vegetables

- Some evidence suggests that the cruciferous vegetables **(broccoli, cauliflower, cabbage, kale, Brussels sprouts, bok choy, collard greens, radish, watercress)**, in particular, are associated with a reduced risk of breast cancer [29-32].
- Consumption of cruciferous vegetables, particularly broccoli, was inversely, though not statistically significant, associated with breast cancer risk in women [29].
- A Swedish study of postmenopausal women reported one to two daily servings of cruciferous vegetables to reduce the risk of breast cancer, possibly by as much as 20-40% [30].
- The U.S. component of the Polish Women's Health Study found that women who consumed raw- or short-cooked cabbage and sauerkraut 3 or more times weekly had a significantly reduced risk of breast cancer [32].
    - o Cabbage that was cooked for a long time had no effect on breast cancer risk.
    - o Researchers suggested that glucosinolates, compounds in cabbage, may affect both the initiation phase of carcinogenesis*, cell mutation*, and inhibit apoptosis*.
- Cruciferous vegetables appear to shift estrogen metabolism in a favorable manner; increasing 2-hydroxyestrone:16-α-hydroxyestrone [33,34]. Fowke and colleagues [34] concluded that consuming more cruciferous vegetables across the population may very well have an impact on the incidence of breast cancer.
- Several studies suggest that compounds found in these foods, isothiocyanates (sulforaphane), have inhibitory effects on breast cancer cells in both cell studies and animal studies [31,35,36].
    - o One mechanism appears to be through potent inhibition of phase I and induction of phase II detoxifying enzymes, such as glutathione-s-peroxidase [29,35].
- Indole-3-carbinol (I3C) is a compound found in cruciferous vegetables that has anticancer properties and anti-proliferative effects on breast cancer cells [37].
    - o I3C may inhibit the growth of blood vessels that the tumor needs to grow (anti-angiogenesis) [38].
- I3C and diindolylmethane (DIM) induce apoptosis*, or cell death, in breast cancer cells [33,39] for both ER+ and ER- tumor cells [40].
- Furthermore, I3C and tamoxifen have been shown to act separately and/or cooperatively to inhibit the growth of ER+ breast cancer cells [41].
- Dietary I3C may have effects that bolster immune function [42].
- Calcium-D-glucarate has been shown to inhibit beta-glucuronidase, an enzyme involved in phase II liver detoxification. Elevated beta-glucuronidase activity is associated with an increased risk for various cancers, particularly hormone-dependent cancers such as breast cancer [43].

Organic Produce

- Organic fruits and vegetables have fewer pesticides, lower levels of total pesticides, and less overall pesticide toxicity than fruits and vegetables grown with chemicals. Although more research is needed, recent evidence indicates a significant increase in antioxidants* in organic and sustainably grown foods versus conventionally grown foods [44-48].

- Organic vegetables contained a greater concentration of phytonutrients* (phenolic acids) when compared to conventionally grown vegetables [47,48].

- Consuming organic foods appears to increase salicylic acid, which may contribute to a lower risk of cancer [47].

- Choosing organic produce will help you reduce your levels of pesticide exposure and will most likely increase your phytonutrient* consumption.

    - Although washing and peeling your non-organic fruits or vegetables may help to reduce pesticide residues, it will not eliminate them.

- Listed below are produce with the most and least pesticide contamination, both in terms of number of pesticides used and the level of pesticide concentration on an average sampling. Thus, for the fruits and vegetables shown on the most contaminated list, it is wise to buy organic. Alternatively, if organic choices are not available, you may want to consider substituting with produce that tends to contain the least amount of pesticides.

Produce most contaminated by pesticides:	Produce least contaminated by pesticides:
Peaches	Avocadoes
Strawberries	Corn
Apples	Onions
Nectarines	Asparagus
Spinach	Cauliflower
Celery	Peas (sweet)
Potatoes	Bananas
Bell peppers	Kiwi
Pears	Mango
Cherries	Papaya
Raspberries	Pineapple
Imported grapes	Broccoli

**Adapted from Environmental Working Group – A Shopper's Guide to Pesticides in Produce

- **It is most important**, however, to eat fruits and vegetables – organic or conventional. If the availability or cost of organic produce is a barrier, you may wish to avoid those fruits and vegetables that have the highest pesticide residue content.

- Consume at least five, preferably eight to ten, servings of fruits and vegetables daily [49].

    - One serving equates to:

        1/2 cup fruit or vegetable

        1 cup raw leafy greens

        1/4 cup dried fruit or vegetable

        6 fl oz fruit or vegetable juice

Pomegranate (Punica granatum; Punicaceae)

- Various parts of the pomegranate fruit (for example: seed oil, juice, fermented juice and peel extract) have expressed the suppressive effects on human breast cancer cells in laboratory research [50].
- Pomegranate seed oil and fermented juice block the cancer cells' oxygen supply, slow cell growth, and promote cell death [51].
- Fermented pomegranate juice polyphenols* appear to have twice the anti-proliferative effect as fresh pomegranate juice polyphenols* [52].
- Furthermore, one study suggests that pomegranate seed oil may have the greatest preventive activity (87% reduction in lesions) compared to fermented pomegranate juice (42% reduction) [53].

FIBER – A PLANT-BASED DIET IS NATURALLY HIGH IN FIBER

- A diet rich in natural fiber obtained from fruits, vegetables, legumes (for example: lentils, split peas, black beans, pinto beans), and whole-grains may reduce cancer risk and/or reduce risk of cancer progression.
- Fiber binds to toxic compounds and carcinogens, which are then later eliminated from the body [54].
- Various mechanisms have been proposed for the protective effects of dietary fiber against cancer. These include:
    - o Increased fecal bulk and decreased intestinal transit time, which allow less opportunity for fecal mutagens to interact with the intestinal epithelium [55].
    - o Binding to bile acids, which are thought to promote cell proliferation [56].
    - o Fermentation in the gut, producing short-chain fatty acids (SCFA). SCFA improve the gut environment and may provide immune protection beyond the gut [55,56].
    - o Additionally, whole grains are rich in antioxidants*, including trace minerals and phenolic compounds, which have been linked to disease prevention [56].
- Furthermore, a high fiber diet works to reduce hormone levels that may be involved in the progression of breast cancer [55,57-60].
    - o Dietary fiber intake increases the amount of estrogen excreted in the stool [61].
    - o Reduced levels of serum estrone* and estradiol* were observed in premenopausal women with a greater intake of dietary fiber [58]. This decrease in estrogen levels in the blood thereby may potentially reduce the risk of hormone-related cancers, such as breast cancer.
    - o Results from a recent high-fiber, low-fat diet intervention found that fiber reduced serum estradiol* (estrogen breaks down into estradiol* in the body) concentration in women diagnosed with breast cancer, the majority of whom did not exhibit weight loss. Thus, increased fiber intake was independently related to the reduction in serum estradiol* concentration [60].
- A high fiber diet is also associated with less obesity [57].
- A recent cohort* study reported that high fiber intakes were associated with a 42% lower risk of postmenopausal breast cancer, when comparing women in the highest quintile of fiber intake compared to the lowest quintile [62].

- An earlier prospective cohort* study, however, reported no protective effect of fiber against breast cancer when comparing women who consumed fewer than 26 grams dietary fiber compared to those who consumed even less [63]. This finding is not surprising given that the total grams of fiber consumption was less than 30 grams.
    - o Similarly, another study that reported no significant findings compared women consuming less than 25 grams fiber daily [64].
- Overall, case-control* studies have reported the greater the fiber intake, the lower the incidence of breast cancer [5,8,65-68]. Data from prospective studies is mixed, reporting protective effects [62,69] or no effect observed [63,64].
- Women who ate beans and lentils at least twice a week had a 24% lower risk of developing breast cancer than women who ate them less than once a month [70].
- Aim for 30-35 grams of fiber daily.
    - o Choose breads with three or more grams of fiber per slice.
    - o First ingredient on the label should be whole or sprouted grain flour, not white flour, unbleached white flour, or enriched wheat flour.
    - o Whole grains include oats, barley, quinoa, amaranth, millet, spelt, bulgur, etc.
    - o Include beans/legumes regularly in the diet.
- Refer to the high-fiber sources table for more information (see pages 24-25).

SUGARS AND THE ROLE OF INSULIN*

- High sugar foods are usually highly processed and refined, low in nutrient value, and also low in dietary fiber. In addition, these foods appear to increase serum insulin* and serum insulin-like growth factor-I (IGF-I) levels [71], which appear to stimulate cancer cell growth.
    - o Overexpression, or high amounts, of IGF increases mammary tumors in mice [72].
    - o IGF's may work by stimulating cell cycle progression & prevent cells from premature death [73-76].
    - o IGF-I may promote tumor growth via upregulation of ovarian steroid secretion [76,77].
    - o Research indicates a synergistic effect between IGF-I and estrogen [78] as well as IGF-I and insulin* resistance [79] in breast cancer.
- A prospective cohort* study observed a significant 310% increased risk of breast cancer in premenopausal women who had the highest quartile of IGF-I compared to women with the lowest quartile [72].
    - o A weaker association was found with fasting insulin* levels where premenopausal women in the two highest quartiles had a 70% greater risk for breast cancer.
    - o In premenopausal women, women in the highest quartile of serum glucose had a 280% increased risk of breast cancer compared with women in the lowest quartile.
    - o In postmenopausal women, the associations of glucose, insulin*, and IGF-I were associated with breast cancer risk in heavier subjects (BMI>26 [1]).
    - o Overall, these findings indicate that chronic change of glucose/ sugar metabolism is related to breast cancer development.

[1]BMI refers to body mass index, which is calculated by body weight (kg)/height^2(m^2).

- Other studies support a stronger link between IGF-I and breast cancer in premenopausal women [75,80].
- Additionally, a case-control* study in China found that IGF-I significantly increased the risk of breast cancer [79].
- Nonetheless, a recent meta-analysis* review of 18 studies reported no overall statistically significant association between circulating IGF-I levels and risk of breast cancer although the levels were greater in breast cancer patients than controls [74].
    - However, IGF-I levels did appear to increase breast cancer risk in premenopausal women by almost 40%.
- Similarly, a large prospective trial reported IGF-I significantly increased risk of breast cancer in premenopausal women under the age of 50; no significant relationship was noted for postmenopausal women [81].
- A cohort* study reported that higher insulin* levels significantly increased risk of breast cancer for both pre- and post-menopausal women [82].
- Recent studies indicate that high insulin* levels, increased concentration of IGF-I, and greater abdominal fat are associated with increased risk for breast cancer [83].
- It has been suggested that decreasing IGF-I levels may be one factor that contributes to tamoxifen's anti-tumor activity in breast cancer therapy [84].
- Research is inconsistent regarding the association of IGF-I and disease-free survival or overall survival [75].
- One study noted a direct association, though not statistically significant, between non-fasting serum insulin* levels and 10-year mortality in postmenopausal breast cancer women [85].
- Among other factors, a diet low in fiber may favor the development of insulin* resistance and hyperinsulinemia [73].
- Hyperinsulinemia may contribute to the development of breast cancer in overweight or obese women [86].
- A recent case-control* study reported that carbohydrate intake significantly increased risk of breast cancer; sucrose (table sugar) imparted the greatest risk [87]. This risk was lessened considerably with a higher fiber intake.
- Furthermore, an Italian case-control* study found that women who consumed the highest tertile of desserts and sugars had a 19% increased risk of breast cancer compared with women in the lowest tertile [88].
- Additionally, obesity and fasting hyperinsulinemia have been associated with a poorer prognosis in women with established breast cancer [89].
- **Sugars to be consumed in limited amounts include products made with refined grains or refined flours** (for example: white breads, white rice, white pastas), alcohol, and desserts, such as candy, cookies, cakes, and pies).

Sugars & Insulin* – Bottom Line

- To help control your insulin* level:
    - o Eat a high-fiber diet with limited refined/processed foods
    - o Follow a low fat diet
    - o Exercise
    - o Maintain a healthy body weight

LOW FAT DIET

Several studies have investigated the relationship of fat and the risk of breast cancer, but the results remain inconsistent. However, two large meta-analyses did report a positive association between total fat intake and risk of breast cancer [90,91]. The potential elevated cancer risk may be, in part, due to the fact that a high fat diet stimulates increased estrogen levels, which is associated with breast cancer growth. A study of adolescent females found that modest reductions in fat intake during puberty resulted in significantly lower concentrations of sex hormones (estradiol*, estrone*, progesterone) [92]. Further research is needed to determine if in fact these lower levels lead to a reduced risk of breast cancer.

Additionally, a low fat, high carbohydrate diet may result in a significant reduction in breast density, particularly in women going through menopause. **Aim for close to 20% of your total calories from fat, with less than 8% of total calories from saturated fat.** Research indicates that the type of fat may be of paramount importance.

Saturated Fats

- Several studies indicate a positive association between saturated fat intake from meat and dairy products (animal sources) and cancer [93-96]. The breast cancer research, however, is inconclusive.
- Total saturated fatty acid intake was significantly associated with breast cancer risk in cohort* studies in postmenopausal women, but not premenopausal women [97].
- Based on a seven-day diary for evaluating saturated fat intake, a high intake of saturated fat was reported to increase the risk of breast cancer [95].
- A meta-analysis* observed a 19% increased risk of breast cancer with greater intake of saturated fats [98].
- Other studies, however, have not found a significant association between saturated fats and breast cancer [99-101].
- **It is suggested to limit consumption of butter, baked goods, meats, mayonnaise, and whole milk dairy products, including cheese.**
    - o Cheese is typically between 60-80% fat, much of which is saturated fat.

Trans-Fatty Acids

- Preliminary research indicates that these fatty acids may be associated with an increased risk of cancer [102-104].

- Minimal research exists on the relationship between trans-fatty acids and risk of breast cancer, thus, more research is needed for conclusive evidence. However, some evidence points to a positive association between these fats and breast cancer risk [104,105].
- These fats may disrupt hormonal systems that regulate healing, lead to the destruction of defective membranes, and encourage the development of cancer.
- One study reported a 40% increased risk of breast cancer in postmenopausal women who had higher tissue levels of trans-fatty acids [106].
- Avoid **hydrogenated** fats, such as margarine, fried foods, commercial peanut butter, and processed foods (breads, crackers, cereals, cookies), which are high in trans-fatty-acids.
    - o When you read that a product contains "hydrogenated" or "partially-hydrogenated" oils, consider putting it back on the shelf.
    - o Consider rice vinegar, balsamic vinegar, lemon juice, low-fat cottage cheese or salsa as an alternative salad dressing.
    - o Trans fatty acid labeling came into effect January 2006 – the amount of these fats in a product must now be clearly identified.

Omega-9 Fatty Acids (Monounsaturated Fats)

- Most research at this time indicates a neutral relationship [99] or a slightly protective effect [90,101,107,108] between these fats and risk of breast cancer.
- Several case-control* studies reported that olive oil consumption, rich in omega-9 fats, resulted in a 13-34% reduction in breast cancer risk [109-111].
- A meta-analysis*, however, that included three cohort* studies reported total monounsaturated fatty acids and oleic acid, a type of omega-9 fatty acid, to significantly increase breast cancer risk [97].
- **Dietary sources include extra-virgin olive oil, canola oil, almonds, and avocadoes.**
- Nuts are generally concentrated in omega-9 fatty acids, but remember they are high in fat.
    - o Minimize consumption of nuts to no more than 1/4 cup with meal or snack to limit total fat and calories.

Essential Fatty Acids (EFA)

Essential fatty acids are necessary for the formation of healthy cell membranes, the proper development and functioning of the brain and nervous system, and for the production of hormone-like substances called eicosanoids* (thromboxanes, leukotrienes, prostaglandins). Among other body functions, these chemicals regulate immune and inflammatory responses.

Eicosanoids* formed from the omega-6 fatty acids have the potential to increase blood pressure, inflammation, platelet aggregation, allergic reactions and cell proliferation. Those formed from the omega-3 fatty acids have opposing affects. Current research suggests that the levels of essential fatty acids and the balance between them may play a critical role in the prevention and treatment of cancer.

Omega-3 Fatty Acids

- Research is growing supporting a protective relationship between omega-3 fatty acids [alpha linolenic acid (ALA), eicosapentanoic acid (EPA), and docosahexanoic acid (DHA)] against the risk of breast cancer [97,99,112-117].
- Studies show that omega-3 fatty acids inhibit breast cancer tumor growth and metastasis. Additionally, these fats are immune enhancing.
- Mechanisms proposed for their protective effects include:
    - o Suppression of eicosanoid synthesis from arachidonic acid (omega-6 fatty acid), which impedes immune function [117,118].
    - o Inhibit cell growth and differentiation via effects on gene expression and signal transduction pathways [117,118].
    - o Alter estrogen metabolism, which reduces estrogen-stimulated cell growth [117,118].
    - o Effects on insulin* sensitivity and membrane fluidity [118].
- A prospective study reported that women who consumed 44 g or more of dietary marine omega-3 fatty acids reduced their risk of breast cancer by 26% when compared with women who consumed 25 g or less [99].
- An inverse relationship was found between omega-3 fatty acids in breast tissue and the risk of breast cancer [115].
    - o When comparing women in the highest tertile of ALA and DHA to the lowest tertile, cancer risk was reduced by 61% and 69%, respectively.
- Preliminary research indicates that DHA may synergistically enhance taxane cytotoxicity [119]. More research is needed, but these findings would indicate that DHA during taxane administration may improve the effects of chemotherapy for breast cancer patients.
- **Dietary sources include cold-water fish (for example: wild salmon, trout, herring, sardines, mackerel, sablefish), flaxseeds, walnuts, pumpkin seeds, and soybeans.**
    - o It may be wise to consume cold-water fish at least twice weekly to obtain an adequate amount of omega-3 fatty acids.
    - o Additionally, incorporating one of the following foods on a regular basis will help to achieve sufficient omega-3 fatty acids:
        - 1-2 Tbsp ground flaxseed
        - 1 oz walnuts
        - 1/2 - 1 cup cooked soybeans
    - o Fish and plant-based foods, however, contain different types of omega-3 fatty acids.
        - Fish contains EPA and DHA, two specific fatty acids that have shown promising results in the research literature [112,120].
        - Fish consumption in general has been associated with a protective effect against breast cancer [113,114,116,121].
        - The plant-based omega-3 fatty acid sources, such as flaxseed and others listed

above, contain ALA. In an ideal environment, ALA is converted to EPA and DHA, however, this process is inefficient [54,118,122]. On the positive side, the conversion process is enhanced by following a diet that is low in saturated fats and low in omega-6 fatty acids [118,123].

- Thus, if you are considering an omega-3 fatty acid supplement, choose one that is highest in EPA and DHA concentration.

Omega-6 Fatty Acids

- Recent studies indicate that a high intake of omega-6 fatty acids (linoleic acid, which can be converted to arachidonic acid) promote breast tumor development and metastasis [90,96,115,116,124].
- A meta-analysis* of 3 cohort* studies found palmitic acid, a type of omega-6 fatty acid, to be significantly associated with an increased risk of breast cancer [97].
- Additionally, researchers reported that arachidonic acid, an omega-6 fatty acid almost exclusively from meat, significantly increased oxidative damage as measured by urinary biomarkers [125].
- It is known that cyclooxygenase is the rate-limiting enzyme that catalyzes the conversion of arachidonic acid to prostaglandins. Furthermore, cyclooxygenase-2 (COX-2) is known to be overexpressed in various human cancers. In this breast cancer study, COX-2 overexpression was significantly correlated with larger tumor size and advanced clinical stage, which indicates a poorer prognosis [124].
- A very interesting finding was reported in a prospective study that found no overall association between omega-6 fatty acids and risk of breast cancer [99]. However, omega-6 fat consumption increased risk by 87% in women who consumed 25 g or less of marine omega-3 fatty acids. This effect was even greater for advanced breast cancer.
    - Thus, the balance between omega-6 and omega-3 fatty acids may be of paramount importance. This was further supported by other studies [115,116,126].
- **Dietary sources include meat, butter, egg yolks, whole milk, corn oil, safflower oil, sunflower oil, and cottonseed oil.**
- Substitute olive or canola oil for your current cooking oil or fat. These oils are rich in omega-9 fatty acids, which do not appear to increase cancer risk.

Fat – Bottom Line

- Less fat is better.
- Limit animal fats.
- Avoid hydrogenated fats.
- Extra-virgin olive oil or canola oil is preferred for salads and cooking.
- Increase omega-3 fatty acids.

ALCOHOL

- Regular consumption of alcohol may increase the risk for breast cancer [127-132].
    - o A recent review study reported that data from many well-designed studies consistently shows a small rise in breast cancer risk with increasing consumption of alcohol [132].
- A recent study found that as little as a half a glass of wine a day raised a woman's risk of developing breast cancer by 6% (increased risk by 18% in postmenopausal women) [127].
    - o Furthermore, 1-2 drinks a day increased risk by 21% and 2 or more drinks a day increased risk by 37%.
    - o The heightened risk was more pronounced for women with ER+ and progesterone-receptor positive (PR+) tumor types.
- A pooled analysis of six prospective studies suggests that the risk of breast cancer increases linearly by 9% with each 10 g /day (~ 1 drink) alcohol [133]. The risk increased to 41% when comparing women who consumed 30-60 g/day (~2-5 drinks) to nondrinkers.
- A large meta-analysis* revealed that one drink daily increased breast cancer risk by 11% [134]. A later meta-analysis* found similar findings [135].
- Since then, another meta-analysis* reported that breast cancer risk increased by 32% and 46% in women who consumed 35-44 g alcohol (~3-4 drinks) daily and 45 g or more (~4.5 drinks or more) daily, respectively [130].
    - o For each additional 10 g of alcohol (~1 drink) daily, risk increased by 7%.
- Other studies [128] claim that one glass of alcohol daily does not increase risk, but consuming 2-5 drinks daily increases the risk of breast cancer by 40% compared to non-drinkers [128].
    - o Greatest risk was among heavy drinkers who were also postmenopausal and had a history of benign breast disease or who used hormone replacement therapy (HRT) [128].
- Among ER+ postmenopausal women, those who consumed approximately 3 drinks or more daily had a 76% increased risk of breast cancer when compared with women who did not consume alcohol [136].
    - o The association between alcohol and ER- tumors was less clearly associated.
    - o Additionally, there was no clear association between alcohol and premenopausal risk of breast cancer.
- A recent cohort* study of postmenopausal women reported that alcohol consumption was associated with an increased risk of breast cancer in ER+, but not ER- tumors [137].
- Petri and colleagues [131] observed a stronger relationship between alcohol and breast cancer in postmenopausal women compared to premenopausal women.
    - o Premenopausal women drinking more than 27 drinks per week had a 3.5% higher risk than women who had one drink per week.
    - o Postmenopausal women drinking six or more alcoholic beverages per week had a 2.4% higher risk than women who had one drink per week.
- Alcohol consumption (1 drink/day) during a woman's fifties increased risk for postmenopausal breast cancer by 12% in a large cohort* study, but statistical significance was not reached for women in their twenties, thirties, or forties [129].

- These differing findings between pre- and postmenopausal women are likely related to the effect of alcohol on estrogen levels. **Alcohol appears to increase endogenous* estrogen levels** [138-140].
- Folate, a B vitamin, may be of even greater significance with alcohol consumption. It has been observed that women with low folate and high alcohol consumption had a 43% greater risk of breast cancer when compared with nondrinkers with adequate folate intake [141].

Alcohol – Bottom Line

- It is best to limit or avoid alcohol.

ADEQUATE FLUIDS

The functions of water in the body include the following:

- o Carries nutrients and waste products.
- o Participates in chemical reactions.
- o Acts as a lubricant and cushion around joints.
- o Acts as a shock absorber in the eyes and spinal cord.
- o Aids in the body's temperature regulation.
- o Maintains blood volume.

- Increased fluid intake is needed for a high fiber diet.
- Drink plenty of water daily to help meet fluid needs.

CALORIC INTAKE

- The risk of breast cancer is much higher in industrial countries than in developing countries where women are characterized by lower energy intake and higher energy expenditure.
- Modest caloric restriction has been shown to inhibit tumor growth in animal models decrease oxidative DNA damage [142].
- Modest caloric restriction has been shown to decrease oxidative DNA damage.
- The mechanism involved may be related to the decrease in IGF-I observed when caloric intake is restricted [143,144].
- Furthermore, evidence suggests that a high calorie diet may increase IGF-I levels [145].

BODY MASS

- Epidemiologic evidence suggests a positive association between body mass and postmenopausal breast cancer [146-148].
- A recent case-control* study of 2000 women found that women who gain weight, particularly after age 50, significantly increase their risk of breast cancer [149]. Conversely, women (young and

middle-aged) who lose weight may decrease the risk of breast cancer.

  - This study suggests excess body fat increases estrogen levels, which may in turn increase the risk for breast cancer.
  - An earlier study reported similar findings with total weight gain serving as a strong predictor of breast cancer risk, specifically among former and never HRT users [146].

- Results from a systematic review showed that, when adjusted for BMI, a larger waist size increased risk of breast cancer among premenopausal women [150]. This study supports the idea that central obesity is of greater concern than general obesity in regards to breast cancer risk.
  - However, for postmenopausal women, a large trial found that, while general obesity was a significant predictor of breast cancer risk, central obesity did not appear to be associated with increased risk [151].
- Total body weight, BMI, and hip circumference were significantly associated with breast cancer risk among HRT nonusers; obese women (BMI > 30) had a 31% greater risk compared to women with BMI < 25 [151].
- Overweight or obesity is associated with poorer prognosis in the majority of the studies that have examined body mass and breast cancer [152-158].
- Various studies report increased BMI or body weight to be a significant risk factor for recurrent disease, survival, or both [152-158].
  - May be related to increased estrogen [159,160] and elevated insulin* and IGF, which can stimulate cell proliferation [84,152].
  - Obese postmenopausal women (BMI >30) had 35% higher concentrations of estrone* and 130% higher concentrations of estradiol* compared with lighter-weight women (BMI < 22.0) [160]. Additionally, free estradiol* and free testosterone were two to three times greater in overweight and obese women compared with lighter-weight women.
  - Recent findings indicated that oxidative damage, measured by urinary biomarkers, was significantly greater in women with a higher BMI [125].
  - One study noted a 50% increased risk in breast cancer for obese postmenopausal women [159].
  - Obesity among premenopausal women, however, may not be associated with increased risk of breast cancer. Nonetheless, obesity during menstruating years is associated with obesity throughout life and therefore to an eventual increased risk of breast cancer [132]. However, other research suggests a stronger relationship between body weight and breast cancer in premenopausal women [156,158].
- A cohort* study of 1300 women reported that breast cancer recurrence and death increased with body weight in both premenopausal and postmenopausal women [158].
- Body weight prior to breast cancer diagnosis significantly increased risk of recurrence and death in nonsmokers [156].
  - Additionally, nonsmokers who gained weight after diagnosis had an elevated risk of breast cancer death during follow-up (median, 9 years), compared with women who maintained their weight.
- Research suggests a potential link between obesity, diabetes mellitus and breast cancer [161].
- Eating foods high in vitamin C, such as fruits and vegetables, may provide protective effect from breast cancer for overweight women (BMI>25) [162].

PHYSICAL ACTIVITY

- Low levels of physical exercise appear to be associated with the risk of breast cancer [132,148,163-165].
- A case-control* study reported significantly reduced breast cancer risk among women who maintained, on average, 17.6 (MET)-hr of activity/week[2] from menarche onward [148]. This decreased risk with physical activity was limited to women without a family history of breast cancer when adjusted for BMI.
- A cohort* study reported that postmenopausal women who were most physically active (> 42.0 MET-h/week)[3] at baseline had a 29% lower incidence of breast cancer than active women with the least activity (> 0-7.0 MET-h/week)[4] [165]. This difference was greatest for women who did not use HRT at enrollment.
- Women who engaged in regular strenuous physical activity at age 35 had a 14% reduced risk of breast cancer compared with less active women [164]. A similar trend was observed for regular strenuous activity at age 18 and at age 50. These findings were consistent with women who did and did not use HRT.
- Furthermore, a prospective observational study reported that physical activity after a breast cancer diagnosis may reduce the risk of death from this disease [163]. The greatest benefit occurred in women who performed the equivalent of walking 3 to 5 hours per week at an average pace. The benefit of physical activity was particularly apparent among women with hormone-responsive tumors.
- Physical activity may reduce the risk of breast cancer through an influence on ovarian function and a decrease in progesterone and estrogen concentrations via reduced body fat [164]. Furthermore, exercise may increase sex hormone-binding globulin* (SHBG) levels and thereby reduce estradiol*.
- Additionally, exercise may decrease IGF-I and improves insulin* sensitivity [164].
- Healthy weight control is encouraged with an emphasis on exercise to preserve or increase lean muscle mass.

[2] This is equivalent to a 150lb individual burning 1257 kcals/week through physical activity.

[3] This is equivalent to a 150lb individual burning about 3000 kcals/week through physical activity.

[4] This is equivalent to a 150lb individual burning 500 kcals/week or less through physical activity.

Additional Nutritional and Lifestyle Factors for Breast Cancer Survivors

ANTIOXIDANTS* – Found in abundance in fruits and vegetables!

- Prevent oxidative damage in body cells.
    - o Research indicates a link between oxidant damage and breast carcinogenesis*.
- Examples of antioxidant* nutrients and non-nutrients include vitamins A, C, and E, selenium, lycopene, and beta-carotene.
- Note that patients may be advised to NOT consume high-dose antioxidant* supplements during chemotherapy or radiation therapy. Antioxidant* consumption via food sources and a basic multivitamin supplement are very safe.

Selenium

- Antioxidant* that scavenges free radicals and suppresses damage due to oxidation. Also is essential for the immune system.
- Promising evidence indicates that selenium may decrease the risk of breast cancer [166-171].
    - o Inhibits cell proliferation and induces apoptosis* [171].
- Selenium may interfere and alter estrogen receptors decreasing mammary tumor incidence [168].
- Research shows that selenium reduces the incidence of malignant cells in animal models [169,170], and enhances the effects of chemotherapeutic drugs, such as taxol and adriamycin [167].
- Toenail selenium concentrations tended to be lower in postmenopausal breast cancer patients when compared with healthy non-cancer patients, but the differences did not reach statistical significance [172].
    - o Interestingly, this study also found that plasma triiodothyronine (T3) (a thyroid hormone) concentration was positively associated with toenail selenium in breast cancer patients and controls. T3 concentration was significantly lower in breast cancer patients compared to healthy non-cancer patients.
- A recent study suggested the combination of selenium and iodine, typical of a Japanese diet, act synergistically in decreasing breast cancer risk [173]. It is known that iodine plays an important role in thyroid function. Thus, selenium status may affect both thyroid hormone status and iodine availability.
- Selenium is a precursor to the glutathione* (GSH) antioxidant* system. GSH is the principal protective mechanism of the cell and is a crucial factor in the development of the immune response by the immune cells [174].
    - o Studies suggest the ratio of selenium to glutathione* is at lower levels in breast cancer patients [166]. Research indicates that dietary selenium supplements correct abnormal glutathione* turnover.
- **Dietary sources include Brazil nuts, seafood, enriched brewer's yeast, and grains.** Selenium content depends somewhat on the amount in the soil in which the products are grown.
- **Recommendation:** 200 mcg daily (2 Brazil nuts or high potency multivitamin supplement that includes 200 mcg selenium).

Turmeric (Curcumin)

- Curcumin, the yellow pigment and active component of turmeric and many curries, is a potent antioxidant*, that exhibits chemopreventive and growth inhibitory activity in several tumor cell lines [175-178].
- Evidence suggests that curcumin may suppress tumor initiation, promotion and metastasis [177,179].
    - o This may occur through enhanced apoptosis* [175,177].
- Additionally, curcumin promotes detoxification in the liver and possesses anti-inflammatory activity, possibly by inhibiting COX-2 activity [180,181].

Vitamin C

- Most research, although not all [182,7], has shown no protective relationship between vitamin C and the risk of breast cancer [183-188].

- However, low plasma levels of vitamin C have been associated with a greater risk of breast cancer [189].
- Risk of recurrence and mortality was reduced in women who consumed vitamin C supplements for more than three years [190].
- **Dietary sources include various fruits and vegetables, including papaya, citrus fruits, kiwi, cantaloupe, mango, strawberries, bell peppers, broccoli, and tomatoes.**

Vitamin E

- Vitamin E acts as a cellular antioxidant* and an anti-proliferating agent. It consists of both tocopherols and tocotrienols.
    - o Some research indicates that tocotrienols are the components of vitamin E responsible for growth inhibition in human breast cancer cells [191].
- Research is inconsistent on the protective effects of vitamin E and breast cancer. Data from most prospective studies have not revealed a protective relationship between vitamin E and risk of breast cancer [183].
- Supplemental vitamin E does not consistently appear to offer protection against breast cancer [125] although taking vitamin E for more than three years has been associated with a modest protective effect [190]. Additionally, these researchers reported a decreased risk of recurrence and mortality associated with long-term use of vitamin E supplements.
- However, low plasma levels of vitamin E have been associated with a greater risk of breast cancer [189].
- It was demonstrated recently that dietary vitamin E, unlike supplemental sources of vitamin E, significantly reduced oxidative damage as measured by urinary biomarkers [125].
- **Dietary sources include vegetable oils, wheat germ, nuts, seeds, soybeans, sweet potatoes, and avocadoes.**

FLAXSEED

- Flax is a good source of omega-3 fatty acids and fiber, contains protein, calcium, potassium, B vitamins, iron, and boron.
- Flax may also work to block tumor growth, inhibit angiogenesis*, and enhance the immune system [192].
- Consumption of 5 or 10 grams of flax for 7 weeks significantly decreased blood levels of estrone* and estradiol* [193].
- Flaxseed is the greatest source of mammalian lignans* [194,195], phytoestrogens found in flax, which appear to bind with estrogen and lower circulating levels of estrogen. This action may act as one of the protective mechanisms of flax for breast cancer.
    - o Lignans* facilitate the removal of estrogens via increased retention within the gut, which are later eliminated in the feces [196,197].
- Furthermore, lignans* positively influence estrogen metabolism by improving the ratio of 2:16α hydroxyestrone [196,197].
- A recent study indicates that flaxseed (25 g daily) and its metabolites, such as lignans*, reduced tumor growth in patients with breast cancer [194].

- Additionally, a recent pilot study observed lower breast density with a greater intake of dietary lignans* [198]. Dense breasts are a risk factor for breast cancer.
- Flax has been shown in vitro and in human trials to decrease tumor proliferation of breast cancer cells [194].
- An animal study reported that flaxseed inhibited established human breast cancer growth and reduced incidence of metastasis by 45%; this effect may be partially due to its downregulation of IGF-I [195]. Other studies support this effect of flax on IGF-I [195,199].
- Ground flax seeds have greater bioavailability than whole flax seeds. Flax seeds may easily be ground in a coffee grinder, blender, or food processor.
- Ground flax seeds can be sprinkled into many foods and beverages, including hot cereals, tomato sauce, fruit smoothies, brown rice or other grains, and more.
- Due to the instability of these fatty acids, it is best to store flax in the refrigerator or freezer.
- Note: Flax seed OIL is highly concentrated and lacks the protein, fiber, vitamins, minerals, and lignans* that are found in ground flax seeds. **The use of ground flax seed is highly preferred.**
- **Dosage:** 2 tablespoons ground flaxseed daily.
    - o Flax can have a laxative-like effect, thus, it is wise to gradually increase consumption.

GENOTOXINS: *Heterocyclic Amines (HCAs) & Polycyclic Aromatic Hydrocarbons (PAHs)*

- Natural components in meat, such as amino acids, creatine*, and polysaccharide precursors, are converted to HCAs during high-temperature cooking. HCAs are known to cause cancer in laboratory animals [200,201].
- While human research is forthcoming, the majority of studies [200-204] although not all [205,206] have observed a significant association between HCAs and breast cancer.
- A large case-control* study found that women who consumed very well-done meat for hamburger, bacon, and steak had a 54%, 64%, and 221% increased risk for breast cancer, respectively [203].
    - o Frequent consumers of these well-done meats had a 462% greater risk of breast cancer.
- Carcinogenic activity of HCA's is affected by various dietary factors [207]:
    - o Factors that <u>enhance</u> carcinogenesis* when combined with HCAs include:
        - High-fat diet
        - Caffeine
    - o Factors that <u>inhibit</u> carcinogenesis* when combined with HCAs include:
        - DHA
        - Conjugated linoleic acid (CLA)
        - Isoflavones
        - Green tea catechins*
        - Indole-3 carbinol

- Probiotics
- Gamma-tocopherol

- The most important variables contributing to the formation of HCAs are:
    - o Cooking temperature (greater than 300°F)
    - o Cooking time (greater than 2 minutes)
    - o Cooking method (frying, oven grilling/broiling, barbecuing)
- Charring of food (charcoal-broiled or smoked foods) contribute to PAHs [208].
- Meat can potentially be made "safer" to eat by being cooked in a way that does not lead to HCA formation.
    - o Choose lean, well-trimmed meats to grill.
    - o Using marinades significantly reduces the amount of HCAs.
    - o Brief microwave preheating substantially reduces HCA content of cooked meat.
    - o Small portions require less time on the grill.
- Additionally, the type of protein cooked can also affect the concentration of HCAs. It has been reported, for example, that chicken has more than 100 times the number of HCAs than salmon [207]. London broiled steak had more than 600 times the amount of HCAs when compared to salmon.
- Grill vegetables or meat alternatives that do not lead to the formation of HCAs or PAHs.

GREEN TEA

- Tea contains phytonutrients* known as polyphenols* (flavonoids) that provide antioxidant* and anticancer properties [209].
    - o May block the formation of cancer-causing nitrosamines* [210].
    - o Prevents DNA damage [211].
    - o May inhibit tumor growth and induce apoptosis* [212,213].
    - o Increase immune response [213].
- There is a significant amount of in vitro and in vivo evidence suggesting tea polyphenols* have chemopreventive agents against various cancers [212,214]. More human data is needed.
    - o Green tea and its catechin* components inhibit breast cancer growth and angiogenesis* in both in vitro and in vivo studies.
    - o Studies suggest green tea extract has been successful inhibiting cell proliferation and breast cancer [209].
- Many studies indicate a lower risk of breast cancer with green tea consumption, but more research is needed for conclusive evidence [215-217].
- Green tea includes the active ingredient epigallocatechin gallate (EGCG), which has been shown in human studies to inhibit human breast cancer cell proliferation, reduce tumor invasion and metastasis and prevent recurrence of breast cancer in early stage cases (stage I & II) [218-220].

- It has been suggested that green tea polyphenols* are capable of preventing the development and growth of breast cancer [221].
- However, combined studies of 35000 Japanese women found that green tea did not affect risk of breast cancer [222].
- Research suggests that while green tea did significantly decrease tumor mass, when green tea was combined with soy phytonutrients*, the tumor mass decreased even further [223]. Further evidence indicates a possible synergistic relationship between soy and green tea consumption [217].
- Furthermore, some evidence suggests that the association of tea catechins* and breast cancer may depend on specific genotypes [214].
- Green tea does naturally contain caffeine although a much lower amount than coffee or black tea. Although decaffeinated green tea is also available, reports suggest that the phytonutrient* content may be significantly less than regular green tea.
- **Recommendation:** 3 cups daily.

MELATONIN

- Melatonin is a hormone produced by the pineal gland. Its primary function involves the regulation of the body's circadian rhythm, endocrine secretions, and sleep patterns.
- Some research indicates that individuals with low levels of melatonin are at greater risk for breast cancer.
    - o Previous studies have reported an increased risk of breast cancer in night-shift workers who are exposed to light at night [224].
    - o In vitro and animal research has supported the protective effect of melatonin against breast cancer [225].
    - o A recent study found that women with higher urinary melatonin levels had a 30-41% reduced risk of breast cancer [226].
- Melatonin may act by:
    - o Inhibiting cell proliferation [227].
    - o Inducing apoptosis* [228].
    - o Enhancing the immune system [227,229].
        - May improve survival in cancer patients by protecting the immune system from damage caused by chemotherapy [228].
    - o Reducing IGF-I [230,231].
    - o Decreasing the number and activity of estrogen receptors, thus reducing ways that the cancer cell connects to estrogen [232].
- Various studies indicate that melatonin may inhibit breast cancer by interfering with estrogen pathways, thus acting in an anti-estrogenic manner [229,233,234].
- Furthermore, the combination of melatonin and retinoids* [235] as well as the combination of melatonin and vitamin D3 [236] appear to work synergistically to inhibit the growth of breast cancer cells.

- Melatonin does have blood thinning properties, thus it is recommended to not use supplemental melatonin 7-10 days prior to surgery.

SOY

- Soy contains various nutrients, including protein, fiber, calcium, and B vitamins.
- Soy is rich in antioxidants* known as isoflavones, namely genistein and daidzein.
- Associated with reduced rates of heart disease [237-239], protection against osteoporosis [240,241], and certain types of cancer, including breast cancer [242,243].
- The majority of short-term soy intervention studies conducted in premenopausal women show a reduction in endogenous* estrogen levels in association with soy intake.
- Additionally, research has indicated that soy protein may decrease IGF-I levels in premenopausal women [244].
- Results from the few soy intervention studies in postmenopausal women, however, are inconsistent.
    - o There are conflicting data on the effects of soy isoflavones and breast tumor growth. The concern is based primarily on in vitro (test tube) studies.
- The type of soy consumed may provide some insight to the inconsistent findings. It has been demonstrated that soy processing increases tumor growth in mice for postmenopausal ER+ breast cancer [245].
    - o The difference in tumor growth observed may be related to isoflavone metabolism and bioavailability, but more research is needed [246].
    - o **Nonetheless, these studies suggest that WHOLE SOY FOODS appear to not have a negative effect on postmenopausal ER+ breast cancer.**
    - o A recent cohort* study of breast cancer patients found that soy foods had no negative impact on breast cancer survival [247].
- Soy consumption has been suggested to exert potential cancer-preventive effects in premenopausal women, such as increased menstrual cycle length and SHBG* levels and reduced estrogen levels.
    - o 40 mg/day soy isoflavones increased menstrual cycle length in Western women [248].
    - o Research also suggests that soy isoflavones may significantly improve the 2-hydroxyestrone:16-a-hydroxyestrone ratio [249].
    - o Additionally, soy intake increases time spent in the follicular cycles, when proliferation is at its lowest [248].
- An Asian-American study on soy found that women, pre- and postmenopausal, who consumed tofu, had a 15% reduced risk of breast cancer with each additional serving per week [242].
- Moreover, a recent trial reported that women in the highest tertile intake of tofu had a 51% decrease risk of premenopausal breast cancer when compared with women in the lowest tertile [243]. No statistical significant association was observed between soy intake and breast cancer risk among postmenopausal women.

- Rat studies have found that the chemopreventive efficacy of tamoxifen can be improved with soy.
- Furthermore, vegan protein sources, such as soy, appear to decrease circulating IGF-I activity, which may impede cancer induction [238].
- Dietary sources include soybeans, tofu, tempeh, edamame, miso, soy nuts, soymilk, and more.

Source	Amount of Soy Protein (gm)	Amount of Soy Isoflavones (mg)
Miso (1 tbsp)	2	7-10*
Soybeans, edamame (1/2 cup)	11	35*
Soymilk (8 fl oz)	10	23*
Soy nuts (1/4 cup)	19	40-50*
Tempeh (1/2 cup)	19.5	36*
Tofu (4 oz)	13	39*

* Isoflavone content varies by brand

- Unless soy has been a part of your diet for years, individuals with ER+ breast cancer may be advised to limit soy consumption to 1-2 daily servings.
- Due to the inconclusive results of soy and breast cancer, soy supplements or isoflavone extracts are not recommended. **Focus instead on the traditional Asian WHOLE SOY FOODS, including tofu, tempeh, edamame, miso, soy nuts, and soymilk.**

FOOD SAFETY

- Especially important for those with weakened or impaired immune systems and while on chemotherapy
- The following recommendations have been adapted from guidelines provided by the American Cancer Society.
    - o Wash foods thoroughly before eating.
    - o Keep all aspects of food preparation meticulously clean.
    - o Use special care in handling raw meats, poultry, and eggs.
        - Thoroughly clean all utensils, countertops, cutting boards, and sponges that contacted raw meat.
        - Thaw meats and fish in the refrigerator.
    - o Transfer large volumes of leftovers, such as soup, rice, or casseroles, to shallow containers and place in refrigerator. This process ensures proper cooling.
    - o Do not eat perishable foods that have been left out of the refrigerator for more than two hours.
    - o Store foods at low temperatures (less than 40°F) to minimize bacterial growth.
    - o When eating in restaurants, avoid foods that may have bacterial contamination, including sushi, salad bars, buffets, unpasteurized beverages or food products, and raw or undercooked meat, poultry, fish, and eggs.

SUMMARY - HEALTHY BREAST CANCER DIET

- Eat 8 to10 colorful fruit and vegetable servings daily
    - o Two to three pieces of fruit
    - o One cup or more of vegetables with lunch and dinner
    - o 8 fl oz vegetable juice
- Consume 25 to 35 grams of fiber daily
    - o You will likely meet your fiber goal if you eat 8 to 10 servings of fruits and vegetables plus one serving of beans/legumes or at least two servings of whole grains daily.
- Avoid processed and refined grains/flours/sugars
    - o Keep WHITE off your plate: bread, pasta, rice, cream sauces, cakes, and more.
- Limit meats and whole milk dairy products
- Include healthy fats like cold-water fish, flaxseed, walnuts, soybeans, olive oil, avocadoes
- Eat 2 Tbsp ground flax daily
- Limit alcohol consumption
- Drink 1 to 4 cups of green tea daily
- Drink plenty of fluids, water or non-caffeinated beverages, daily to help meet fluid needs
- Engage in daily physical activity to help achieve and maintain a healthy weight

PRACTICE PRECAUTION

- Always discuss changes in diet and supplement use with your health care provider.

WORDS OF WISDOM

“Let food be your medicine and medicine be your food.”
- Hippocrates

For additional information or resources, please visit the Ida and Joseph Friend Cancer Resource Center at 1600 Divisadero St. on the first floor, or call at (415) 885-3693. The information in this publication is designed for educational purposes only and is not intended to replace the advice of your physician or health care provider, as each patient’s circumstances are individual. We encourage you to discuss with your physician any questions and concerns that you may have.

High-Fiber Sources

FRUITS:

Food	Serving Size	Fiber Grams/ Serving
Apple	1 medium	3.7
Banana	1 medium	2.8
Blackberries	1/2 cup	1.9
Blueberries	1 cup	1.3
Cantaloupe	1/2 cup	6.0
Figs (dried)	1/4 cup	6.0
Grapefruit	1 medium	3.4
Grapes	1 cup	1.6
Guava	1 medium	4.9
Kiwi	1 medium	2.6
Orange	1 medium	3.1
Pear	1 medium	4.0
Persimmon	1 medium	6.0
Prunes	1/4 cup	3.1

GRAINS & OTHER PRODUCTS:

Food	Serving Size	Fiber Grams/ Serving
Amaranth	1/4 cup dry	7.4
Barley	1/2 cup cooked	3.0
Beans, black	1/2 cup cooked	8.3
Beans, red kidney	1/2 cup cooked	8.2
Beans, garbanzo	1/2 cup cooked	5.0
Bran cereals	3/4 cup	Check labels (5.0-22.0)
Brown rice	1/2 cup cooked	1.4
Bulgur	1/2 cup cooked	4.0
Cream of wheat	1/2 cup cooked	0.5
Oatmeal	1/2 cup cooked	2.0
Peanuts	1/4 cup	2.9
Quinoa	1/4 cup dry	2.5
White rice	1/2 cup cooked	0.3

VEGETABLES:

Food	Serving Size	Fiber Grams/ Serving
Artichokes	1 medium	6.9
Beets	1/2 cup cooked	1.7
Broccoli	1/2 cup cooked	2.3
Brussel sprouts	1/2 cup cooked	2.0
Carrots	1/2 cup cooked	2.6
Kale	1/2 cup cooked	1.3
Lima beans	1/2 cup cooked	4.5
Peas, green	1/2 cup cooked	4.4
Spinach	1/2 cup cooked	2.2
Squash, winter-type	1/2 cup cooked	3.4
Sweet potatoes (yams)	1/2 cup cooked	2.7

Three Day Menu Plan: 3 Meals + Snack

This menu is based on 1600 calories, calories can be adjusted by altering portion sizes. The menu has been designed to merely serve as a guide in making healthy food choices. Experiment with substitutions as desired.

Day 1	Day 2	Day 3
Oatmeal, cooked (1 cup) Soy milk (1 cup) Flaxseed, ground (2 tbsp) Blueberries (1/2 cup) Green tea (2 cups)	Bagel, whole grain (1 med) Hummus (2 tbsp) Tomato (6 slices) Lemon pepper Cantaloupe (1 cup) Green tea (2 cups)	Tofu scramble Tofu (4 oz) Onions (1/4 cup) Peppers (1/2 cup) Mushrooms (1/2 cup) Toast, whole grain (1 slice) Jam (1 tbsp)
Turkey sandwich Whole grain bread (2 slices) Turkey (2 oz) Lettuce (1/2 cup) Tomato (4 slices) Red peppers (1/4 cup) Onions (2 tbsp) Mustard (1 tsp) Carrots (1/2 cup) Snap peas (1/2 cup)	Vegetable Bean Soup (2 cups) Corn tortilla (1 med) Green salad (2 cups) Oil/vinegar dressing (1 tbsp)	Salad Spinach (3 cups) Broccoli (1/2 cup) Carrots (1/2 cup) Tomato (1/2 cup) Garbanzo beans (1 cup) Barley, cooked (1/2 cup) Avocado (4 slices) Olive oil (1/2 tbsp) Vinegar, balsamic (1 1/2 tbsp) Roll, whole grain (1 med) Orange (1 med)
Vegetable juice (12 oz) Granola bar (1 each)	Fruit smoothie Banana (1 med) Berries (1 cup) Flaxseed, ground (2 tbsp) Yogurt, plain nonfat (1/2 cup) Soy milk (1 cup)	Green tea (2 cups) Popcorn, air-popped (3 cups)
Fish (3 oz) Pasta, whole grain (1 1/2 cups) Tomato sauce (1 cup) Mushrooms (1/2 cup) Olive oil (1/2 tbsp) Broccoli (1 cup) Mixed fruit (1 cup)	Chicken & vegetable stir-fry Chicken breast (4 oz) Mixed vegetables (2 cups) Walnuts (2 tbsp) OR Olive oil (1/2 tbsp) Brown rice, cooked (1 cup)	Salmon (4 oz) Quinoa, cooked (1 cup) Asparagus (1 cup) Fruit salad (1 cup)

Recipes

Baked Tofu

Ingredients:

- 1 pound tofu, firm, drained
- 3-4 tbsp marinade or sauce (personal favorite: Veri Veri Teriyaki by Soy Vay)

Chop drained firm tofu into 1" cubes. Place tofu cubes in glass dish for baking. Pour marinade or sauce over tofu, stir well. Place tofu in oven at 350 F for 1 hour. Stir every 15-20 minutes.

Makes four 4-ounce servings.

Nutrition Information (per 4 oz serving):

Calories: 96	Dietary fiber: <1 gm
Protein: 8 gm	Sodium: 318 mg
Fat: 5 gm	Calcium: 155 mg
Saturated fat: <1 gm	Iron: 1.4 mg

Recipe developed by **Natalie Ledesma**, **MS, RD**

Washington Insider Salad

Ingredients:

- 1 can (15 oz) kidney beans, drained
- 1 can (15 oz) black eyed peas, drained
- 1 1/2 cups cooked barley
- 6 tbsp cilantro, chopped finely
- 1 can (11 oz) corn
- 1 1/2 cups tomatoes, diced
- 3 tbsp balsamic vinegar
- 2 tbsp olive oil

Prepare vegetables. Mix all ingredients together, and serve on a bed of dark green leafy lettuce. Add salt and pepper to taste.

Makes 8 servings (1 cup each).

Nutrition Information (per serving):

Calories: 215
Protein: 10 gm
Fat: 4 gm
Dietary fiber: 9 gm

Recipe developed by Sous Chef Chris at the **Occidental Grill,** Washington D.C.

Spinach Spread

Ingredients:

- 1 package (10.5 ounces) silken tofu
- 1 tbsp lemon juice
- 1/4 tsp garlic powder
- 3/4 tsp onion powder
- 1/2 tsp dried tarragon
- 1/4 tsp salt
- 1 box (10 ounce) frozen chopped spinach, thawed
- 1 cup coarsely shredded carrots
- 1/4 cup chopped green onion

Puree the tofu and lemon juice in blender until smooth. Whirl in the garlic and onion powders, tarragon, and salt just to blend. Scrape into a mixing bowl. Squeeze the spinach as dry as possible. Stir it into the tofu, along with the carrots and green onion. Mix well. Serve with crackers, pita triangles, or vegetables.

Makes 8 servings (1/4 cup each).

Nutrition information (per serving):

Calories: 39	Sodium: 82 mg
Fat: 1 gm	Calcium: 51 mg
Saturated fat: 0 gm	Carbohydrate: 5 gm
Protein: 4 gm	Dietary Fiber: 2 gm

Recipe from the **U.S. Soyfoods Directory**, 1998.

Tofuntastico – Tofu Sauce

Ingredients:

- 1 package (12.3 ounce) silken tofu
- 1/2 cup water
- 3/4 cup fresh basil, chopped
- 4 tbsp nutritional yeast
- 3 tbsp Bragg's liquid aminos (or tamari or soy sauce)
- 1 tbsp lemon juice
- 1 tsp garlic, minced
- 3/4 tsp black pepper
- Alternative: Use lime/cilantro rather than lemon/basil

Blend all ingredients together in a blender or food processor. Serve over pasta, vegetables, baked potato, or other.

Makes 6 servings (1/2 cup each).

Nutrition Information (per serving):

Calories: 47	Carbohydrate: 4 gm
Protein: 7 gm	Dietary fiber: 2 gm
Fat: <1 gm	

Recipe developed by **Natalie Ledesma, MS, RD**

Alaska Salmon Bake with Walnut Crunch Coating

Ingredients:

- 1 pound salmon fillets, thawed if necessary
- 2 tbsp Dijon-style mustard
- 1-2 tbsp olive oil
- 4 tsp honey
- 1/4 cup bread crumbs
- 1/4 cup walnuts, finely chopped
- 2 tsp parsley, chopped
- Salt and pepper to taste
- Lemon wedges

Mix together mustard, olive oil, and honey in a small bowl; set aside. Mix together bread crumbs, walnuts, and parsley in a small bowl; set aside. Season each salmon fillet with salt and pepper. Place on a lightly greased baking sheet or broiling pan. Brush each fillet with mustard-honey mixture. Pat top of each fillet with bread crumb mixture. Bake at 450 F for 10 minutes per inch of thickness or until salmon just flakes when tested with a fork. Serve with lemon wedges.

Makes 4 servings (4 oz each).

Nutrition Information (per serving):

Calories: 228
Protein: 20 gm
Fat: 12 gm
Omega-3 fatty acids: 1.7 gm

Adapted from **Alaska Seafood Marketing Institute.**

Banana Bread

Ingredients:

- 3/4 cup ground flax seed
- 1 cup mashed banana
- 1/4 cup apple juice concentrate
- 1/2 cup brown sugar

- 1/4 cup applesauce
- Egg replacer for 2 eggs or 2 eggs (Ener-G Egg Replacer is made from potato starch & tapioca flour; works wonderfully in baked goods.)
- 1 1/2 cup whole wheat pastry flour
- 1 tsp baking soda
- 1/2 tsp salt
- Additional optional ingredients may include 1/2 cup walnuts, raisins, or chocolate chips.

Mix all ingredients together. Pour in a coated 8"x4" pan. Bake at 350 F for about 40-45 minutes.

Makes 10 servings.

Nutrition Information (per serving):

Calories: 168	Carbohydrate: 29 gm
Protein: 5 gm	Dietary fiber: 5 gm
Fat: 4 gm	Omega-3 fatty acids: 1.4 gm

Recipe developed by **Natalie Ledesma, MS, RD**

Dilled Salmon Salad with Peas

Ingredients:

- 1 can (15 oz) salmon, drained
- 1 package (16 oz) frozen peas, thawed
- 1/4 cup lemon juice
- 1/4 cup fresh dill (or 1-2 tbsp dried dill)
- 2 tbsp Dijon-style mustard
- 2 shallots, sliced thinly (about 1/2 cup)
- 1 bunch radishes (about 11 medium), thinly sliced
- 6 cups red leaf lettuce
- Salt and pepper to taste

Drain salmon, place in a mixing bowl, and break into pieces. Prepare the lemon juice, shallots, radishes, and lettuce. Add to the salmon the peas, lemon juice, dill, mustard, shallots, and radishes. Mix together gently. Add salt and pepper to taste. Serve salmon mixture over lettuce.

Makes 6 servings (2 cups each).

Nutrition Information (per serving):

Calories: 160
Protein: 17 gm
Fat: 4 gm
Dietary fiber: 5 gm

Adapted from the **Women's Healthy Eating & Living Study (WHEL)** at the University of California, San Diego. Developed by **Vicky Newman, MS, RD, WHEL** nutrition coordinator.

Neat Loaf

Ingredients:

- 2 cups cooked brown rice
- 1 cup walnuts, finely chopped
- 1 onion, finely chopped
- 1/2 medium bell pepper, finely chopped
- 2 medium carrots, shredded or finely chopped
- 1 cup wheat germ
- 1 cup quick-cooking rolled oats
- 1/2 tsp each: thyme, marjoram, sage
- 2 tbsp soy sauce
- 2 tbsp stone ground or Dijon mustard
- Barbecue sauce or ketchup

Preheat the oven to 350 F. Combine all the ingredients except the barbecue sauce or ketchup. Mix for 2 minutes with a large spoon. This will help bind it together. Pat into an oil-sprayed 5x9" load pan and top with barbecue sauce or ketchup. Bake for 60 minutes. Let stand 10 minutes before serving.

Makes 8-10 servings.

Nutrition Information (per serving):

Calories: 204	Sodium: 248 mg
Protein: 9 gm	Cholesterol: 0 mg
Fat: 9 gm	
Carbohydrate: 19 gm	

Recipe from **The Peaceful Palate** written by **Jennifer Raymond** (1996).

Chinese Cabbage and Radish Salad

Ingredients:

- 4 cups Chinese cabbage, quartered and then thinly sliced
- 1/4 cup radishes
- 1/4 cup red onion, thinly sliced
- 2 tbsp white miso
- 2 tbsp brown rice vinegar
- 1 tsp maple syrup
- 1 tsp dill, dried
- 2 tbsp sunflower seeds, toasted

With a fork, mix the miso, vinegar, maple syrup, and dill. Mix the vegetables and press with a plate until

submerged in liquid for about 1 hour. Fluff the vegetables to serve and garnish with sunflower seeds.

Makes 4 servings.

Nutrition Information (per serving):

Calories: 64	Carbohydrate: 9 gm
Protein: 2 gm	Cholesterol: 0 mg
Fat: 2 gm	Sodium: 275 mg

Source **anonymous.**

Quinoa/Sweet Potato Patties

Ingredients:

- 1 1/2 cups sweet potato, peeled and chopped
- 1 cup quinoa
- 2 tbsp parsley, fresh
- 1/2 tsp sea salt
- 2 tsp extra-virgin olive oil

Steam or bake sweet potatoes until done. Drain and mash potatoes. Wash the quinoa well and drain. Dry toast the quinoa in a skillet until slightly browned. Meanwhile, bring a pot of water to a boil. Add the toasted quinoa to the boiling water and cook, with lid off, for ~15 minutes. Drain well. Mix the mashed potatoes and quinoa. Add the parsley and salt. Form 8 patties and place in a lightly oiled pan over medium-high heat. Cook for about 5 minutes on each side and serve warm.

Makes 8 servings.

Nutrition Information (per serving):

Calories: 125	Sodium: 165 mg
Protein: 4 gm	Cholesterol: 0 mg
Fat: 2 gm	
Carbohydrate: 22 gm	

Recipe adapted from the **Vegetarian Resource Group** (1997).

Nutrition Resources

Books

How to Prevent & Treat Cancer with Natural Medicine – written by Michael Murray (2002)

The Color Code – written by James Joseph, Daniel Nadeau, & Anne Underwood (2002)

Cookbooks

Cancer Lifeline Cookbook - written by Kimberly Mathai & Ginny Smith (2004)

Fat-Free and Easy: Great Meals in Minutes – written by Jennifer Raymond (vegetarian cookbook) (1997)

Lickety-Split Meals – written by Zonya Foco (1998)

One Bite at a Time – written by Rebecca Katz, Marsha Tomassi, & Mat Edelson (2004)

The Peaceful Palate – written by Jennifer Raymond (vegetarian cookbook) (1996)

12 Best Foods Cookbook: Over 200 Recipes Featuring the 12 Healthiest Foods – written by Dana Jacobi (2005)

Newsletters/Magazines

Cooking Light www.cookinglight.com Fax: (205) 445-6600

Environmental Nutrition http://www.environmentalnutrition.com (800) 829-5384

Nutrition Action Health Letter http://www.cspinet.org/nah/ Fax: (202) 265-4954

Websites

American Cancer Society http://www.cancer.org (415) 394-7100

American Institute for Cancer Research http://www.aicr.org (800) 843-8114

Cancer Nutrition Info - Provides up-to-date & comprehensive information on the connection between nutrition & cancer – http://www.cancernutritioninfo.com

Center for Informed Food Choices - Offer cooking classes in the Bay Area that emphasize plant-based foods. http://www.informedeating.org

Consumer Lab - Evaluates quality of over-the-counter supplements http://www.consumerlab.com

Diana Dyer, MS, RD – Breast cancer survivor & dietitian http://www.cancerrd.com

Ida & Joseph Friend Cancer Resource Center – UCSF Mt.Zion http://cc.ucsf.edu/crc (415) 885-3693

National Cancer Institute http://www.nci.nih.gov/ (800) 4-CANCER (800-422-6237)

Oncolink – Provides information regarding clinical trials, newsgroups, psychosocial support, & more. http://oncolink.upenn.edu

San Francisco Vegetarian Society – Monthly restaurant outings & pot-luck dinners; call 415-273-5481. http://www.sfvs.org

The Vegetarian Resource Group - Provides vegetarian nutrition information & vegetarian recipes http://www.vrg.org

WebMD http://my.webmd.com

Glossary

Angiogenesis – The formation of new blood vessels.

Antioxidant – A substance that inhibits oxidation or inhibits reactions promoted by oxygen or peroxides.

Apoptosis – Programmed cell death.

Carcinogenesis – Beginning of cancer development.

Case-Control Studies – An epidemiological study in which a group of, say, cancer patients (cases) is compared to a similar but cancer-free population (controls) to help establish whether the past or recent history of a specific exposure such as smoking, alcohol consumption and dietary intake, etc. are causally related the risk of disease.

Catechin – One of the tannic acids; phytonutrient, specifically, one of the flavonoids found in green tea.

Creatine – An amino acid that is formed in the muscle tissue of vertebrates; supplies energy for muscle contraction.

Cohort Studies – Follow-up study of a (usually large) group of people, initially disease-free. Differences in disease incidence within the cohort are calculated in relation to different levels of exposure to specific factors, such as smoking, alcohol consumption, diet and exercise, that were measured at the start of the study and, sometimes, at later times during the study.

Eicosanoids – Biologically active compounds that regulate blood pressure, blood clotting, and other body functions. They include prostaglandins, thromboxanes, and leukotrienes.

Endogenous – Originating from within, as within the body.

Estradiol – A naturally occurring powerful estrogen secreted by the mammalian ovary.

Estrone – A naturally occurring weak estrogen secreted by the mammalian ovary.

Glutathione – A polypeptide produced primarily in the liver; involved in DNA synthesis and repair, protein and prostaglandin synthesis, amino acid transport, metabolism of toxins and carcinogens, immune system function, prevention of oxidative cell damage, and enzyme activation.

Insulin - Insulin is a hormone produced by the pancreas in the body that regulates the metabolism of carbohydrates and fats, especially the conversion of glucose to glycogen, which lowers the body's blood sugar level.

Lignans - Phytoestrogens that have a similar chemical structure to estradiol and tamoxifen; appear to offer protection against breast cancer.

Meta-analysis – The process of using statistical methods to combine the results of different studies.

Mutation – Abnormal cell development.

Nitrosamines – Derivatives of nitrites that may be formed in the stomach when nitrites combine with amines; carcinogenic in animals.

Phytonutrients – Plant compounds that appear to have health-protecting properties.

Polyphenols – Phytonutrients that act as an antioxidant; compounds that protects the cells and body chemicals against damage caused by free radicals, reactive atoms that contribute to tissue damage in the body.

Retinoids – Chemically related compounds with biological activity similar to that of retinol; related to vitamin A.

Sex hormone-binding globulin (SHBG) – A protein in the blood that acts as a carrier for androgens and estradiol; inhibits the estradiol-induced proliferation of breast cancer cells.

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