

# Eat Right to Fight Cancer

## Tomatoes

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### Introduction

Tomatoes can be found in the majority of home gardens in the U.S., and food consumption surveys rank them second on the list of Americans' favorite vegetables, right after potatoes. Tomatoes are a key ingredient in many popular dishes, adding flavor and texture to salads, soups, sauces, pizza, casseroles, and tacos (among other foods). With a wide range of health promoting compounds including vitamin C, potassium, and the phytochemical lycopene, tomatoes offer many health benefits, including the potential to help prevent cancer.

### Tomatoes Through Time

The tomato (*Lycopersicon esculentum*) was considered poisonous during colonial times because it is a member of the Nightshade family, but over the past two centuries has become widely popular in the U.S. The Indians of Mexico called them *tomati*, but over time the name evolved to tomato (1). In the 16th century, the tomato made its way to Europe by way of Italy, where it was embraced in a variety of dishes. As tomatoes began traveling the globe, they became an important element in dishes as diverse as Indian curries, Italian pasta sauces, and Mexican burritos. Botanically identified as a fruit, tomatoes are considered a vegetable by the U.S. Department of Agriculture (USDA) (2). With the advent of food preservation techniques, canning tomatoes for use throughout the winter months became an important and economical way to enjoy tomato products. Today, about 75 percent of the total tomato crop is processed into juice, canned tomatoes, sauces, pastes, and catsup. (3)

Tomatoes are a classic example of a nutrient rich food. They provide a wide variety of nutrients and phytochemicals yet are low in calories. Table 1 summarizes the energy, macronutrient, and micronutrient content of the tomato (4).

Daily Values provide a basis to compare nutritional content of various foods. Foods providing 20% or more of the DV are considered to be high sources of a nutrient. Foods providing less than 5% are low in that nutrient (5), but can still provide a valuable contribution to a healthy diet.

### Star Compounds in Tomatoes

Tomato products contain a symphony of nutrients that provide health benefits. They are naturally rich in vitamin C, vitamin A (as provitamin A carotenoids), fiber, potassium and carotenoids without provitamin A

**Table 1. Energy, Macronutrient, and Micronutrient Analysis of the Tomato (4)**

Nutrient	Year round Average Nutrition Content of 1 medium red, ripe tomato (2 3/5 inches in diameter)	Percent Daily Value
Calories	22	0.01
Total Fat	0.25 grams (g)	0.00
Total Carbohydrate	4.78 grams (g)	0.02
Protein	1.08 grams (g)	0.02
Cholesterol	0	0.00
Saturated Fat	0.034 grams (g)	0.00
Dietary Fiber	1.5 grams (g)	0.06
Sugars	3.23 grams (from dextrose and fructose only) (g)	n/a*
Vitamin A	1,025 International Units and 52 micrograms retinol activity equivalents (RAE)	0.20
Vitamin C	16.9 milligrams (mg)	0.28
Vitamin D	0	0.00
Vitamin E (alpha-tocopherol)	0.66 milligrams (mg)	2.20
Vitamin B6	0.098 milligrams (mg)	0.05
Calcium	12 milligrams (mg)	1.20
Iron	0.33 milligrams (mg)	1.80
Folate	10 micrograms (mcg)	2.50
Potassium	292 milligrams (mg)	8.30
Selenium	0	0.00
Zinc	0.21 milligrams (mg)	1.40

\*n/a = not applicable

activity. The most abundant carotenoid in tomato products is lycopene, followed by phytoene, phytofluene, zeta-carotene, gamma-carotene, beta-carotene, zeaxanthin, and lutein. Of these, lycopene, other carotenoids, vitamin C, and fiber are most associated with cancer prevention.

Tomato products account for more than 80 percent of the lycopene in the American diet, and processed tomato products are particularly concentrated sources. Depending upon the variety of the tomato, lycopene concentrations in fresh tomatoes range from approximately 0.9 to 4.2 mg/100 grams while concentrations in tomato sauce and ketchup range from 33 to 68 mg/100 g (6). An Ohio State University study found that a single daily serving of processed tomato products will significantly increase lycopene concentrations in blood and buccal mucosal cells in healthy adults (7). Furthermore, lycopene from processed tomatoes versus fresh tomatoes is more bioavailable because processing breaks down the tomato cell matrix, resulting in greater absorption of lycopene (8).

Lycopene is the pigment responsible for the deep red color of ripe tomatoes. Its antioxidant properties are primarily credited with lycopene's cancer-preventive potential, but lycopene is also believed to slow angiogenesis, which is the expansion of circulatory vessels required by growing tumors. Lycopene may also promote apoptosis (i.e. death) of cancer cells and help regulate cell cycles, thus allowing cells to control their rates of proliferation (6). Studies have examined lycopene's ability to prevent or possibly treat prostate, breast, skin, colon, stomach, liver, ovarian, pancreatic, esophageal, and head & neck cancer (9). Table 2 summarizes the variety of phytonutrients found in tomatoes (4)

### Tomato Products Take on Cancer

Tomatoes provide a number of nutrients and compounds linked to cancer protection. The majority of the evidence for their cancer protection is based on observational studies of populations. Britt Burton-Freeman, Ph.D., Director, National Center for

**Table 2. Phytonutrients in Tomatoes (4)**

Phytonutrient	Year-round Average Nutrition Content of 1 medium red, ripe tomato (2 3/5 inches in diameter)	Year-round Average Nutrition Content of 1 cup tomatoes, red, ripe, canned, stewed
Beta-Carotene	552 mcg	263 mcg
Alpha-Carotene	124 mcg	0
Beta-Cryptoxanthin	0	0
Lycopene	3,165 mcg	10,424 mcg
Lutein & Zeaxanthin	151 mcg	321 mcg
Beta Tocopherol	0.01 mg	0.00 mg
Gamma Tocopherol	0.15 mg	0.51 mg
Delta Tocopherol	0	0.00 mg

\*USDA National Nutrient Database for Standard Reference, Release 23

Food Safety & Technology, Illinois Institute of Technology, reviewed 178 original research articles reporting findings on the relationship between lycopene, tomatoes and tomato-based products and cancer risk in humans. For breast, colorectal and gastric cancers, the research supported a neutral, yet potentially protective relationship between tomato products and lycopene intake and cancer risk. While the research results were limited for gastric and lung cancers, the cancer protective association was strongest for tomato intake over dietary lycopene intake (10).

### Tomatoes and Prostate Cancer

Tomatoes have attracted particular attention from prostate cancer researchers because lycopene and its related compounds tend to concentrate in tissues of the prostate. The second expert report of the American Institute for Cancer Research (AICR), *Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective*, found substantial and convincing evidence that foods containing lycopene probably protect against prostate cancer (11). Evidence supporting this comes from observational, laboratory, and animal studies. In the laboratory, cell studies suggest that tomato components have the ability to stop proliferation of several cancer cell types, including breast, prostate, lung, and endometrial. In animal models, consumption of tomato compounds has

been linked to decreases in prostate cancer risk. Moreover, there is evidence that this cancer-fighting potential is increased if tomatoes are consumed in a processed form that allows these natural compounds to be released and more easily absorbed, such as tomato sauce, tomato paste or tomato juice.

To confirm findings linking greater intake of tomato products with a lower risk of prostate cancer, Edward Giovannucci, M.D., Sc.D., and colleagues from Brigham and Women's Hospital and the Harvard School of Public Health analyzed tomato-product-consumption patterns and prostate cancer cases among roughly 47,400 men enrolled in the Health Professionals Follow-Up Study (12). This epidemiological study found an inverse association between intake of tomato sauce and risk of prostate cancer (12). The researchers found that the consumption of tomato sauce was associated with a reduced risk of prostate cancer among men of Southern European descent (who typically have tomato-rich diets), and among men of Caucasian ancestry. The authors concluded that frequent intake of tomato products is associated with a reduced risk of prostate cancer. They also noted, however, that it remains to be seen whether lycopene is the key compound in reducing prostate cancer risk.

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A small number of intervention trials focusing on tomato products have been performed with positive results measuring improvements in prostate specific antigen concentrations (13–16) and increased cell death in carcinomas (17). In addition, researchers from Montreal conducted a meta-analysis that included 11 case-control studies and 10 cohort studies or nested case-control studies on the intake of tomato, tomato products, or lycopene. Compared with infrequent intake of tomato products, those consuming large amounts of raw tomatoes had an 11 percent reduced risk of prostate cancer while those with a high intake of cooked tomato products experienced a 19 percent reduced risk (18).

Although the evidence suggests it is likely that foods containing lycopene, including tomatoes, offer cancer protection, AICR stresses the importance of eating a variety of plant foods to ensure the most protection against cancer development. No food in isolation can effectively lower cancer risk.

### Tips to Incorporate More Tomato Products into the Diet

Consuming more tomato products may be an easy, nutritious way to build up one's cancer defense. Tomato products are shelf-stable, economical, convenient, delicious, and a key element in many popular dishes. Canned tomatoes, tomato paste, salsa, tomato juice, and tomato soup can be used in lasagna, enchiladas, rice dishes, chicken cacciatore, tacos, pizzas, pasta dishes, meatloaf, curries, stews, soups, and many other recipes. Recipes for most tomato based foods can be adapted to meet specific nutritional needs, including heart healthy and lower calorie versions. For those with a compromised appetite, high energy and high protein recipes can be developed. To learn more about cooking tips and recipes featuring tomato products, visit [www.tomatowellness.com](http://www.tomatowellness.com).

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## NCCAM Time to Talk Campaign

NCCAM's Time to Talk campaign encourages patients to tell their providers about CAM use and providers to ask about it by offering tools and resources—such as wallet cards, posters, and tip sheets—all of which are available for free at <http://nccam.nih.gov/timetotalk/>.