

# The Role of Tomato Products for Human Health (*Solanum lycopersicum*)- A Review

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## Abstract

Tomato (*Solanum lycopersicum*) is most popular vegetable edible fruit. Tomato plants are dicots and grow as a series of branching stems, with a terminal bud at the tip that does the actual growing. The fruit is rich in lycopene which may have beneficial health effects. Carotenoid lycopene may be involved in cancer prevention, reducing the risk of cardiovascular disease, and limiting the mortality of other chronic diseases. The main objective of this paper is **to review the medicinal role of tomato, in addition its nutritional and economical value**. It is a fruit of good nutritive value as it is fairly rich in vitamins, and other minerals like calcium, phosphorus and iron. Considering its low cost, it qualifies for inclusion in the daily diet of young and growing children. Lycopene has also been shown to improve the skin's ability to protect against harmful UV rays. People use fresh juice extract to stop excessive bleeding from wounds. The antioxidant function of lycopene-its ability to help protect cells and other structures in the body from oxygen damage-has been linked in human research to the protection of DNA inside of white blood cells. Prevention of heart disease has been shown to be another antioxidant role played by lycopene against a growing list of cancers. A high dietary intake of tomato products significantly reduced total and LDL cholesterol levels. The serum concentration of lycopene was significantly diminished in patients with bronchial asthma as compared with healthy individuals. At the present time, definitive conclusions and recommendations remain controversial. However, ongoing research will continue to provide data regarding these relationships. At the present time, it is reasonable to recommend to the public that a diet rich in fruit and vegetables may contribute to a lower risk of many cancers. The research findings on various aspects of the role of tomato Products for Human Health are reviewed.

**Keywords:** Tomato, Carotenoid, Lycopene, Antioxidant, Prostate cancer

## 1. Introduction

The tomato is a savory, typically red, edible fruit, as well as the plant (*Solanum lycopersicum*) which bears it. Tomato plants are dicots and grow as a series of branching stems, with a terminal bud at the tip that does the actual growing. When that tip eventually stops growing, whether because of pruning or flowering, lateral buds take over and grow into other, fully functional, vines (Peet & Mary, 2008).

The tomato fruit is consumed in diverse ways, including raw, as an ingredient in many dishes and sauces, and in drinks. While it is botanically a fruit, it is considered a vegetable for culinary purposes (as well as by the United States Supreme Court, see *Nix v. Hedden*), which has caused some confusion. The fruit is rich in lycopene, which may have beneficial health effects. The tomato belongs to the nightshade family. The plants typically grow to 1–3 meters (3–10 ft) in height and have a weak stem that often sprawls over the ground and vines over other plants. It is a perennial in its native habitat, although often grown outdoors in temperate climate as annual (M.Ganesan *et al.*, 2012)

Tomato (*Lycopersicon esculentum*) is a warm-season crop with origins in elevated regions of Peru and Ecuador. A member of the Solanaceae family, tomato is the second most produced vegetable in the U.S., behind potato. Domestic production is year-round, although winter and spring imports from Mexico are having an increased impact. Cultivated tomatoes vary in size from tom berries, about 5mm in diameter, through cherry tomatoes, about the same 1–2 centimeters (cm) size as the wild tomato, up to beefsteak tomatoes 10 cm or more in diameter. The most widely grown commercial tomatoes tend to be in the 5–6 cm diameter range. Most cultivars produce red fruit; but a number of cultivars with yellow, orange, pink, purple, green, black, or white fruit are also available. Multicolored and striped fruit can also be quite striking. Tomatoes grown for canning and sauces are often elongated, 7–9 cm long and 4–5 cm diameter; they are known as plum tomatoes, and have a lower water content. Roma-type tomatoes are important cultivars in the Sacramento Valley (Arthur, 2009).

About 130 million tons of tomatoes were produced in the world in 2008. China, the largest producer, accounted for about one quarter of the global output, followed by United States and Turkey. For one variety, known as plum or processing tomatoes, California accounts for 90% of U.S. production and 35% of world production (Hartz *et al.*, 2010). According to Faostat (2015) the top producers of tomatoes (in metric tonnes) in 2008 (Table 1).

**Table 1:-** The Top 5 Tomato Producing Countries

Country	Tomato Production (metric tonnes)	% of World Total
China	50,552,200 m/t	6.82%
India	18,227,000 m/t	2.46%
United States	12,574,550 m/t	1.69%
Turkey	11,820,000 m/t	1.59%
Egypt	8,533,803 m/t	1.15%
World Total	129 649 883	

**Source:** FAOSTAT (2015)

Tomato has Lycopene; a member of carotenoid family; is a lipid soluble antioxidant synthesized by many plants and microorganisms but not by animals and humans and where it serves as an accessory light-gathering pigment and protects them against the toxic effects of oxygen and light (Komal *et al.*, 2011). The main objective of this paper is to review the medicinal role of tomato, in addition its nutritional and economical value.

## 2. Nutritional value

Tomatoes are now eaten freely throughout the world, and their consumption is believed to benefit the heart among other organs. They contain lycopene, one of the most powerful natural antioxidants. In some studies lycopene, especially in cooked tomatoes, has been found to help prevent prostate cancer and has also improve the skin's ability to protect against harmful UV rays (World Cancer Research Fund, 2007)

Tomato (*Lycopersicon esculentum* Mill.) is termed as "the most popular vegetable fruit". Tomato is cooked as vegetable alone or in combination with potato besides eaten raw when ripe. It is a fruit of good nutritive value as it is fairly rich in vitamins (vitamin C), and other minerals like calcium, phosphorus and iron. Considering its low cost, it qualifies for inclusion in the daily diet of young and growing children (Stahl, 2011).

Prostate cancer is the most common cancer among men in North America. A growing body of evidence has shown that tomato products may decrease the risk of prostate cancer. This is thought to be due to a high concentration of lycopene, a potent antioxidant. As a result, intake of lycopene supplements has become popular among men who are concerned about their risk of prostate cancer. Although some observational studies have shown a protective effect (Tzonou *et al.*, 1999) with the use of tomato products, others have failed to show this benefit (Cohen *et al.*, 2000).

## 3. Medicinal value

Traditionally different plant parts of the tomato as well as juice and extract are being used orally, externally and internally to treat several health related problems in several countries. Literature review suggests use of fresh fruit juice to induce vomiting in children in case of food poisoning in Fiji. Here, people use fresh juice extract to stop excessive bleeding from wounds. Likewise, it is used externally in Greece to treat furuncles. In Italy, it is used to cure scorpion and other insect bites. Here, people use tomato fruit as a caustic. Fresh tomato fruit is used for different purposes in several other countries. In Mexico, it is used externally as febrifuge whereas in Philippines, the fresh fruit is used to treat edema by pregnant women. Fresh fruit is used by Americans orally for kidney and liver problems, as a cathartic and also to keep good digestion (Singh, 2010).

**Table 2:** – Vitamin source found in and benefits of Tomatoes

Vitamin	Health Benefits
Vitamin A & Carotenoids Good source of antioxidant	Important to vision, bone growth, reproduction & cell function, promotes healthy surface lining of eyes, respiratory, urinary & intestinal tract
Vitamin C & Bioflavonoids Good source of antioxidant	Strengthens immune system, bones, teeth, capillaries, required for growth & repair of body tissues, essential for healing wounds, and repair cartilage, strengthen and protect & other connective tissues, anti-inflammatory & antiviral
Vitamin E, good source of antioxidant	lights free radicals – unbalanced molecules that can cause damage to your cells. F cell or healthy condition of your skin.
B Complex Vitamins (B1, B2, B3, B6, & B9)	Helps metabolise food and blood cells to form and flow, used to lower blood cholesterol, essential to tissue growth Helps neurological health

**Source:** George Mateljan Foundation (2010).

### 3.1. Antioxidant benefits of lycopene

According to Sharon (2009) research suggests that lycopene obtained through high consumption of tomato products provides a protective effect against the risk of colorectal cancers and may help reduce the risk of pancreatic cancer. In the area of food and phytonutrient research, nothing has been hotter in the last several years than studies on the *lycopene* in tomatoes. This carotenoid found in tomatoes (and everything made from them)

has been extensively studied for its antioxidant and cancer-preventing properties. The antioxidant function of *lycopene*-its ability to help protect cells and other structures in the body from oxygen damage-has been linked in human research to the protection of DNA (our genetic material) inside of white blood cells. Prevention of heart disease has been shown to be another antioxidant role played by *lycopene* against a growing list of cancers. These cancers now include colorectal, prostate, breast, In contrast to many other food phytonutrients, whose effects have only been studied in animals, *lycopene* from tomatoes has been repeatedly studied in humans and found to be protective endometrial, lung, and pancreatic cancers. While lycopene may play an important role in tomatoes' health benefits, it seems that it is not the only nutritional star integral for giving this food a red-hot reputation for health promotion; recent research discussed below in the section "Protection Due to Synergy of Tomato's Nutrients, Not Just Lycopene" describes how scientists are finding out that it is the array of nutrients included in tomatoes, including, but not limited to lycopene, that confers it with so much health value. All the while, it's still important to understand the many benefits that lycopene provides (George Mateljan, 2010).

### 3.2. Role in cholesterol reduction

A high dietary intake of tomato products significantly reduced total and LDL cholesterol levels, while also increasing LDL's resistance to oxidation (damage by free radicals) in a study involving 21 healthy subjects published in the *British Journal of Nutrition*. (Study volunteers followed a diet free of tomato products for 3 weeks, followed by a high tomato diet 13.5 ounces tomato juice and 1 ounce tomato ketchup daily). At the end of the high tomato diet period, study participants' total cholesterol levels had dropped an average of 5.9%, with LDL cholesterol levels reduced by 12.9%. Blood samples also showed increases in lycopene, beta-carotene and gamma-carotene-antioxidant carotenoids found in tomatoes-plus a 13% increase in the ability of circulating LDL cholesterol to resist oxidation (Silaste *et al.*, 2007)

In a study published in the *British Journal of Nutrition*, 21 healthy subjects followed a diet free of tomato products for 3 weeks, followed by a high tomato diet (1 ounce ketchup and 13.5 ounces tomato juice daily). At the end of the high tomato diet period, the subjects' total cholesterol levels had dropped an average of 5.9%, with LDL (bad) cholesterol reduced by 12.9%. Blood samples also showed an increase in lycopene, beta-carotene and other carotenoids, as well as 13% increase in the ability of LDL cholesterol to resist oxidation. (Silaste *et al.*, 2007).

### 3.3. Promote prostate health

As Etminan *et al.*,(2004) A meta-analysis of 21 studies published in *Cancer Epidemiology Biomarkers and Prevention* confirms that eating tomatoes, especially cooked tomatoes, provides protection against prostate cancer. Meta-analyses are considered the gold standard in medical research since, by combining the results of numerous studies, they integrate the results that occurred in different settings and include a much larger group of people, so they are thought to provide a more accurate assessment. When the data from all 21 studies was combined, men who ate the highest amounts of raw tomatoes were found to have an 11% reduction in risk for prostate cancer. Those eating the most cooked tomato products fared even better with a 19% reduction in prostate cancer risk. Even eating just one 6-ounce serving a day of raw tomato provided some benefit-a reduction in prostate cancer risk of 3% (National Cancer Institute Initiative, 2006).

Tomato and tomato products have been the focus of intense investigation in recent years, especially in relation to prostate cancer (Stacewicz-Sapuntzakis & Bowen, 2005). As Giovannucci (1999) reviewed the epidemiological literature on the relationship between intake of tomatoes and tomato-based products and plasma levels of lycopene and risks of various cancers. Among 72 studies identified, 57 reported inverse associations between tomato intake or blood lycopene level and the risk of cancer at defined anatomical sites, and 35 of these inverse associations were statistically significant. No study indicated that higher tomato consumption or blood lycopene level increased the risk of cancer at any of the sites investigated. Evidence for a benefit was strongest for cancers of the lung, stomach and prostate gland.

**Table 3:-** Prostate cancer risk associated with tertiles of intake of selected foods and food groups by ethnicity

Food item or group	OR (95% CI) <sup>b</sup>							
	African-Americans (505 cases/519 controls)				Whites (510 cases/501 controls)			
	1 (10w)	2	3 (high)	P for trend	1 (10w)	2	3 (high)	P for trend
Yellow-orange vegetables	1.0	0.76 (0.55–1.05)	0.91 (0.66–1.26)	0.88	1.00	0.73 (0.53–1.00)	0.90 (0.66–1.22)	0.85
Cruciferous vegetables	1.0	1.09 (0.82–1.46)	0.90 (0.65–1.24)	0.41	1.00	0.92 (0.69–1.23)	1.17(0.83–.63)	0.31
Corn	1.0	0.93 (0.68–1.28)	0.92 (0.67–1.26)	0.67	1.00	0.78 (0.56–1.08)	0.72 (0.52–1.00)	0.10
carrot	1.0	0.92 (0.68–1.25)	0.77 (0.56–1.06)	0.11	1.00	0.73 (0.52–1.03)	0.87(0.63–.20)	0.89
<b>Tomato(cooked)</b>	<b>1.0</b>	<b>0.93 (0.68–1.27)</b>	<b>0.72 (0.41–1.26)</b>	<b>0.25</b>	<b>1.00</b>	<b>1.07 (0.80–1.44)</b>	<b>0.90(0.54–.51)</b>	<b>0.83</b>
soyfoods	1.0	0.85 <sup>c</sup> (0.60–1.21)		0.37	1.00	0.75 (0.56–1.02)	0.77(0.45–.30)	0.52
legumes(w/soyab)	1.0	0.71 (0.49–1.03)	0.58 (0.40–0.84)	0.01	1.00	0.97 (0.70–1.35)	0.97 (0.69–1.36)	0.91
All legumes	1.0	0.78 (0.58–1.06)	0.65 (0.47–0.92)	0.02	1.00	1.03 (0.76–1.38)	0.90 (0.64–1.26)	0.52

**Source:** Laurence *et al.*, (2000)

*a* Based on all cases and all controls. *b* Adjusted for age, education, geographic area, and calories.

*c* Consumption too low for tertiles. ORs and *P* based on intake above *versus* below the median

### 3.4. Reduction in heart disease risk

More good news for those at risk of atherosclerosis, or just trying to avoid it, is that tomatoes are a very good source of potassium and a good source of niacin, vitamin B6, and folate. Diets rich in potassium have been shown to lower high blood pressure and reduce the risk of heart disease (Sanjiv A and Rao AV, 2000).

These nutrients work together to make tomatoes a truly heart-healthy food. In a cup of tomato, you'll get 11.4% of the daily value for potassium, 5.6% of the DV for niacin, and 7.0% of the DV for B6, and 6.8% of the DV for folate. The lycopene in tomatoes may also provide cardiovascular benefits. Research conducted at Brigham and Women's Hospital, Boston, MA, suggests that in addition to its inverse association with various cancers, a high dietary consumption of lycopene may play a role in cardiovascular disease prevention.

The researchers tracked close to 40,000 middle-aged and older women who were free of both cardiovascular disease and cancer when the study began. During more than 7 years of follow-up, those who consumed 7 to 10 servings each week of lycopene-rich foods (tomato-based products, including tomatoes, tomato juice, tomato sauce and pizza) were found to have a 29% lower risk of cardiovascular disease compared to women eating less than 1.5 servings of tomato products weekly. Women who ate more than 2 servings each week of oil-based tomato products, particularly tomato sauce and pizza, had an even better result—a 34% lower risk of CVD.

Tomatoes and Broccoli Team Up to Fight Prostate Cancer With further regard to cardiac health, recent (2009) research from Cambridge University in the U.K., indicated that supplemental lycopene derived from Tomato can reduce the oxidation of harmful fats in the blood to almost zero within eight weeks, and a natural supplement made from Tomatoes, taken daily, may stave off heart disease and strokes.

### 3.5. Role in liver health

Natural chlorine helps to stimulate the liver. It assists liver in its task as an important filter for body wastes. Tomato also assists the liver in removing the toxic waste products from the system. Sulphur helps to protect the liver from cirrhosis and other debilitating conditions. Drinking fresh tomato juice can help to regenerate the damaged, destroyed or surgically removed liver (International Cyber Business Services, 2000).

Russian doctors prescribe tomatoes in the diets of factory workers exposed to toxic chemical. Tomatoes are useful detoxifiers because of the presence of chlorine and sulphur, two very important detoxifying trace elements. 100 grams of uncooked tomato contains 51 mg. of chlorine and 11 mg. of sulphur.

Tomato is also believed to stimulate the liver in its function as a filter for body wastes and to help remove toxic waste products from the system. In the old Soviet Union, doctors often prescribed Tomato to factory workers who were exposed to toxic chemical occupational environments. It is thought that the reason was due to the fact that Tomatoes contain two very important detoxifying trace elements, i.e., chlorine and sulfur. Natural chlorine is said to help stimulate liver function, and the sulfur is said to protect the liver from cirrhosis and other liver problems (<http://www.holisticonline.com>). Liver has larger amount of lycopene (M. Ganesan *et al.*, 2012) and distribution of lycopene in various body organs and tissues are listed in Table.4.

Table 4: Distribution of Lycopene in Various Body Organs and Tissues

Tissue	nmol/g wet weight
Live	1.28–5.72
Kidney	0.15–0.62
Adrenal	1.9–21.6
Testes	4.34–21.4
Ovary	0.25–0.28
Adipose	0.2–1.3
Lung	0.22–0.57
Colon	0.31
Breast	0.78
Skin	0.42

Source –M.Ganesan *et al.*(2012)

### 3.6. Human vision and tissues

Vitamin A present in tomato helps to improve the vision and help to prevent the development of night blindness (M.Ganesan *et al.*,2012)

The parts of blood Platelets responsible for the preservation or damage of healthy blood vessels, as in the case of diabetes, platelets stick to the lining of the vessel wall, which, over time, can lead to the development of cardiovascular disease. Susceptible the platelets were to clotting before and after the people with type 2 diabetes due to tomato juice taken (Lazarus *et al.*, 2004).

### 3.7. Bronchial asthma treatment

The serum concentration of various carotenoids including lycopene, acarotene, b-carotene, zeaxanthin, lutein, b-cryptoxanthin and atocopherol and retinol were measured by HPLC (Fig. 1) in 266 healthy subjects (189 males and 77 females, age of  $47 \pm 1$  (mean  $\pm$  SEM) years old) and 53 patients with bronchial asthma (38 males and 15 females, age of  $50 \pm 1$  years old). No significant difference was observed in a-carotene, bcarotene, zeaxanthin/lutein, b-cryptoxanthin and retinol between healthy volunteers and patients with bronchial asthma (McDevitt *et al.*, 2005).

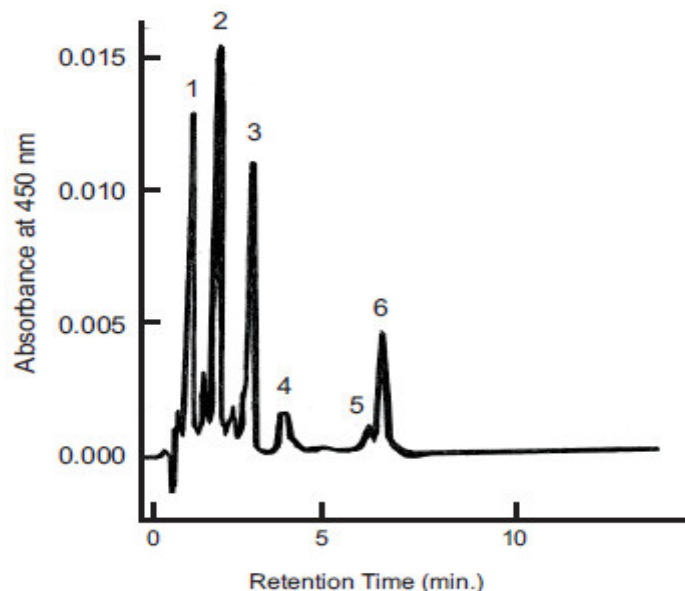


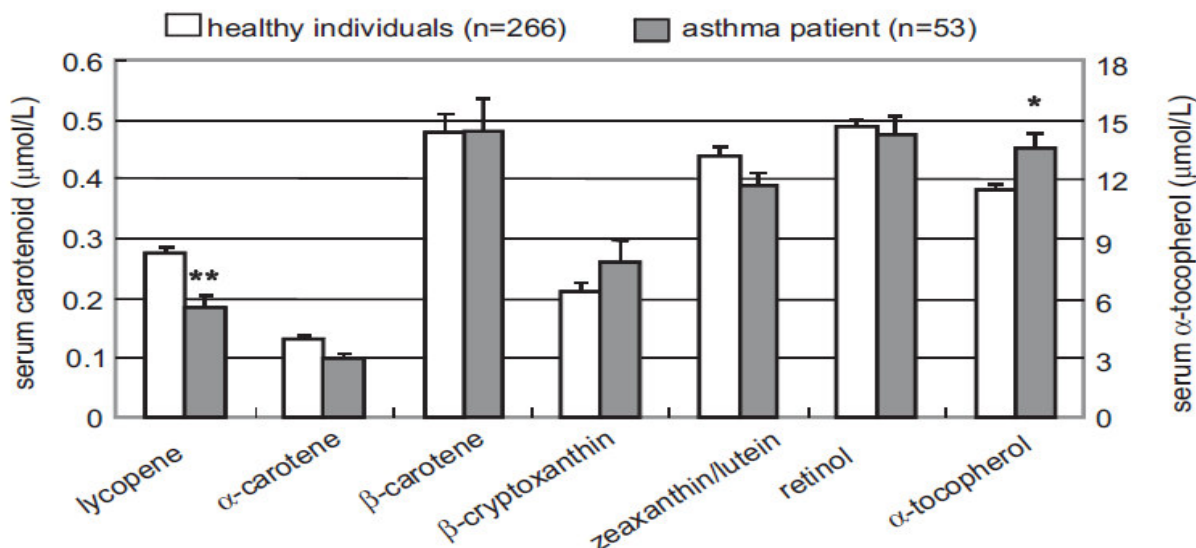
Fig1 Determination of carotenoids in the serum by HPLC.

Carotenoids were extracted from 200 ml of serum with ethanol followed by hexane/dichloromethane (4:1) and then analyzed by HPLC (Oshima *et al.* 1997). Peaks indicated are: 1, zeaxanthin/lutein; 2, apocarotenal (internal control); 3, b-cryptoxanthin; 4, lycopene; 5, a-carotene; and 6, b-carotene. HPLC, high performance liquid chromatography.

Source: Oshima *et al.*, 1997

Only the serum concentration of lycopene was significantly different between the healthy volunteers ( $0.26 \pm 0.01$  mg/mL, mean  $\pm$  SEM) and patients with bronchial asthma ( $0.18 \pm 0.02$  mg/mL,  $p < 0.001$ ) (Fig. 2). Compared to healthy subjects, serum lycopene concentration was about 30% lower in patients with bronchial asthma. Although patients with severe asthma often showed low values, a significant correlation between the

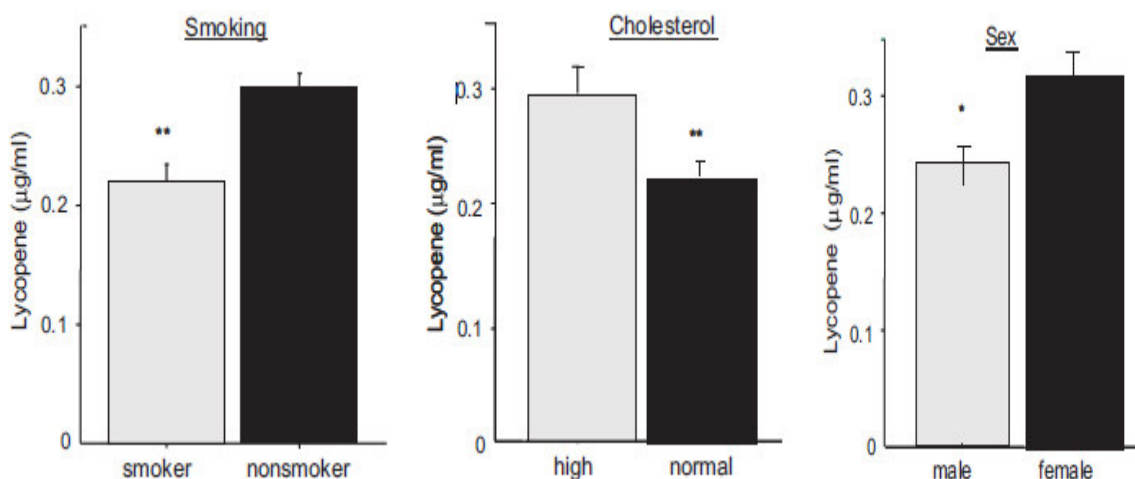
severity of asthma and the serum lycopene concentration was not confirmed. It remains unclear, however, whether the lowered lycopene level is a reflection of an excessive consumption according to the increased oxidative stress in the airway and/or the clinical conditions of asthma. In healthy individuals, there exists no correlation between serum levels of each of the carotenoids and lycopene. Gender, smoking habits, and the cholesterol level in the serum have been shown to influence the serum lycopene concentration, but not age (Fig. 3). Although the study population was limited, the tendency observed in healthy individuals was also observed in patients with bronchial asthma (Rahman et al., 1999).



**Fig. 2** Serum concentrations of carotenoids.

The serum concentration of lycopene was significantly diminished in patients with bronchial asthma as compared with healthy individuals. Data are presented as mean ± SEM (\* $p < 0.05$ , \*\* $p < 0.001$ ).

Source: - McDevitt *et al.*, 2005



**Fig. 3** Influence of clinical background on serum lycopene concentration in healthy volunteers. Data are presented as mean ± SEM (\* $p < 0.05$ , \*\* $p < 0.001$ ). The cholesterol in the serum is designated as high if it is greater than 220 mg/dL.

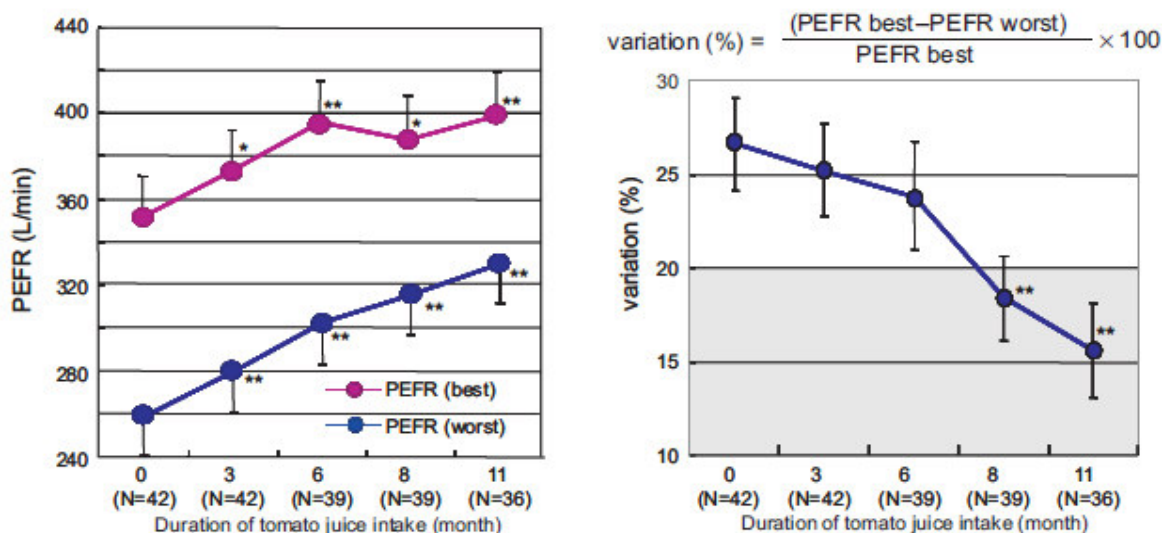
Source: Rahman et al., 1999

Generally, the antioxidative state was analyzed in both healthy subjects and asthma patients by determining the serum concentration of carotenoids. The results demonstrated that the serum lycopene concentration was significantly lower in asthma patients than in healthy subjects. On the other hand, no significant difference has been detected in other carotenoid concentrations.

Sixteen patients with bronchial asthma (11 males and 5 females, age  $55 \pm 4$  (mean ± SEM)) drank at least 160 mL tomato juice a day (no salt added, Kagome Co., Ltd., Tochigi, Japan) for 3 mon. Changes in asthmatic symptoms and quality of life were measured. In addition, 46 patients with bronchial asthma (30 males and 16 females, age  $53.1 \pm 5.4$  (mean ± SEM)) drank tomato juice (no salt added, Kagome Co., Ltd.) for 12

months. The patients drank the tomato juice twice a day (at least 160 mL per day, basically at breakfast and dinner). Patients continued the medicines they had taken prior to the trial and did not change medication except in response to acute exacerbation (McKeever *et al.*, 2004).

Before starting the daily intake of tomato juice, the maximum value of peak flow rate (PEFR) was  $352 \pm 19$  L/min (mean  $\pm$  SEM), but it gradually increased to  $396 \pm 19$  L/min after 6 mon ( $p < 0.01$ , as compared with the baseline) and to  $399 \pm 21$  L/min after one year (Fig. 4). In addition, the minimum value of PEFR before the trial was  $259 \pm 18$  L/min and it increased up to  $302 \pm 20$  L/min after 6 months and up to  $330 \pm 18$  L/min after one year ( $p < 0.01$ , see Fig. 4). Atopic patients and male patients showed greater improvement in PEFR than the non-atopic and female patients. The dairy variation of PFER was also improved from 27% to 16% (Fig. 4) (Misso *et al.*, 2005). Accordingly, an additional study was conducted in patients with asthma who continued to take tomato juice every day for 12 mon to evaluate its effect on peak flow rate (PEFR), daily variation of PEFR, daily symptoms, and quality of life. After a year of daily tomato juice ingestion, the best PEFR value increased from  $352 \pm 19$  to  $399 \pm 21$  (L/min) after 12 mon ( $p < 0.01$ ). Decrease of the daily variation of PEFR value was also observed ( $p < 0.01$ ). Atopic patients with asthma responded better than non-atopic patients. Most patients had a positive impression on daily tomato juice intake since asthma patients realized the improvements of quality of life and asthmatic symptoms. No obvious adverse effect was observed throughout the study. Although the precise mechanism(s) and the active ingredient(s) responsible for these results must be elucidate in detail, the daily intake of tomato juice could therefore be a new candidate of controller for asthma patients.



**Fig.4** Significant improvements of PEFR and its variation were observed over time. In the left panel, PEFR (best) or (worst) of the day during the given month was averaged per individual and then the value of PEFR (best) or (worst) of the given month was calculated (mean  $\pm$  SEM, \* $p < 0.05$ ,\*\* $p < 0.01$ ). In the right panel, individual variations were calculated using the best or worst PEFR value of the given month, and then the value of variation of the given month was calculated (mean  $\pm$  SEM, \*\* $p < 0.01$ ). PEFR, peak flow rate. SAM: senescence-accelerated mouse

**Source:** - Misso *et al.*, 2005

Quality of life was improved regardless of gender, disease severity, age and atopic factors. The significant improvement on quality of life was already observed as early as 3 month ( $p < 0.05$ ) from starting the daily intake of tomato juice and continued until the end of the study. More than 80% of patients with bronchial asthma recognized the positive effect on their asthmatic symptoms while they were daily taking tomato juice. Blood examinations showed no significant change in the levels of eosinophils, IgE, liver function, and lipids while patients were taking tomato juice for a year. No adverse effect was observed (Kasagi *et al.*, 2006).

### 3.8. Tomatoes with other crops to Prevent prostate cancer

#### 3.8. 1. Broccoli

Tomatoes and broccoli-two vegetables separately recognized for their cancer-fighting capabilities-are even more successful against prostate cancer when working as a team in the daily diet, shows a study published in *Cancer Research*. When tomatoes and broccoli are eaten together, we see an additive effect. We think it's because different bioactive compounds in each food work on different anti-cancer pathways, said John Erdman, Professor of Food Science and Human Nutrition at the University of Illinois ( Canene-Adams *et al.*, 2007).

An additive effect also were implanted on Rats with prostate tumors, Erdman and doctoral candidate Kirstie Canene-Adams fed the animals' one of 5 different diets. Then they compared the cancer-preventive

effects of the diets to treatment with finasteride, a drug commonly prescribed for men with enlarged prostates, or surgical castration. The diets contained one of the following: 10% tomato, 10% broccoli, 5% tomato plus 5% broccoli, 10% tomato plus 10% broccoli, or lycopene (23 or 224 nmol/g diet). The tomato and broccoli given as powders made from the whole vegetable to compare the effects of eating the whole food to simply consuming one active compound as a nutritional supplement- in this case, lycopene, a carotenoid found in tomatoes. After 22 weeks, when the rats' were sacrificed and their prostate tumors weighed, the 10% tomato/broccoli combination was shown to greatly outperform all other diets, shrinking prostate tumors by 52%. Broccoli alone decreased tumor weight by 42% and tomato alone by 34%. Lycopene alone (23 or 224 nmol/g diet) came in last, reducing tumor weight by 7% and 18% respectively. Only castration-a last resort option for most men, although it resulted in a 62% reduction in prostate tumor weight-approached the level of protection delivered by the tomato/broccoli diet. Said Erdman, as nutritionists, it was very exciting to compare this drastic surgery to diet and see that tumor reduction was similar ( Boileau,2003).

### 3. 8. 2. Green tea

Choosing to eat lycopene-rich tomatoes *and* regularly drink green tea may greatly reduce a man's risk of developing prostate cancer, suggests research published the *Asia Pacific Journal of Clinical Nutrition*. In this case-control study involving 130 prostate cancer patients and 274 hospital controls, men drinking the most green tea were found to have an 86% reduced risk of prostate cancer compared, to those drinking the least(Jian L. *et al.*,2007).

A similar inverse association was found between the men's consumption of lycopene-rich fruits and vegetables such as tomatoes, apricots, pink grapefruit, watermelon, papaya, and guava. Men who most frequently enjoyed these foods were 82% less likely to have prostate cancer compared to those consuming the least lycopene-rich foods (Lev J., 2004).

## 4. Summary and conclusions

Tomato has many applications in the food industry. Besides being a nutritious food with low calorific content the tomato is an excellent source of antioxidants and vitamins. Tomato products may play a role in the prevention of prostate cancer and perhaps slow the progression of established disease is one of the most important concepts under study in the area of diet, nutrition, and prostate cancer. More research in this area is needed to determine the type and quantity of products involved in this prevention.

At the present time, definitive conclusions and recommendations remain controversial. However, ongoing research will continue to provide data regarding these relationships. At the present time, it is reasonable to recommend to the public that a diet rich in fruit and vegetables may contribute to a lower risk of many cancers. It is very reasonable to include tomato products as part of a healthy dietary pattern. In contrast, it is premature to suggest that the proposed benefits of a diet rich in tomato products can be achieved with supplements containing lycopene.

Tomatoes and tomato products such as tomato juice are an important source of micronutrients and some phytochemicals. Certain carotenoids found in tomatoes and tomato products appear to be more highly associated with potential health benefits. However, synergistic or additive effects of several tomato micronutrients and phytochemicals may mediate these findings. Therefore, future studies of tomato juice micronutrients and bioactive components on bioavailability, metabolism, and bioactivity will provide more insight into these potential health benefits.

## Reference

- Arthur Allen, 2009. A Passion for Tomatoes. Smithsonian magazine
- Boileau TW, Liao Z, Kim S, Lemeshow S, Erdman JW Jr, Clinton SK,2003.Prostate carcinogenesis in N-methyl-N-nitrosourea (NMU)-testosterone-treated rats fed tomato powder, lycopene, or energy-restricted diets. *J Natl Cancer Inst.* 2003 Nov 5;95(21):1578-86.. PMID:14600090.
- Canene-Adams K, Lindshield BL, Wang S, Jeffery EH, Clinton SK, Erdman JW Jr, 2007. Combinations of tomato and broccoli enhance antitumor activity in dunning r3327-h prostate adenocarcinomas. *67(2):836-43.*
- Cohen JH, Kristal AR, Stanford JL., 2000. Fruit and vegetable intake and prostate cancer risk. *J Natl Cancer Inst.*; 92:61 – 8.
- Etminan M, Takkouche B, Caamano-Isorna F. ,2004. The role of tomato products and lycopene in the prevention of prostate cancer: a meta-analysis of observational studies. *Cancer Epidemiol Biomarkers Prev.* 2004 Mar;13(3):340-5.
- FAOSTAT, 2015. Crop statistics *Internet document accessed* on July 2016 <http://faostat.Fao.Org/site>
- George Mateljan Foundation, 2010. The World's Healthiest Food.
- Giovannucci, E., Rimm, E. B., Wolk, A., Ascherio, A. Stampfer, M. J., Colditz, G. A., and Willett, W. C. 1998. Calcium and fructose intake in relation to risk of prostate cancer.



- Hartz, T., 2010 Processing Tomato Production in California. UC Vegetable Research and Information Center. International Cyber Business Services, Inc. 2000. Medicinal (Healing) Applications of Tomatoes.
- Jian L, Lee AH, Binns CW, 2007. Tea and lycopene protect against prostate cancer. *Asia Pac J Clin Nutr.* 2007;16 Suppl 1:453-7.. PMID:17392149.
- Kasagi, S. and K. Seyama, H. Mori, S. Souma, T. Sato, T. Akiyoshi, H. Suganuma, and Y. Fukuchi. 2006. Tomato juice prevents senescence-accelerated mouse P1 strain from developing emphysema induced by chronic exposure to tobacco smoke. *Amer. J. Physiol. Lung Cell. Mol. Physiol.* 290: L396-404.
- Komal Chauhan<sup>1</sup>, Sheel Sharma, Nidhi Agarwa and Bhushan Chauhan.. 2011. Lycopene of tomato fame: its role in health and disease. Volume 10, Issue 1, Article-018
- Laurence N. Kolonel, 2000. Products and Lycopene in the Prevention of Prostate Cancer
- Lazarus SA, Bowen K, Garg ML. Tomato juice and platelet aggregation in type 2 diabetes. *JAMA.* 2004. ; 292(7):805-6.
- Lev J, 2004. Lycopene research presented at the annual meeting of the American Association for Cancer Research. ([www.aacr.org](http://www.aacr.org)), Orlando.
- M. Ganesan\*, M. Rajesh, P. Solairaj and T. Senthilkumar. 2012. Tomato as a pioneer in health management. *IJPCBS*, 2(3), 210-217
- McDevitt, T.M. and R. Tchao, E.H. Harrison, and D.W. Morel. 2005. Carotenoids normally present in serum inhibit proliferation and induce differentiation of a human monocyte/macrophage cell line (U937). *J. Nutr.* 135: 160-164
- McKeever, T.M. and J. Britton 2004. Diet and asthma, *Amer. J. Respir. Crit. Care Med.* 170: 725-729.
- Misso, N.L. and J. Brooks-Wildhaber, S. Ray, H. Vally, and P.J. Thompson. 2005. Plasma concentrations of dietary and nondietary antioxidants are low in severe asthma. *Eur. Respir. J.* 26: 257-264.
- National Cancer Institute Initiative 2006 "Eat tomato 5 to 9 A Day for Better Health.
- Oshima, S. and H. Sakamoto, Y. Ishiguro, and J. Terao. 1997. Accumulation and clearance of capsanthin in blood plasma after the ingestion of paprika juice in men. *J. Nutr.* 127: 1475- 1479.
- Rahman, I. and W. MacNee. 1999. Lung glutathione and oxidative stress: implications in cigarette smoke-induced airway disease. *Amer. J. Physiol.* 277: L1067-1088.
- Sanjiv A and Rao AV. 2000. Tomato lycopene and its role in human health and chronic diseases. *Can Med Assoc J.* 163:739-744.
- Sesso HD, Liu S, Gaziano JM. 2003. Dietary lycopene, tomato based food products and cardiovascular disease in women. *J Nutr.* ;133:2336-2341
- Sharon Palmer, R. 2009. SCANNERS . Vol 2, No 2
- Silaste ML, Alfthan G, *Br J Nutr*, 2007. Health Benefits of tomatoes.
- Silaste ML, Alfthan G, Aro A, 2007. Tomato juice decreases LDL cholesterol levels and increases LDL resistance to oxidation. *Br J Nutr.* 98(6):1251-8.
- Singh, 2010. Tomatoes-To-eat-or-not-to-eat-what-does-the-research-suggests.
- Stacewicz-Sapuntzakis M & Bowen PE, 2005. Role of lycopene and tomato products in prostate health. *Biochim Biophys Acta.*; 1740:202-5.
- Stahl. 2011. Betacarotene and other carotenoids. *Inst of Medicine Food and Nutrition Board.* 17:6-7.
- Tzonou A, Signorello LB, Laigou P, 1999. A diet and cancer of the prostate: a case-control study in Greece. *Int J Cancer.*;80:704 – 8.
- World Cancer Research Fund / American Institute for Cancer Research. 2007. *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective.*