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Research Article

TOMATO AS A PIONEER IN HEALTH MANAGEMENT

M. Ganesan*, M. Rajesh, P. Solairaj and T. Senthilkumar

Sankaralingam Bhuvaneswari College of Pharmacy, Sivakasi, Tamilnadu, India.

ABSTRACT

Tomatoes, which are actually a fruit are loaded with all kinds of health benefits for the body. They are delicious too and have tons of vitamins and minerals in them that our body needs. One of the most well known tomato eating benefit is its Lycopene content. Lycopene is a vital anti oxidant that helps in the fight against cancerous cell formation as well as other kinds of health complications and diseases. Lycopene is not a naturally produced element within the body and the human body requires sources of Lycopene in order to make use of this powerful anti-oxidant. Compared to other fruits or vegetables, tomato has high concentration of Lycopene. Cancers such as prostate cancer, cervical cancer, colon cancer, rectal cancer, and cancers of the stomach, mouth, pharynx, and esophagus have all been proven to be staved off by high levels of Lycopene. Although the effect of lycopene is biologically relevant, the tomato is also an excellent source of nutrients, including folate, vitamin C and various other carotenoids and phytochemicals, such as polyphenols, which also may be associated with lower cancer risk. Tomatoes also contain significant quantities of potassium, as well as some vitamin A and vitamin E. A brief overview of tomato and medicinal benefits of its constituents were discussed in this article.

Key words: Anticancer, Bone, CVS, Diabetes, Lycopene and Tomato.

INTRODUCTION

The word "tomato" may refer to the plant *Solanum lycopersicum*. The word "tomato" may actually originate from the Nahautl (Aztecan) word "*tomatl*" meaning "the swelling fruit" Originally, tomato was named after the food family to which it belongs to the *Solanaceae*. While it is botanically a fruit, it is considered a vegetable for culinary purposes. The tomato fruit is consumed in diverse ways, including raw, as an ingredient in many dishes and sauces and in drinks. 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 climates as an annual. [1] Tomatoes grow best under temperatures of 20–27°C. Fruit setting is poor when average temperatures exceed 30°C or fall below 10°C. Most cultivars produce red fruit, but a number of cultivars with yellow, orange, pink, purple, green, black, or white fruit are also available. However, the tomato has much lower sugar content than other fruits, and is therefore not as sweet.

Varities of tomato[2]

1. Tomato varieties are roughly divided into several categories, based mostly on shape and size.
2. "Slicing" or "globe" tomatoes are the usual tomatoes of commerce, used for a wide variety of processing and fresh eating.
3. Beefsteak tomatoes are large tomatoes often used for sandwiches and similar applications.
4. Oxheart tomatoes can range in size up to beefsteaks, and are shaped like large strawberries.
5. Plum tomatoes, or paste tomatoes (including pear tomatoes), are bred with a higher solid content for use in tomato sauce and paste, and are usually oblong (square).
6. Pear tomatoes are obviously pear-shaped, and are based upon the San Marzano types for a richer gourmet paste.
7. Cherry tomatoes are small and round, often sweet tomatoes generally eaten whole in salads.
8. Grape tomatoes, a more recent introduction, are smaller and oblong, a variation on plum tomatoes, and used in salads.
9. Campari tomatoes are also sweet and noted for their juiciness, low acidity, and lack of mealiness. They are bigger than cherry tomatoes, but are smaller than plum tomatoes.
10. Bright yellow tomatoes, Italian pear-shaped tomatoes, and the green tomatoes are famous for its fried preparation in Southern American cuisine.

Chemical constituents of Tomato

1. Flavonones: Naringenin ,chalconaringenin.
2. Flavonols: Rutin, kaempferol, quercetin.
3. Hydroxycinnamic acids: Caffeic acid, ferulic acid coumaric acid.
4. Carotenoids: Lycopene, lutein, zeaxanthin, beta-carotene.
5. Glycosides: Esculeoside A.
6. Fatty acid derivatives: 9-oxo-octadecadienoic acid.
7. VitaminC, vitamin K, vitamin E,vitamin B_6, vitaminB_1,folate,niacin, potassium, phosphorus ,Sodium, manganese, iron and copper.

Nutritional Profile

While most often associated with lycopene, tomatoes provide a unique variety of phytonutrients such as carotenoids, flavonoids, hydroxy cinnamic acids, glycosides and fatty acid derivatives. Tomatoes are also an excellent source of free radical scavenging vitamin C and vitamin A as well as bone healthy vitamin K. They are a very good source of enzyme promoting molybdenum, heart healthy potassium, vitamin B_6, folate, and dietary fiber, blood sugar balancing manganese. In addition, tomatoes are a good source of heart healthy magnesium, niacin and vitamin E, Energy producing iron, vitamin B_1, and phosphorus, muscle building protein, and bone healthy copper. The nutrients present in one cup of raw tomatoes (180 g) are listed in fig.1.

Tomato extract

Tomato extract contains carotenoids (5-15%w/w) as well as non carotenoid components. The carotenoid fraction of the tomato extract consists mainly of lycopene, of which 86 % is all-*trans*-lycopene, 6% is 5-*cis*-lycopene, 2% is 9-*cis*-lycopene and 2% is 13-*cis*-lycopene and 4% are other carotenoids. The major non carotenoid components of tomato extract include fatty acids and acylglycerols (69-74%), phospholipids (8.9-14%), and waxes (5-8.4%).

Chemistry of Lycopene

Lycopene is a major beneficial constituent of tomato. It is a carotenoid pigment that has long been associated with the deep red color of many tomatoes. From various data lycopene from orange and tangerine colored tomatoes may actually be better absorbed than the lycopene from red tomatoes. That's because the lycopene in deep red tomatoes is mostly *trans*-lycopene, and the lycopene in orange, tangerine tomatoes is mostly tetra-*cis*-lycopene. Lycopene is a polyunsaturated hydrocarbon (an unsubstituted alkene). Structurally, it is

a tetra terpene assembled from eight isoprene units, composed entirely of carbon and hydrogen and is insoluble in water.

All-*trans*-lycopene is an unsaturated acyclic hydrocarbon with chemical formula $C_{40}H_{56}$ and molecular weight of 536.85.The chemical name of all-*trans*-lycopene is (all-E)-2,6,10,14,19,23,27,31-octamethyl-2,6,8,10,12,14,16,18,20,22,24,26,30-dotriacontatridecaene. Common names include Ψ,Ψ-carotene, all *trans*- lycopene, and (all-E)-lycopene. Lycopene in tomatoes and tomato products consists predominantly of all-trans-lycopene (35-96% of the total lycopene content) and low levels of cis-lycopenes (1-22% of the total lycopene content).The stability of various forms of lycopene is given below.(Highest stability: *5-cis ≥ all-trans ≥ 9-cis ≥ 13-cis > 15-cis > 7-cis >11-cis:* lowest).[3]The structure of *cis* and *trans* Lycopene is shown in Fig 2 and 3.

The lycopene content in tomato typically ranges from 70 to 130 mg/kg and depends on the variety, geographic location, technique of cultivation, climatic conditions and degree of ripeness of tomato fruits.Lycopene extract from tomato is a dark red viscous liquid. It is freely soluble in ethyl acetate and *n*-hexane, partially soluble in ethanol and acetone, and insoluble in water. A solution in *n*-hexane shows an absorption maximum at approximately 472 nm.

Distribution of Lycopene in Body

Lycopene will be distributed in various tissues in our body, among that liver has larger amount of lycopene.[4]The distribution of Lycopene in various body organs and tissues are listed in Table.1.

HEALTH BENEFITS OF LYCOPENE

Cardiovascular system

Reduced risk of heart disease is a health benefit in which tomatoes truly excel. There are two basic lines of research linked in tomatoes to heart health. The first line of research involves antioxidant support, and the second line of research involves regulation of fats in the bloodstream.Cardiovascular system needs greater antioxidant protection than other body systems.[5] The heart and bloodstream are responsible for taking oxygen breathed in through the lungs and circulating it around throughout the body[6]. In order to keep this oxygen in check, antioxidant nutrients are needed in an ample supply. Vitamin E and vitamin C provide critical antioxidant support in the cardiovascular system, and they are an important part of the contribution made by tomatoes to our heart health. The carotenoid lycopene however has got the most attention as tomatoes' premier antioxidant and heart supportive nutrient. Lycopene has the ability to lower the risk of lipid per oxidation in the bloodstream. Lipid per oxidation is a process in which fats that are located in the membranes of cells lining of the bloodstream or fats that are being carried around in the blood, get damaged by oxygen. This damage can be repaired if it is kept at manageable levels. However, chronic and or excessive lipid per oxidation in the bloodstream leads to trouble[7].The second line of research linking tomatoes with heart health involves regulation of fats in the blood. Dietary intake of tomatoes, consumption of tomato extracts, and supplementation with tomato phytonutrients (like lycopene) have shown to improve the profile of fats in our bloodstream. Specifically, tomato intake has been shown to result in decreased total cholesterol, decreased LDL cholesterol, decreased triglyceride levels and decrease in accumulation of cholesterol molecules inside the macrophage cells.[8] Many phytonutrients in tomatoes are likely to be involved with the improvement of blood fat levels. Two little known phytonutrients esculeoside-A and 9-oxo-octadecadienoic acid which are currently under active investigation by researchers as tomato phytonutrients which are especially important for the regulation of fat in the blood.

Tomato contains important nutrients, such as niacin, folate and vitamin B_6 that have associated with the reduction of risk of heart disease. Lycopene intake has also been found to be associated with a lower risk of myocardial infarction.[9] Potassium and vitamin B present in tomato will help to lower blood pressure and high cholesterol levels. This, in turn, could help prevent

strokes, heart attack and other potentially life threatening heart problems.

Platelets (Antiaggregatory effect)

The phytonutrients present in tomato helps in preventing excessive clumping of platelet cells. This ability is referred as an "Antiaggregatory effect". In combination with the other heart benefits mentioned above, this platelet regulating impact of tomato puts them in a unique position to help our cardiovascular health.[10, 11, 12]

Bones

Bone health is another area of growing interest in tomato research. Interestingly, the connection of tomato intake to bone health involves the rich supply of antioxidant in tomatoes, since antioxidant protection is important for bone health. Tomatoes have a fair amount of vitamin K and calcium, which helps to strengthen and possibly repair the bones and bone tissue in minor ways.

Cancer

The important constituent of tomato lycopene has some beneficial anticancer activity particularly for cancers of the lung, stomach, and prostate gland. Lycopene is considered some what of a natural miracle antioxidant that may help to stop the growth of cancer cells. And interestingly enough, cooked tomatoes produce more lycopene than do raw tomatoes. Lycopene is also the most efficient oxygen and free radical quencher and is the prime carotenoid in plasma and other tissues. Lycopene is also found in lung tissue and is valuable in protecting lymphocytes from NO_2 damage found in lung cancer. Lycopene also decrease the impact of oxidative load from pylori infections in the stomach. The tomato derived carotenoid lycopene may reduce risk of cancer by activating special cancer preventive enzymes such as phase II detoxification enzymes, which remove harmful carcinogens from cells and the body.[13] In addition to its inhibitory effect on basal endometrial cancer cell proliferation. Lycopene also was found to suppress insulin like growth factor which are major autocrine/paracrine regulators of mammary and endometrial cancer cell growth. Therefore, lycopene interference in this major autocrine/paracrine system may open new avenues for research on the role of lycopene in the regulation of endometrial cancer and other tumors.[14] In different studies however, lycopene was even found to have an inhibitory effect on cataract development[15] and several different kinds of cancer cells including breast and endometrial cancer cells, prostate carcinoma cells and colon cancer cells. Intake of lycopene was significantly and inversely associated with risk for ovarian cancer, predominately in postmenopausal women. The foods most strongly associated with a decreased risk for ovarian cancer were raw carrots and tomato sauce.[16]

Diabetes

Tomatoes are packed full of valuable mineral known as chromium, which works effectively to help diabetics keep their blood sugar levels under better control. Tomato consumption might also be beneficial for reducing cardiovascular risk associated with Type-II diabetes.[17]

Antiaging and Skincare

Lycopene is the most powerful carotenoid quencher of singlet oxygen,[18] being 100 times more efficient than vitamin E, which in turn has 125 times the quenching action of glutathione (water soluble) singlet oxygen produced during exposure to ultraviolet light is a primary cause of skin aging.[19,20] Because of high amounts of lycopene, a substance found in many of the facial cleansers, tomatoes are great for skin care.

Smoking

Tomatoes can reduce the amount of damage done to the body by smoking cigarettes. Tomatoes contain coumaric acid and chlorogenic acid that work to protect the body from carcinogens that are produced from cigarette smoke.[21]

Vision

Vitamin A present in tomato helps to improve the vision and help to prevent the development of night blindness.[21]

Other Health Benefits

Diets that include tomatoes have been linked with reduced risk of some neurological diseases (including Alzheimer's disease) in multiple studies.[22] Some of the reports shown it might be strongly protective against some neurodegenerative diseases.[23, 24, 25] Tomato containing diets have also been linked in a few studies with reduced risk of obesity. Tomatoes are high in important antioxidants such as vitamin C and Vitamin A. These vitamins work to fend of DNA damage from free radicals. Consequently, tomatoes may help to ward off age related disease like atherosclerosis. Tomatoes and tomato sauces and puree (US food contain only a tomato) are said to help lower urinary tract symptoms.[26]

CONCLUSION

The review concludes lycopene and eating tomatoes could protect against many types of cancer, with the higher protection going to prostrate, lung, and stomach cancer, also protect against colorectal, breast, esophageal, oral, pancreatic, and cervical cancers. A substance called lycopene, which is responsible for tomatoes red color, is thought to be the reason for this cancer protective effect.Lycopene may account for or contribute to these benefits, but numerous other potentially beneficial compounds are present in tomatoes, and, conceivably, complex interactions among multiple components may contribute to the anticancer properties of tomatoes. The consistently lower risk of cancer for a variety of anatomic sites that is associated with higher consumption of tomatoes and tomato-based products adds further support for current dietary recommendations to increase fruit and vegetable consumption. Even with all the plentiful research that has gone into the health benefits of tomatoes, there is still more research being conducted as the medical science community understands that we have not fully tapped into the potential presented by a tomato just yet. Research is now slowly proving that there is a high likelihood that the consumption of tomatoes and tomato based products actually may prevent serum lipid oxidation and reduce the risk of macular degenerative disease. In conclusion, the Tomatoes are by far the healthiest of the fruits and vegetables with the power to ward off some of the worst known diseases to man.

Table 1: Distribution of Lycopene in Various Body Organs and Tissues

Tissue	nmol/g wet weight
Liver	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

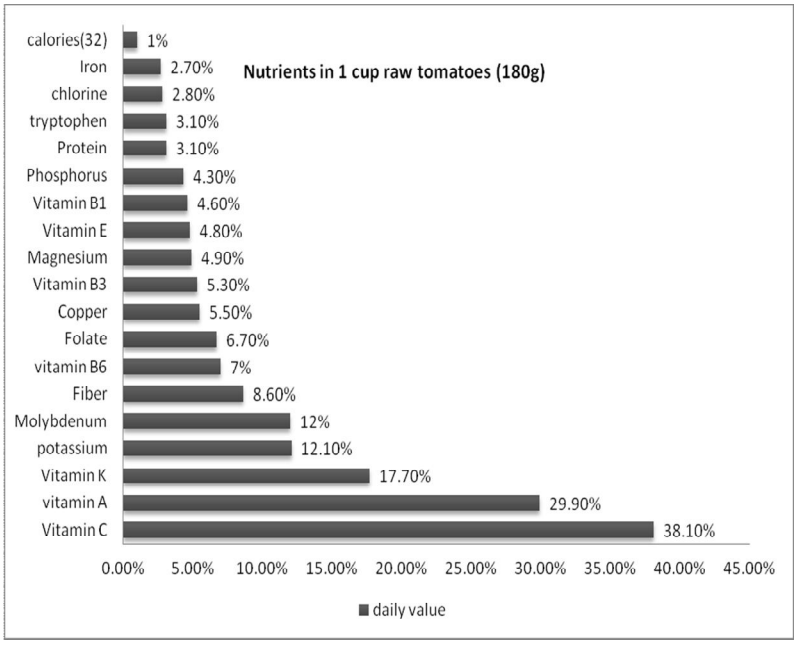

Fig. 1: Nutrients in 1cup raw tomatoes (180g)

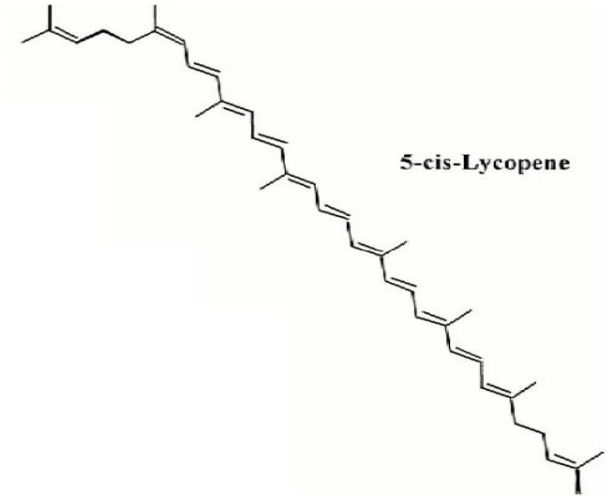

Fig. 2: Structure of *cis* –Lycopene

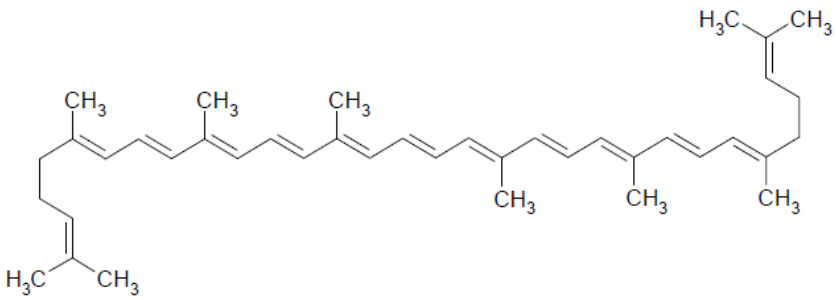

Fig. 3: Structure of *trans* -Lycopene

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