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Lycopene in Tomatoes: A Trailblazer in Health Management

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SUMMARY

Tomatoes, often mistaken as vegetables, offer a myriad of health benefits, thanks to their abundance of essential vitamins and minerals. Beyond their culinary appeal, tomatoes stand out for their high lycopene content, a potent antioxidant known for its role in combating cancer and various health complications. With its unique nutritional profile, tomatoes serve as a valuable source of nutrients, including folate, vitamin C, and various phytochemicals. This article provides a comprehensive exploration of tomatoes' medicinal properties and their potential in promoting overall well-being.

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. 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.

Varieties of tomato

Tomato varieties are typically categorized based on their shape and size.

- Commonly known as "slicing" or "globe" tomatoes, these varieties are widely utilized in commercial settings for various processing methods and fresh consumption.
- Beefsteak tomatoes, renowned for their size, are frequently chosen for sandwiches and similar culinary uses.
- Oxheart tomatoes, resembling large strawberries, can be as substantial as beefsteaks in size.
- Plum tomatoes, also referred to as paste tomatoes, possess a higher solid content, making them ideal for tomato sauce and paste; typically, they have an oblong (square) shape.
- Pear tomatoes, displaying an evident pear shape, are derived from San Marzano types, offering a richer gourmet paste.
- Cherry tomatoes, small and spherical, are often sweet and commonly enjoyed whole in salads.
- Grape tomatoes, a more recent addition, are smaller and oblong, akin to plum tomatoes; they are frequently included in salads.
- Campari tomatoes are recognized for their sweetness, juiciness, low acidity, and lack of graininess. They are larger than cherry tomatoes but smaller than plum tomatoes.
- Bright yellow tomatoes, Italian pear-shaped tomatoes, and green tomatoes are renowned for their preparation in Southern American cuisine, particularly when fried.

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 B6, vitaminB1,folate,niacin, potassium, phosphorus ,Sodium,manganese, iron and copper.

Nutritional Profile

While commonly recognized for their lycopene content, tomatoes offer a diverse array of phytonutrients, including carotenoids, flavonoids, hydroxycinnamic acids, glycosides, and fatty acid derivatives. Additionally, tomatoes serve as an abundant source of antioxidant vitamins C and A, crucial for scavenging free radicals, as well as bone-strengthening vitamin K. They are rich in molybdenum, promoting enzyme activity, and provide heart-healthy potassium, vitamin B6, folate, and dietary fiber, along with blood sugar-regulating manganese. Moreover, tomatoes provide significant amounts of heart-healthy magnesium, niacin, and vitamin E, as well as energy-boosting iron, vitamin B1, and phosphorus. They contribute to muscle development with their protein content and support bone health through copper availability.

Tomato Extract Composition:

Tomato extract comprises carotenoids (5-15%w/w) along with non-carotenoid components. The carotenoid segment of the tomato extract primarily consists of lycopene, with 86% being all-trans-lycopene, 6% as 5-cis-lycopene, 2% as 9-cis-lycopene, 2% as 13-cis-lycopene, and 4% as other carotenoids. The primary non-carotenoid constituents of tomato extract encompass fatty acids and acylglycerols (69-74%), phospholipids (8.9-14%), and waxes (5-8.4%).

Lycopene Distribution in the Body:

Lycopene is distributed across various tissues in the human body, with the liver containing a significant amount of lycopene compared to other tissues.

Health Benefits of Lycopene

Cardiovascular system

Tomatoes boast exceptional prowess in reducing the risk of heart disease, with research highlighting two primary avenues: antioxidant support and regulation of blood fats. The cardiovascular system necessitates robust antioxidant protection, given its crucial role in circulating oxygen throughout the body. Vitamin E and vitamin C play pivotal roles in providing antioxidant support to the cardiovascular system, constituting essential contributions from tomatoes to heart health. Notably, the carotenoid lycopene garners significant attention as tomatoes' premier antioxidant and heart-supportive nutrient. Lycopene exhibits the ability to mitigate the risk of lipid peroxidation in the bloodstream, a process wherein fats within cell membranes or circulating in the blood are damaged by oxygen. While manageable levels of lipid peroxidation damage can be repaired, chronic or excessive levels pose considerable risks. The second avenue linking tomatoes to heart health pertains to the regulation of blood fats. Research indicates that dietary consumption of tomatoes, tomato extracts, and supplementation with tomato phytonutrients, such as lycopene, contribute to improved blood fat profiles. Tomato intake has been associated with reductions in total cholesterol, LDL cholesterol, triglyceride levels, and cholesterol accumulation within macrophage cells. Various phytonutrients present in tomatoes likely contribute to enhancing blood fat levels, with emerging attention on lesser-known compounds like esculeoside-A and 9-oxo-octadecadienoic acid, currently under active investigation for their role in blood fat regulation. Tomatoes also provide essential nutrients like niacin, folate, and vitamin B6, all associated with reducing the risk of heart disease. Moreover, lycopene intake has been correlated with a decreased risk of myocardial infarction. Potassium and vitamin B present in tomatoes aid in lowering blood pressure and high cholesterol levels, potentially mitigating the risk of strokes, heart attacks, and other life-threatening heart conditions.

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.

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 key component of tomatoes, lycopene, exhibits beneficial anticancer properties, particularly against lung, stomach, and prostate cancers. Lycopene is often regarded as a natural antioxidant with potential to impede cancer cell growth. Interestingly, cooked tomatoes yield higher lycopene content compared to raw ones. It is recognized as the most effective scavenger of oxygen and free radicals, prominently present in plasma and various tissues, including lung tissue, where it safeguards lymphocytes from NO2 damage associated with lung cancer. Lycopene also mitigates the oxidative burden resulting from H. pylori infections in the stomach. The carotenoid lycopene derived from tomatoes may lower cancer risk by activating specialized cancer preventive enzymes such as phase II detoxification enzymes, which eliminate carcinogens from cells and the body. Additionally, it inhibits basal endometrial cancer cell proliferation and suppresses insulin-like growth factors, crucial regulators of mammary and endometrial cancer cell growth. This interference in the autocrine/paracrine system presents promising avenues for researching lycopene's role in regulating endometrial cancer and other tumors. Despite variations in study findings, lycopene has demonstrated inhibitory effects on cataract development and various cancer cell types, including breast, endometrial, prostate carcinoma, and colon cancer cells. Consumption of lycopene has been significantly associated with reduced ovarian cancer risk, particularly in postmenopausal women. Foods strongly linked with decreased ovarian cancer risk include raw carrots and tomato sauce.

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.

Antiaging and Skincare

Lycopene is the most powerful carotenoid quencher of singlet oxygen, 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. 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

Vision

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

Other Health Benefits

In numerous studies, diets incorporating tomatoes have been associated with a decreased risk of certain neurological disorders, including Alzheimer's disease. Several reports suggest that such diets could provide significant protection against certain neurodegenerative conditions. Moreover, research indicates that diets rich in tomatoes may also reduce the risk of obesity, as they are abundant in essential antioxidants like vitamin C and vitamin A. These antioxidants play a crucial role in defending against DNA damage caused by free radicals, potentially aiding in the prevention of age-related diseases such as atherosclerosis. Additionally, tomatoes and tomato-based products, such as sauces and purees (which solely contain tomatoes in the case of US food), are purported to alleviate lower urinary tract symptoms.

CONCLUSION

The analysis concludes that lycopene, found abundantly in tomatoes, may offer protection against various types of cancer, particularly prostate, lung, and stomach cancer, as well as colorectal, breast, esophageal, oral, pancreatic, and cervical cancers. Lycopene, responsible for the red color of tomatoes, is believed to be the

key factor behind this protective effect against cancer. While lycopene may play a significant role in these benefits, tomatoes contain numerous other potentially advantageous compounds, and complex interactions among these components might contribute to their anticancer properties. The consistent reduction in cancer risk across various body sites associated with higher tomato and tomato-based product consumption further underscores the importance of adhering to dietary recommendations that advocate for increased intake of fruits and vegetables.

Despite the extensive research on the health benefits of tomatoes, ongoing studies suggest that we have not fully explored the potential health advantages they offer. Emerging evidence indicates that consuming tomatoes and tomato-based products may also help prevent serum lipid oxidation and reduce the risk of macular degenerative disease. In summary, tomatoes stand out as one of the healthiest fruits and vegetables, possessing the capability to mitigate some of the most prevalent diseases known to humanity.

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