

Comparison of Lycopene Content in Various Fruits and Vegetables

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Abstract: Lycopene, belonging to the carotenoids, is a tetraterpene compound abundantly found in tomato and tomato-based products. It is fundamentally recognized as a potent antioxidant and a non-provitamin A carotenoid. Lycopene has also been studied in relation to its potential health effects. It has been found to be efficient in ameliorating cancer insurgences, diabetes mellitus, cardiac complications, oxidative stress-mediated malfunctions, inflammatory events, skin and bone diseases, hepatic, neural and reproductive disorders.

Keywords: Antioxidant, carotenoids, chromoplasts, phytoene., tetraterpene

Introduction

Tomato and tomato-based products are the major dietary sources of lycopene and account for approximately 80% of the consumption of lycopene in western countries (Canene-Adams et al, 2005). In North America, most dietary lycopene comes from tomato products such as ketchup, tomato juice, sauce or paste. Sun-dried tomatoes, which have been dehydrated to remove their water content, are one of the most concentrated food sources of lycopene. Cooking tomatoes, which is done when making tomato juice, paste and ketchup, makes lycopene easier for our bodies to absorb compared to the lycopene found in raw tomatoes. Carotenoids like lycopene are fat-soluble, which means that they are best absorbed when eaten with some type of fat, such as olive oil or butter.

Lycopene contents significantly differ in diverse varieties of tomato and other fruits and vegetables. Its content depends on several factors:

- (i) the degree of maturity
- (ii) the weather temperature (lycopene is transformed to beta-carotene at temperatures higher than 35 °C)
- (iii) the soil quality (conditions including necessary microorganisms may cause lycopene content to be increased about 36%) .

In plant foods, lycopene can occur in a number of forms such as carotenoid–protein complexes in chloroplasts or in crystalline form inside the chromoplasts. Some fruits' and vegetables' red and orange coloration is attributed to this liposoluble pigment. In tomatoes, full ripening takes place in 40-60 days after planting, during which chloroplasts change to chromoplasts. Fruit ripening involves the active biosynthesis of carotenoids, the chemical precursors for which are synthesized in the plastids. The first committed step is the formation of the colorless molecule phytoene by the enzyme phytoene synthase. Phytoene is then converted to the red pigment lycopene through a series of reactions. During ripening in tomato, the concentration of carotenoids increases between 10-14 fold, mainly due to the accumulation of the deep red pigment lycopene. Besides tomatoes and tomato products, other lycopene-rich foods include watermelon, pink grapefruit, pink guava, apricot and papaya (Maiani et al,2009). Despite this, it is found in some non-red or non-orange plants such as asparagus and parsley.

Lycopene (C₄₀H₅₆), a tetraterpene carotenoid , includes an acyclic open chain structure containing eight isoprene units and 11 double linear bonds that are subjected to isomerization (Fig 1). The double bonds in lycopene can undergo isomerization from *trans* to mono or poly-*cis* isomers by light, thermal energy, and chemical reactions . All-*trans*-lycopene, a natural form of lycopene, comprises 94–96% of total lycopene included in red tomato (Walfisch et al, 2003). When ingested in its natural *trans* form, lycopene is poorly absorbed . However, isomerization of lycopene from all-*trans* to *cis* configuration by heat

processing increases its bioavailability (Burton-Freeman and Sesso, 2014). Lycopene is a non-provitamin A carotenoid (Pennathur et al, 2010) and considered to be an intermediate of carotenoid synthesis in plants. Since it cannot be synthesized in the human body, so it must be consumed in a daily diet (Woodside et al, 2015). The absorbed lycopene is mostly stored in the liver, adrenals, and prostate. Moreover, it can be found in brain and skin also in a lower concentration (Moran et al, 2013).

In recent years, there has been an ever-increasing interest in lycopene's health benefits –for prevention and treatment of a wide variety of diseases **cancer, atherosclerosis (hardening of arteries), cardiovascular disease, prostate cancer, human papillomavirus (HPV) infection, cataracts and asthma**. It can improve ventricular remodeling, and vascular and endothelial function. In addition, it is useful in the reduction of atherosclerotic plaque size, and arterial stiffness. Therefore, it can be concluded that this nutraceutical has a vital role in the primary and secondary prevention of cardiovascular diseases.

Moreover, lycopene is a natural neuroprotective agent. It seems that this carotenoid contributes to cognitive longevity and the treatment of several neuronal diseases, including cerebral ischemia, Parkinson's disease, Alzheimer's disease, subarachnoid haemorrhage, epilepsy, Huntington's disease, and depression. A recent study found that consuming 14 milligrams a day of lycopene can improve fertility in healthy young men by about 40 percent. Lycopene has been shown to reduce pain to a degree similar to that of ibuprofen medication. It can be used in different skin, oral, and dental diseases too. Lycopene is the most potent antioxidant. It is an important deactivator of reactive oxygen species (ROS). For instance, it can remove singlet oxygen two and ten times more than β -carotene and α -tocopherol, respectively .

Lycopene bioavailability is influenced by a number of factors such as dietary composition and food processing ,being higher in processed tomato products than in unprocessed fresh tomatoes. It can be greatly enhanced by various storage as well as processing methods that break down the cell walls, making lycopene more accessible, and also through enhanced *cis*-isomerization. Unlike most vitamins e.g., vitamin C, the bioavailability increases upon cooking, partially because processing tomato-based foods releases lycopene tightly bound to vegetable fibers, and thus allowing lycopene to be more readily available to be absorbed in the digestive tract. However, lycopene bioavailability can be decreased by ageing, and some of the pathological states, such as cardiovascular diseases (Petyaev, 2016).

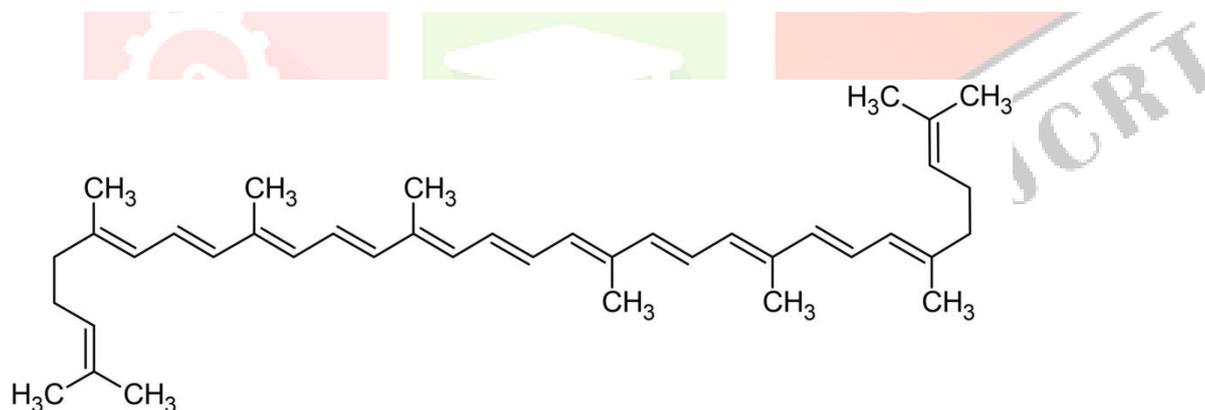


Fig 1: Chemical structure of Lycopene pigment

Materials and methods

Lycopene estimation was done using protocol of Thimmaiah (2009). Weighed approx 10g tomato paste by grinding 3-4 tomatoes in pestle mortar. Added 20 ml of acetone in lots and filtered through muslin cloth. Transferred the filtrate in separating funnel and added 20 ml petroleum ether. Added 20 ml of 5% sodium sulphate solution and swirled the separating funnel gently. After rotating the separating funnel for a few minutes, two layers of solution appeared. Lower layer containing acetone was discarded and upper layer containing petroleum ether mixed with pigment was kept in dark brown bottle containing 10g anhydrous sodium sulphate. Kept it aside for 30 min or longer. Decanted the petroleum ether extract into 100 ml volumetric flask through a funnel containing cotton wool. Washed sodium sulphate slurry with petroleum ether until it is colorless and transferred the washings to the volumetric flask. Made up the volume and measured the absorbance in a spectrophotometer at 503nm using petroleum ether as blank.

Same procedure for lycopene estimation was repeated for red bell pepper and water melon.

Calculation

Absorbance (1 unit) = 3.1206 μ g lycopene/ml

mg lycopene in 100g sample = 31.206 x Absorbance/ Weight of sample (g)

Result and Discussion

The result presented in Table 1 has shown that lycopene content varied widely among tomato based products, fruits and vegetables indicating the need of different servings of these foods.

Table 1: Lycopene content in various fruits and vegetables

S.N.	Sample	Weight of sample (g)	Absorbance	Lycopene content (mg)
1	Desi tomato	9.136	1.421	4.853
2	Water melon	9.67	0.764	2.465
3	Cherry tomato	8.47	0.068	0.250
4	Red bell pepper	9.5	0.075	0.246

Among the food samples analysed, Desi tomato had the highest content of lycopene followed by water melon and cherry tomato. Red bell pepper had the least amount of lycopene content.

Lycopene has been linked to health benefits ranging from heart health to protection against sunburns and certain types of cancers. Lycopene is a powerful antioxidant that can protect our body against oxidative stress and offer some protection from certain environmental toxins and chronic diseases. Lycopene's strong antioxidant properties may help improve cholesterol levels and prevent the clotting of blood thus reducing likelihood of dying prematurely from heart disease.

In vitro studies show that lycopene may protect the body against damage caused by pesticides, herbicides, monosodium glutamate (MSG) and certain types of fungi. Recently it has been studied that lycopene plays role in cell development regulation, gap junction communication, gene expression modulation, immune responses, and protection of lipid peroxidation.

Conclusions

Lycopene is known to be one of the most potent antioxidant among dietary carotenoids. Knowledge of the lycopene content of commonly consumed foods is useful in planning dietary strategies to satisfy the reference daily intake for antioxidant and also as useful indices of potential health benefits of individual plants based foods.

References

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