

**A REVIEW ON LYCOPENE AND IT'S HEALTH BENEFITS**

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ABSTRACT

Tomato commonly considered as vegetable, has become popularly consumed food globally. It can be consumed in various ways like in the form of sauce, salads etc. Tomato contains phytochemicals and nutrients which have various health benefits. In tomato there is a presence of lycopene which is considered as main carotenoid mainly responsible for red colour of tomato. Lycopene is a carotenoid which is only synthesized by plants but not by animals. Lycopene also studied in affiliation to its potential health benefits. Lycopene plays an important role in preventing various diseases mainly degenerative

diseases in human beings. Lycopene is the most potential reviver of singlet oxygen and free radicals species and that's why it have a efficacious duty in the protection from different diseases. This article describes the information about tomato, composition of tomato, structure of lycopene and its health benefits.

KEYWORDS: Tomato, Lycopene, Bioavailability, Health benefits.

INTRODUCTION

Solanum lycopersicum known as Tomatoes which is edible red fruit belongs to the nightshade family in which there are 3000 more species. There are some examples of nightshade family like potato, pepper, tobacco. Tomato commonly considered as vegetable, has become popularly consumed food in India. Tomato can be consumed in diverse ways which includes sauce, salads and drinks. For nutritional purpose mainly tomatoes are use. Due to its increasing dietary value and large production as well as it use as a model plant for various research Tomatoes are considered as most important vegetable in global.

According to the food and agriculture organization corporate statistical database India and China are the biggest producers of tomato. Around 11% of the total world tomatoes were produce and cultivated in India. Globally 160 million tones of tomatoes were produce annually. Tomatoes are the 4th most popular fresh market vegetable, most easily available and most frequently consumed vegetable in India.

Tomatoes consumption in diet can protect against cancer and reduce blood glucose in diabetics patient. Tomatoes have specific properties towards health. It contains many health supportive or health promoting compound such as phenolic compound carotenoids and vitamins which plays very important role with related to the health. It have economic as well as nutritional value. Tomato contain most worthy phytochemical which includes polyphenols and carotenoids which improves some sensory qualities For example carotenoids like red pigmented lycopene, β -carotene, pro-vit A compound phytofluens, phytoene, majorly found in raw tomatoes and in their products. With 98% flavonol content occurs major part of total flavonol contained in the skin as in combination forms of kaempferol and quercetin.

By means of phytochemicals present in the tomatoes risk factors for human such as prostate cancer, liver cirrhosis, cardiovascular disease can be reduced. Bioactive compound play an important role. Tomatoes contains bioactive compound which have wide range of physiological properties which includes various parts like cardio-protective, anti-inflammatory, anti-allergic, antithrobic, antioxidant effects and vasodilatory.

In tomato mainly 94-96% water content is present and 4.5 to 9.5 % is solid matter in which 1% is skin and seed (measured on fresh basis).Solid percentage is present in tomatoes and behind this there are various reasons present like soil characteristics, irrigation property etc. In tomato juice there is insoluble solid present which ranges from 16-21% of all total solid which in composed of pectin and cellulose.

In tomato main part of soluble solid is free sugar and in this reduces sugar are predominant. Fructose and glucose are the main reducing sugar which holds 50-70% of tomato solid and sucrose founds very negligible which is not more than 0.1%. The ratio of fructose to glucose in tomato is (54:46) therefore fructose is major part than that of glucose.

In tomatoes there us presence of various acids in small quantity. In which Citric acid which acts as citric monohydrate is the main or dominant acid present in tomato. Besides this

succinic acid, oxalic acid etc. Glutamic acid and aspartic acid which are amino acids are also present in tomatoes. Glutamic acid as an amino acid shows higher concentration than aspartic acid.

Tomato composition and nutrient content

Tomatoes consists of pericarp, skin, and locular contents and it was consist of 9-10 % of dry matter of which is approximately 75% is soluble and about 1-3% consists of skin and seed. Tomatoes contain lycopene, micronutrients and phytochemicals which consists of or include carotenoids, polyphenols, potassium, folate, ascorbic acid, and alpha-tocopherol. Lycopene and carotenoids are the major and important precursors of tomatoes. In tomato the lycopene content was normally range from 6 to 10 mg lycopene in raw tomato material whereas this lycopene value can be depend on the maturity, variety and environmental conditions such as temperature and availability of light. The nutrient content and fresh raw tomatoes differ substantially when compared with processed tomatoes therefore it is important to note which form of tomatoes we are consumed. Mainly and largest consumption of proceed tomatoes comes from sauces (35%), paste (18%), juice (15%) etc.

LYCOPENE

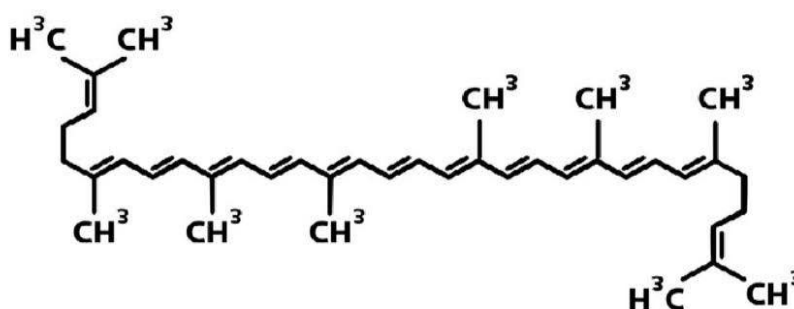
Humans are not able to synthesize carotenoids de novo and must need to get these micronutrients through their diets. Carotene is the precursor of vitamin A and its necessity has been recognized for many years, its the lycopene, a carotenoid that lacks provitamin A activity, that has attracted the most attention of late. Lycopene is the pigment which is mainly responsible for the deep-red color of ripe tomato. Lycopene is a bright red carotenoid pigment found in tomatoes and any other red fruits. As lycopene is red colour pigment so it can be generally found in all other red color fruit. Lycopene was first discovered by DUGGAR. Its name is derived from the tomato's species classification, *Solanum lycopersicum*. In plants, algae, and other photosynthetic organisms, lycopene is most important intermediate in the biosynthesis of many carotenoids, including beta carotene, which are responsible for pigmentation, photo-protection, and photosynthesis.

Structurally, it is a tetraterpene assembled from eight isoprene units, composed entirely of carbon and hydrogen, and is not soluble in water. Lycopene's eleven conjugated double bonds give it its deep red colour and are reason for its antioxidant activity. Due to its strong colour and non-toxicity, lycopene is useful the food colouring. Tomato is the richest source of lycopene among all the red colour fruits.

Lycopene is not an essential nutrient for humans, but it is commonly included in the diet, mainly from dishes which include tomato and tomato products such as tomato sauce, tomato ketchup. When it is get absorbed in the stomach, lycopene is transported in the blood by various lipoproteins and accumulates in the liver, adrenal glands, prostate and testes. Between all the carotenoids, lycopene is one of the most potent and important antioxidants, particularly able to quench singlet oxygen and peroxy radicals, both of which are thought to be reasons for damaging DNA in a process which can lead to the initiation of cancer. Because of this ability, lycopene is being suggested as a potential agent for the prevention of some types of cancers. Lycopene have the special ability to treat the breast cancer.

Information regarding the effect of processing on lycopene showed that lycopene is more stable in tomato processing and storage. Lycopene may be degraded by long term exposure to oxygen or sunlight, low water activity and quite high processing temperature. However, researchers substantially agree that this compound is very stable in commercial production, in term of degradation.

Structure and physical properties of Lycopene



Lycopene is an unsaturated acyclic hydrocarbon. It contains 13 double bonds, of which 11 are conjugated. The chemical name of lycopene is 2,6,10,14,19,23,27,31-octamethyl-2,6,8,10,12,14,16,18,20,22,24,26,30-dotriacontatriecaene. Common names include Ψ , Ψ -carotene, all-trans-lycopene, and (all-E)-lycopene. The chemical formula is C₄₀ H₅₆.

Lycopene is a symmetrical tetraterpene assembled from 8 isoprene units. It is a member of the carotenoid family of compounds, and because it consists of carbon and hydrogen, it is called as a carotene. All-trans form, the molecule is long and straight, constrained by its system of eleven conjugated double bonds. Each double bond in this extended π electron system reduces the energy required for electrons to transition to higher energy states,

permitting the molecule to absorb visible light of progressively longer wavelengths. Lycopene absorbs all but the longest wavelengths of visible light, that's why it appears red. When exposed to light or if we provide heat, all-trans lycopene can undergo isomerization to any of a number of cis-isomers. Lycopene is insoluble in water but soluble in any organic solvent and oil.

LYCOPENE WITH ITS HEALTH IMPORTANCE

Lycopene

Lycopene is a carotenoid which is only synthesized by plants but not by animals. Lycopene is an acyclic isomer of β -carotene which lacks vitamin A activity. Lycopene is a straight chain hydrocarbon which is highly unsaturated and with 2 non-conjugated and 11 conjugated double bonds. Nowadays Lycopene is getting more attention and value because of its antioxidant properties.

Lycopene sources

As lycopene is a carotenoid, it is present in a very limited number of fruits and vegetables. There are various sources by which lycopene is obtained. The most common sources of lycopene are tomato, pink grapefruit, apricot, watermelon and pink guava. Tomato and tomato processed products are good and rich source of lycopene. Because of varieties of tomato and its ripening stage lycopene quantity can be affected.

Its occurrence in plants, Lycopene exists principally in most thermodynamically trans-configuration in plants which are stable. Natural chemical reactions, thermal energy and light can cause its cis-trans isomerization.

Occurrence in human plasma

In human plasma, lycopene occurs as an isomeric mixture. That it contains 50% cis and 50% trans isomers. The most commonly known forms of lycopene are 15-cis, 13-cis, 9-cis, 5-cis and all the trans forms. Clinton *et al.* also observed high concentration of the cis isomers in human serum and prostate tissues. It is the main carotenoid in human plasma and in various tissues.

Bio-availability of lycopene

Lycopene gets absorbed in very small amount and in raw tomatoes it is present in its natural trans form. Laterally, many research and studies have proved that heat processing of tomato

into its different products like tomato ketchup, paste and sauces activate isomerization of lycopene from trans configuration to cis configuration and hence magnify its bioavailability. A minimal increase in plasma lycopene level was observed after taking of unheated tomato juice. In spite of that when oil was mixed with heated tomato juice and consumed then plasma lycopene concentration was found to increase after many hours about 30-48 hrs. Lycopene bio-availability depends upon processing of food which contains lycopene and heat caused isomerization and depending upon the fat present in meal lycopene absorption can be considered.

Action of Lycopene on health

Because of reactive oxygen species (ROS)^[11] various oxidative damages occurs and because of this various chronic diseases can be occur. Lycopene is the most potential reviver of these singlet oxygen and free radicals species and that's why it have a efficacious duty in the protection from different diseases. Thus biochemical properties of lycopene potentially viable it to save cellular components against the damage happened by reactive oxygen species. These reactive species may be formed by chronic inflammation, temperature, sunlight and by normal metabolic process. Lycopene possess antioxidant properties and these antioxidant properties of lycopene may prevent atherogenesis and carcinogenesis by protecting i DNA, low density lipoprotein, lipid and proteins. Oxidation of low density lipoprotein is said to be the main factor to cause atherosclerosis, which carries cholesterol to the blood stream and headships to ischemic stroke and heart attack.

Protection of cancer by lycopene

A very large number of studies showed an inverse relation between cancer and plasma lycopene level. In Giovannucci (2) reviewed he obtained strongest proofs in about lycopene in decreasing the cancer of prostate, lungs and stomach. Lycopene fellowship in decreasing the risk of other types of cancers like oral mucosa, oesophagus, rectum, colon, pancreas, cervix and breast cancer.

Lycopene makes cell-to-cell communication by increasing 'Gap junctions' between cells. Two main mechanisms have been introduced to explain the ant carcinogenic activities of lycopene first is nonoxidative and second is oxidative mechanisms. Lycopene is hypothesized to inhibit carcinogen-caused phosphorylation of regulatory proteins such as p53 and Rb anti-oncogenes and to stop cell division at the G0-G1 cell cycle phase. The use of lycopene appears to be a potential anticancer program of regulating the cell cycle by suppression of abnormal cellular

growth. Lycopene has been hypothesized to stop carcinogenesis by protecting critical cellular biomolecules, including lipids, lipoproteins, DNA and proteins.

Protection from lung cancer

Cigarette smoke has tremendous level of nitric oxide (NO) which reacts with oxygen to form NO₂ free radical. These radicals arrest in smoke and reach to the lung tissues and may cause lung cancer after long term exposure. Prime carotenoid found in the Lungs is lycopene.^[12] Lycopene helps to protect lymphocytes from damage induced by NO₂ radical and its ability to press singlet oxygen is also twice as high as β -carotene. This carotenoid has also proved anti cancerous properties in carcinogenesis model of mouse lung studies.

Prevention of cardiovascular disease

Lycopene causes an increase in low density lipoprotein (LDL) receptors so finally decreases the cholesterol formation. In vitro, lycopene resulted 34% increase in low density lipoprotein degradation and decrease of about 73% cholesterol synthesis, and also enhances about 110% removal of LDL from circulation. Lowering the cholesterol means there is low chance of the risk of heart diseases. Peto et al.^[7] found 1:3 ratio between decrease in risk of myocardial infarction and reduction in cholesterol level. It means there is 30-40% reduction of the risk of cardiovascular disease in a person who takes lycopene on regular basis.

CONCLUSION

In this article, we describes the properties of tomato with their nutrient content along with lycopene sources, occurrence, health impacts, its bioavailability and protection against various diseases because of its antioxidant and other properties. It is considered that there is low nutritional value of processed vegetables and fruits but actually it is not correct all the time. Processing may results an increase in lycopene content, amino acids and total antioxidant activity. By taking tomato and its products may results in increase concentration of plasma lycopene and correlated with lower risk of various types of diseases.

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