



## LYCOPENE'S ANTIOXIDANT ACTIVITY IN COSMETICS MEADOW

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### ABSTRACT

Upon exposure to UV light or other oxidative stresses, photo oxidative reactions are initiated which are damaging to biomolecules and affects the integrity of cells and tissues. Photo oxidative damage plays a role in pathological processes and is involved in the development of disorders affecting skin. Carotenoids like  $\beta$ -carotene and lycopene act as antioxidant in photo oxidation by quenching singlet molecular oxygen and peroxy radical generated during peroxidation. There are many low molecular weight agents that serve as free radicals quenchers. Compounds capable of inhibiting free radical reactions are defined as antioxidants which have been claimed to prevent lipid peroxidation reaction in the skin and to inhibit free radicals and resulting inflammatory responses. Tomato fruit is the major source of lycopene and can be studied for its antioxidant activity in cosmetic and pharmaceutical field.

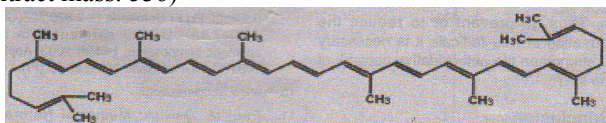
**Keywords:** Biomols; Pathological processes; Oxidative stress; Phytochemicals; Sunscreens; Super oxide; ROS; DNA; PUFA; Photo-ageing

### INTRODUCTION

Lycopene is an open chain pigment of unsaturated carotenoid, which gives red color to fruits and vegetables<sup>1</sup>. It is a natural pigment, orange red in color and found in tomatoes, grape fruit, rose hip, water melon, red pepper, daffodil, yellow marigold, papaya and orange<sup>2</sup>. Upon exposure to UV light photo oxidative reactions are initiated which are damaging to biomols and affects the integrity of cells and tissues. Photo oxidative damage plays a role in pathological processes and is responsible for disorders affecting skin. Carotenoids like  $\beta$ -carotene and lycopene act as antioxidants in photo oxidation by quenching singlet mole oxygen and peroxy radical generated during peroxidation. Following figure shows the structure of lycopene<sup>3</sup>.

#### Structure of Lycopene

(Molecular formula:  $C_{40}H_{56}$ , Molecular weight: 536.89, Extract mass: 536)



Lycopene is a carotenoid, which gives red color to the tomatoes. It is not merely a pigment but a powerful antioxidant, neutralizes free radicals especially those derived from oxygen, present under the lipid membrane and skin cover. It is phytochemically synthesized by plants and microorganisms but not by animals. Lycopene with its carbon atoms and double bonds, is one of the most unsaturated compounds in the nature. Because its double bonds are conjugated; lycopene absorbs radiation at long wavelength of the visible spectrum<sup>4</sup>. Lycopene may reduce the damaging effect which UV light can have on the skin and can boost protection against both the short term (sunburn) and cumulative effects of sun exposure (cancer). The use of carotenoids, particularly lycopene, in cosmetic composition is intended to support the epidermal renewal and to support the regeneration of the skin and/or to increase the thickness of epidermis. Lycopene has chemical properties that are effective in blocking the damaging UV rays<sup>5</sup>.

### TOMATOES

Botanical name: *Lycopersicon esculatum*, Mill

Synonym: Solanum L.

Family: Solanaceae

Plant description: Annual herb, strong scented leaves are alternate, simple but deeply pinnately lobed and toothed, flowers 5 parted, yellow, fruit a red or yellow berry

Origin: South America

Part used: Fruit

Constituents: Vitamin A, Vitamin C, lycopene 6%, carbohydrate, ascorbic acid, protein, iron, sodium, potassium, water, calcium, etc.

Medicinal uses: the fruits are sweet, emollient, carminative, liver and kidney stimulant and tonic, intestinal antiseptic<sup>6,7</sup>.

#### Benefits of Tomato

For skin:

- Juice is a natural bleaching agent.
- Antiaging agent
- Helps to protect from sun damage (heals sunburns)
- Heals wound and sores
- Cleanses and revitalizes the skin
- Tomato pulp used as an ingredient in face masks since it tones, firms and acts as nutrient to skin

Tomato is also a great help to-

- Combat pimples
- Soften and nourish the dry skin
- Relieve irritated skin from excessive sun exposure

For health (Dietary benefits):

- Prevents and heals of certain types of cancers (lung, stomach, upper respiratory tract, digestive tract, mouth, pharynx, prostate, skin)
- Good for coronary heart diseases
- Reduces hypertension
- Prevents diarrhoea
- Soothes eye irritation and age related eye disease (cataract)
- Supports liver health
- Helps to lose weight

Tomato is obtained in local variety and hybrid varieties. Local variety is not available round the year but hybrid variety is available throughout the year. Fruit which is not fully ripe is green in colour, contains other carotenoids along with lycopene but, in fully ripe stage lycopene is the only carotenoid present in tomato.

#### EXTRACTION OF LYCOPENE

**Solvent extraction method** can be used to extract lycopene. Material required: Acetone (AR grade), Petroleum ether, (40-60°C), Anhydrous sodium sulphate, 5% sodium sulphate solution

#### Color test for carotenoids

To the small amount of extracted sample, concentrated sulphuric acid should be added drop by drop. If blue color is obtained, it shows the presence of carotenoid.

#### Identification of Lycopene by Paper Chromatography

Petroleum ether (40-60°C): Acetone mixture (97:3) is used as developing solvent. The edge of paper is just dipped in the solution. The spots are identified by calculating their Rf value<sup>8</sup>.

#### Free Radical Generation

The skin is exposed to daily environmental stresses such as pollutants, solar radiations, artificial lights, heat and cold. Common to all is the ability to generate or propagate the formation of reactive oxygen species (ROS) which are limited but continually growing family of small oxygen based molecule that either contain an unpaired electron (free radical) e.g. super oxide ( $O_2^{2-}$ ) or are capable of forming hydrogen peroxide ( $H_2O_2$ ). The oxygen atom which in a stable state and has four pairs of electron is referred to as a free radical.

Stratum Corneum has been found to generate a large amount of free radicals under UV exposure. Excessive generation of free radicals within tissues can damage DNA, lipids, proteins and carbohydrates<sup>9</sup>. Normally the premier target of UV exposure is the bilayer making up the cell membrane. It is made up of significant amount of unsaturated lipids, which are more prone to attack by free radicals. Typically a hydrogen atom is stripped away from a conjugated double bond in fatty acids chains of phospholipids by a free radical; this satisfies the free radical thirst for an electron but creates another radical in fatty acid chain. After molecular arrangement, this lipid free radical removes another hydrogen atom from a neighbouring lipid molecule propagating the chain reaction, leading to lipid peroxidation<sup>10</sup>.

Lipid peroxidation is believed to damage the cell by loss of polyunsaturated fatty acid (PUFA) of cell membrane. Moreover the formed lipid peroxides and their secondary compounds may damage cellular constituents including various enzymes. Damage by free radicals is assumed to be one of the causative factors of ageing, inflammation and hyper pigmentation, etc<sup>11</sup>.

#### Free Radical Scavengers, Quenchers and Antioxidants

There are many low molecular weight agents that serve as free radical quenchers. Compounds capable of inhibiting free radical reaction are defined as antioxidants which have been claimed to prevent lipid peroxidation reaction in the skin and to inhibit free radicals and resulting inflammatory responses. To exert the inactivation of free radicals the quenchers have to be present in an adequate concentration at the site of reaction to provide effective concentration in epidermis to

inactivate the UV induced production of free radicals and ROS.

#### Sunscreens

Sunscreen is to screen the sun and to protect or shelter viable cells of skin against potentially harmful effects of solar UV radiations. The skin can be protected against free radical reactions and oxidative stress of ROS or some other form of photoactivated states of molecules. Accordingly, photoprotactants<sup>11</sup> may or may not absorb UV radiations but acts as free scavengers or antioxidants or as quenchers of photoexcited state and protect the skin cells from damage. Skin is one of the body's largest organs and protects the body from various types of external stimuli and damages as well as from moisture loss. As the skin is continuously exposed to the sunlight, the UV rays of sunlight stimulate the production of free radicals and may cause some damaging effect like ageing. The formation of free radical has effect on all molecular component of the skin. Free radicals cause damage to DNA, collagen and elastin, which are essential for elasticity and renewal process of the skin. Thus to prevent or to reduce the formation of free radicals, it is necessary to strengthen the anti-oxidative network of the skin.

#### CONCLUSION

Skin is the outer covering of the body, which protects the inner parts of the body, and being a cover to the body, it is exposed to various stress conditions like dust, grease, sunrays, pollutants, etc. so it is most important to protect this outer cover of the body. Sunrays or the UVR composed of UVA, UVB and UVC of which UVB followed by UVA causes maximum damage like tanning, sunburns, erythema, photo-ageing. Though the skin produces melanin for the protection but the skin itself requires a shield, thus a need for use of sunscreen arises as these provide better protection and prevent the skin from tanning also. Since the lycopene is naturally active and reported as most potent antioxidant (lycopene > tocopherol > carotene >  $\beta$ cryptoxanthin > zeaxanthin =  $\beta$ carotene > lutein) as well as sunburn preventing agent, it can also be studied as a suncreening agent for which the tomato can act as a good source.

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