

STUDY OF LYCOPENE IN FOOD AND COSMETICS INDUSTRY IN INDIA AND TO KNOW THE IMPORTANCE OF LYCOPENE

Prathmesh Nere*¹, Tanushree Patil², Sayali Patil³, Rushikesh Sonawane⁴, Dr. Shital J. Patil⁵

^{1,2,3,4}Student, Department of Pharmaceutical Chemistry, Mahatma Gandhi Vidyamandir's Pharmacy College,
Panchavati, Nashik-03, Maharashtra.

⁵Assistant Professor, Department of Pharmaceutical Chemistry, Mahatma Gandhi Vidyamandir's Pharmacy College,
Panchavati, Nashik-03, Maharashtra.

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***Corresponding Author: Prathmesh Nere**

Student, Department of Pharmaceutical Chemistry, Mahatma Gandhi Vidyamandir's Pharmacy College, Panchavati, Nashik-03, Maharashtra.

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ABSTRACT

The lycopene market is expected to grow at a compound annual growth rate (CAGR) of 5.2% from 2021 to 2030, from its 2020 valuation of \$107.2 million to \$187.3 million. In 2020, the powder category held the most market share for lycopene, and it is anticipated to continue to do so for the duration of the forecast. Lycopene, a potent natural antioxidant and carotenoid, has gained significant attention in health sciences and the food industry for its diverse health benefits and functional applications. This project explores lycopene's role in promoting human health and its application as a natural ingredient in food products. Found in tomatoes, watermelon, red oranges, and other red-hued fruits and vegetables, lycopene helps counteract oxidative stress by neutralizing harmful free radicals, thus reducing the risk of various chronic diseases, including cancer, heart disease, and diabetes. Additionally, lycopene's neuroprotective properties may alleviate symptoms related to neurological conditions, such as Alzheimer's and Parkinson's, while also supporting skin and hair health. The food industry leverages lycopene for its antioxidant properties, natural color enhancement, and role as a functional ingredient. As consumer demand shifts towards clean-label and health-promoting food products, lycopene's natural red-pigment qualities make it a popular choice over synthetic additives, especially in tomato-based products. Furthermore, lycopene-enriched functional foods allow companies to highlight health benefits, such as supporting heart, immune, and skin health, due to its anti-inflammatory and protective properties. This project examines lycopene's biological benefits and its integration into food products, contributing to a broader understanding of its potential to improve consumer health and align with natural ingredient trends in the food industry.

KEYWORDS: Anti-oxidant, Market Data, Carotenoid, Detoxification, Anti-inflammatory.

1. INTRODUCTION

Phytochemicals and Bioactive Compounds in Fruits and Vegetables

Phytochemicals are naturally occurring compounds in plants that have been shown to have various health benefits. These compounds, including flavonoids, carotenoids, and polyphenols, can help improve health by supporting the body's detoxification systems and modifying metabolic processes. Many of these compounds are antioxidants, which help to neutralize harmful free radicals, reducing oxidative stress that can lead to chronic diseases like cardiovascular diseases, diabetes, and cancer.

In the context of cancer prevention, these bioactive compounds can help prevent the mutation of cells that might lead to tumor formation. In addition, they support immune function and protect against the damage caused by environmental factors such as pollution, UV radiation, and smoking.^[1]

Lycopene's Role in Health

Lycopene is one such bioactive compound found in fruits and vegetables, especially in tomatoes, watermelon, pink grapefruit, and red peppers. As a potent antioxidant, lycopene helps neutralize free radicals, reducing oxidative stress in the body, and thus lowering the risk of chronic diseases like cardiovascular disease and cancer.^[2]

Specific Finding by Bates et al. (1997)

High levels of lycopene may help enhance antioxidant status in diabetic moms, according to a 1997 study by Bates and colleagues. This study revealed that increasing lycopene intake may help battle the oxidative stress associated with diabetes, perhaps delivering preventive benefits for diabetic patients and enhancing their overall health. This discovery also highlighted lycopene's wider potential as a dietary supplement that can aid in the treatment of diseases like diabetes that are linked to metabolic dysfunction.^[3]

Broader Impact of Functional Foods

When combined with a healthy lifestyle, functional foods—those that offer health advantages beyond simple nourishment—help to advance wellbeing. One of the best examples of a functional food that provides both therapeutic and preventive health advantages is lycopene, which is found in diets high in fruits and vegetables. Functional foods like those that contain lycopene not only promote general wellbeing but also lower the risk of lifestyle-related diseases like cancer, heart disease, and type 2 diabetes, highlighting the significance that nutrition plays in preventing disease.^[4]

Medical Application

1. Antioxidant Effects: Lycopene helps reduce oxidative stress by neutralizing free radicals, which can lead to chronic diseases.
2. Cardiovascular Health: It improves arterial health, lowers cholesterol levels, and enhances vascular function, collectively reducing the risk of heart disease.
3. Cancer Prevention: Lycopene has shown potential in reducing the risk of certain cancers, especially prostate cancer.^[5]



**Figure 1: Whole Foods Market Lycopene Capsules - 30ct, Antioxidant Supportant
(Marketed preparation)**

2. LYCOPENE IN FOOD INDUSTRY

2.1. Lycopene as a Naturally Occurring Carotenoid

The red, orange, and pink colours of fruits and vegetables are caused by carotenoid pigments, such as lycopene. Lycopene, a potent antioxidant and part of the carotenoid family, is essential for shielding the body from oxidative stress brought on by free radicals. Unstable molecules known as free radicals have the ability to harm tissues and cells, resulting in a number of health difficulties, such as accelerated ageing and chronic illnesses [6]. Tomatoes are the richest and most popular source of lycopene, making them the most prevalent source. However, other red and pink fruits like papaya, watermelon, pink grapefruit, and red peppers all contain lycopene. Frequently added to a variety of foods and drinks, these fruits offer a great It is more readily absorbed by the body when taken with fats from food. This makes fat-based cooking techniques, such roasting tomatoes in olive oil, especially useful for increasing lycopene's bioavailability. The fat maximises the health advantages of lycopene by enhancing its efficiency and absorption in the body.^[7]

2.2. Antioxidant Properties and Health Benefits

Effects of Antioxidants Lycopene is a strong antioxidant that aids in the body's defence against dangerous free radicals.^[8] Chronic diseases including diabetes, cancer, and cardiovascular disease can arise as a result of oxidative stress, which is brought on by free radicals and damages cells, proteins, and DNA. Lycopene helps shield cells from oxidative harm by scavenging these free radicals, which promotes general health.^[9] Risk Reduction for Chronic Diseases Lycopene's potent antioxidant qualities have been connected to a lower risk of a number of chronic illnesses.^[10]

2.2.1 Cardiovascular Disease: By reducing LDL cholesterol (the "bad"), stopping LDL cholesterol from oxidising, and enhancing blood vessel health, lycopene helps protect the heart. Consequently, this lowers the chance of heart disease and atherosclerosis, or the hardening of the arteries.^[11]

2.2.2 Prostate Cancer: Lycopene is especially well-known for its ability to lower the risk of prostate cancer, which is one of the most prevalent tumours in males. According to research, lycopene may suppress the development of malignant tumours and lessen oxidative damage, which would slow the growth of prostate cancer cells.^[12]

2.2.3 Skin Ageing: Lycopene has demonstrated potential in the fight against skin ageing. Its antioxidant properties assist to preserve skin suppleness, minimise wrinkles, and stop photoaging—aging brought on by exposure to the sun by shielding the skin from oxidative stress brought on by environmental factors like UV radiation.^[13]

2.3. Lycopene in Functional Foods and Dietary Supplements

Lycopene has grown in popularity as an ingredient in functional meals, dietary supplements, and nutraceutical goods because of its numerous health advantages.^[14] Beyond meeting dietary requirements, these items are made to provide further health advantages in addition to basic nourishment. Tomato-based goods like tomato sauce, ketchup, and tomato juice are frequently fortified with lycopene for additional health advantages. These are a few examples of functional meals enhanced with lycopene.^[15]

Watermelon, pink grapefruit, and other fruits high in lycopene are used to make fruit juices.

Supplements with concentrated lycopene in the form of powders or capsules for people who wish to be sure they get enough of this powerful antioxidant.^[16]

2.4. Rising Market Demand for Lycopene

The global lycopene market has grown as a result of consumers' increasing interest in plant-based products and natural antioxidants. Consumers are increasingly focused on wellness and illness prevention, rather than merely waiting for health issues to occur and seeking treatment thereafter.^[17] The demand for functional foods that include bioactive substances like lycopene, which can promote health and well-being, has increased as a result of the shift in emphasis from treatment to prevention. As a result, the market for lycopene has grown significantly, and a greater variety of consumer goods now include it. Increasing consumer knowledge of the health advantages of natural antioxidants, the growing acceptance of plant-based diets, and the need for plant-derived components in foods, supplements, and other products are some of the drivers propelling the market. The use of functional foods to enhance health outcomes and the growing interest in preventative healthcare.^[18]

2.5. Global Lycopene Market Statistics

The lycopene market is expected to grow at a compound annual growth rate (CAGR) of 5.0% from 2021 to 2030, from its 2020 valuation of \$107.2 million to \$187.3 million. • Due to its adaptability and ease of incorporation into a wide range of food products and supplements, the powder category held the biggest market share for lycopene in 2020 and is predicted to continue to do so.^[19]

3. LYCOPENE IN COSMETIC INDUSTRY

3.1. Anti-inflammatory Benefits and Skin Redness Reduction: Lycopene has strong anti-inflammatory qualities in addition to being a potent antioxidant.^[20] Because of this, it works well to lessen skin irritation and redness, which are frequently brought on by environmental stresses including pollution, UV rays, and severe weather. By soothing the skin and lowering swelling and irritation, lycopene helps to lessen inflammation, which is a significant cause of skin discomfort and early ageing.^[21] Because of its anti-inflammatory properties, lycopene is frequently included in a variety of cosmetic products, such as:

3.1.1 Sunscreens: Lycopene's anti-inflammatory properties are essential for shielding the skin from UV rays, which can result in sunburn, inflammation, and more serious long-term damage like ageing and an elevated risk of cancer.^[22]

3.1.2. Moisturisers: In goods designed to Lycopene helps soothe and moisturise the skin by reducing inflammation, which is especially helpful for people with sensitive or irritated skin.

3.1.3. Serums: Lycopene-based anti-inflammatory serums reduce redness and irritation while also enhancing the texture and look of the skin.^[23]

Manufacturers can improve the effectiveness of their formulations and provide consumers with ways to control inflammation, lessen skin irritation, and guard against environmental stresses that cause ageing by adding lycopene to cosmetic products.^[24]

3.2. Prevention of Photo damage and Protection against UV Damage: Lycopene's capacity to shield the skin from UV rays is among its most important skincare advantages. One of the main causes of photo damage, which includes early ageing (fine lines, wrinkles, and age spots), is UV radiation from the sun.^[25] Damage to DNA that may result in mutations and skin malignancies. The loss of collagen, which reduces the suppleness and firmness of the skin. Free radicals created by UV radiation can be absorbed and neutralised by lycopene thanks to its strong antioxidant qualities. This lessens the harm that oxidative stress causes, which speeds up skin ageing.^[26]

Studies have demonstrated that lycopene protects skin cells from UV-induced oxidative stress. Lycopene can lessen the acute impacts of sun exposure by lowering inflammation and neutralising free radicals.^[27] Prevent photo aging Lycopene-containing sunscreens and skincare products may shield the skin against ageing symptoms brought on by prolonged sun exposure. Lycopene is therefore frequently added to sunscreens and skincare products for use after the sun, when it can provide an additional layer of defence against the obvious and unseen symptoms of solar damage.^[28]

3.3. Collagen production, Skin Hydration, and Smoothness: It has been demonstrated that lycopene promotes collagen production, which is necessary to preserve the skin's elasticity and structural integrity. One protein that gives skin its structure is collagen resilience and strength. Collagen production naturally declines with age, resulting in fine lines, wrinkles, and sagging.^[29] Lycopene aids in the production of collagen, which improves the firmness and smoothness of skin.

Additionally, lycopene improves skin hydration by helping to maintain the skin's moisture balance. Proper hydration is crucial for maintaining a healthy, youthful appearance, and it helps improve the skin's overall texture and smoothness. It also supports the repair of damaged skin cells, leading to more even-toned and radiant skin.^[30]

3.4. Lycopene's Effectiveness in Improving Skin Texture and Elasticity

When applied topically or ingested as supplements or tomato-based products, lycopene has demonstrated a discernible improvement in the suppleness and texture of skin. Research has shown that:

3.4.1. Topical Application: By encouraging cell turnover and lessening the visibility of fine wrinkles and rough spots, lycopene helps to enhance skin texture when administered directly to the skin through creams, serums, or lotions.^[31]

3.4.2. Dietary Intake: Eating a lot of tomatoes, which are a major source of lycopene, can also make the skin look and feel more elastic. The antioxidant properties of lycopene help skin cells regenerate, improving their capacity to hold onto moisture and preserve smoothness. Lycopene's dual benefits of enhancing skin elasticity and texture make it a perfect component for anti-aging and skin-rejuvenating products.^[32]

3.5. Key Cosmetic Products Using Lycopene

Because of its many advantages, lycopene has been used to a large range of cosmetic items, including:

3.5.1. Anti-aging serums and creams: These treatments are designed to firm the skin, encourage the creation of collagen, and lessen wrinkles.^[33] Lycopene is included to sunscreens and sun protection products because it can shield the skin from UV rays, avoiding sunburn, ageing, and skin cancer.^[34]

3.5.2. Moisturisers: The anti-inflammatory qualities of lycopene are advantageous for products that seek to moisturise the skin while simultaneously lowering redness and inflammation.^[35]

3.5.3. Face masks: Lycopene-enriched masks assist to revitalise and restore suppleness and moisture to sun-damaged or ageing skin.^[36]



**Figure 2: Tomato lycopene UV protector and moisturizer.
(Marketed preparation in cosmetic industry)**

4. MARKET SCOPE AND PRESENT DATA

Lycopene was first discovered in the tomato by Millardet in 1876, and was later named by Schunck (Kong et al., 2010). Nowadays, it is ubiquitous in the diet of humans around the world.^[37]

Due to its high antioxidant power Lycopene is an active ingredient in dermatology and cosmetics as well, representing a key nutrient for skin health.^[38]

1. The global lycopene market size was valued at \$107.2 mn in 2020, and is projected reach \$187.3 mn by 2030, registering a CAGR of 5.0 % from 2021 to 2030. And USD \$ 161 mn by 2025-p.^[39]
2. In 2020, the powder category held the most market share for lycopene, and it is anticipated to continue to do so for the duration of the forecast.^[40]
3. Based on form, type, application, and geography, the worldwide lycopene market is divided into different segments.^[41] The worldwide lycopene market is divided into powder and various forms based on form.^[42]

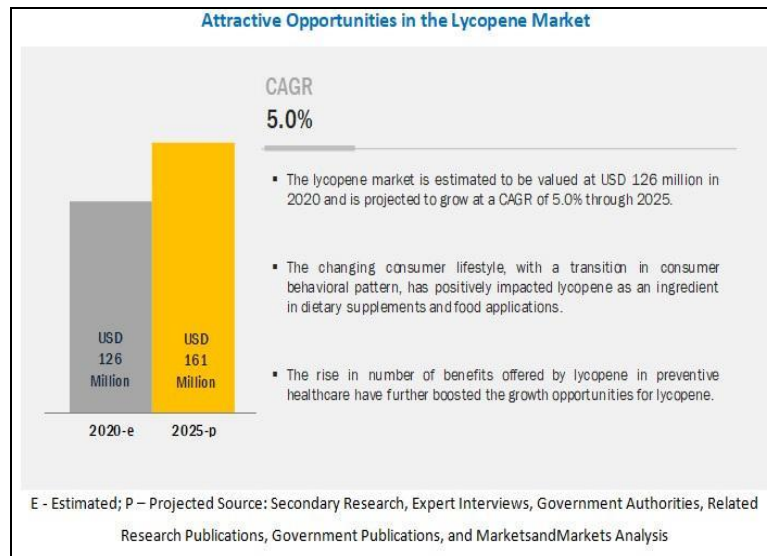


Figure 3: Lycopene Market Size Graph Image.

5. BY DOING EXPERIMENTAL LITERATURE SURVEY ON LYCOPENE SOME POINTS ARE CONCLUDED AS FOLLOWS

5.1 Market Restraints

High cost associated with lycopene products manufacturing and extraction.^[43]

5.2 Market Opportunities

1. Proliferation in utilization of lycopene in food and beverage sector worldwide.^[44]
2. As new market players arise, lycopene extraction technologies continue to expand.^[45]
3. Up surging demand for lycopene products in the cosmetics and skin-care manufacturing.^[46]

5.3 Market Challenges

1. Low-cost substitutes for lycopene products are available.^[47]
2. High Production Cost.^[48]
3. Regulatory Requirements.^[49]



Figure 4: Global Market Data Image.

6. CONCLUSION

Lycopene is valued in the food industry as an organic coloring and health-boosting ingredient, supporting heart health and reducing cancer risks. In cosmetics, it provides anti-aging and UV protection benefits, enhancing skin hydration and elasticity. Its widespread use reflects growing consumer demand for natural wellness ingredients.

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