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LYCOPENE AS AN EFFECTIVE AGENT FOR SKIN PROTECTION AND RESTORATION

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Abstract. Lycopene is a natural carotenoid known for its powerful antioxidant and anti-inflammatory properties. It plays a key role in protecting and repairing the skin by preventing cell damage caused by oxidative stress and environmental hazards such as UV radiation and air pollution. In the cosmetics industry, lycopene is widely used in anti-aging and sun protection products because it stimulates collagen production, improves skin elasticity and slows down the aging process. Regular use of lycopene products helps reduce the appearance of wrinkles, lighten pigmentation and improve skin texture. Advanced methods such as supercritical carbon dioxide extraction and ultrasound extraction are used to extract and stabilize lycopene, which preserves the active properties of this component.

In addition, lycopene is often encapsulated in liposomes or nanoparticles, which facilitates its better penetration into the deeper layers of the skin and ensures stability in cosmetic products. The use of lycopene in cosmetics not only improves the appearance of the skin, but also protects it from the negative impact of the environment, which helps to maintain its youth and health for many years. Lycopene also strengthens the natural barrier functions of the skin, retaining moisture and preventing its loss, which makes it an indispensable component in the care of dry and damaged skin. The use of products with lycopene after procedures such as peeling or laser therapy accelerates the healing process. In the future, researchers intend to study the interaction of lycopene with other active ingredients and determine its optimal concentrations in cosmetic formulas to achieve maximum effect.

Key words: lycopene, antioxidant, carotenoid, tomato, cosmetology, photoaging, bioavailability.

Introduction. Lycopene is a naturally occurring carotenoid responsible for giving vibrant red color to fruits such as tomatoes, watermelons, red grapefruits, and guavas. It is well-known for its powerful antioxidant effects and protective benefits, making it widely used in fields like medicine, skincare, and nutrition [1, p. 252]. Lycopene's ability to neutralize reactive oxygen species helps shield cells from oxidative damage and harm caused by UV radiation [2, pp. 73–78]. Today, lycopene is extensively researched and incorporated into various skincare products designed to protect the skin, delay aging, and enhance skin texture [3, pp. 73–78].

Tomatoes are considered one of the richest dietary sources of lycopene. The levels of lycopene in tomatoes fluctuate based on factors such as tomato variety, cultivation conditions, and ripeness. Interestingly, processed tomato goods, including juice and paste, contain higher concentrations of lycopene compared to raw tomatoes due to heat treatments that improve the carotenoid's bioavailability [4, pp. 28-40]. A wealth of research has demonstrated the health benefits of lycopene, highlighting its role in reducing the risk of cardiovascular diseases and some cancers [5, pp. 44–49].

The goal of this article is to examine lycopene's chemical composition, biological functions, methods of extraction, and its applications across different sectors such as cosmetology, medicine, and nutrition. It also explores lycopene's presence in tomatoes and its role in anti-aging and skin-protective cosmetics.

Chemical Composition of Tomatoes and Lycopene. Tomatoes (Solanum lycopersicum) are a key dietary source of lycopene. They are packed with essential bioactive substances, including carotenoids (lycopene and β-carotene), vitamins (like vitamin C), flavonoids, and polyphenols, all of which are crucial for defending the body against free radicals [4, pp. 28-40]. In fresh tomatoes, lycopene levels typically range from 3 to 4 mg per 100 grams, while processed tomato products such as paste and juice can contain between 15 and 20 mg per 100 grams.

In addition to lycopene, tomatoes are rich in β-carotene, another potent antioxidant that supports skin health and vision [7, pp. 44–49]. Tomatoes are also a good source of flavonoids and polyphenols, which promote better circulation and reduce inflammation, making them a valuable addition to a healthy diet [7, p. 400].

Table 1.

Chemical Composition of Tomatoes (per 100 g of Product).

Component	Content (mg/100 g)
Lycopene	3-4
Vitamin C	10-20
β-carotene	0,5-1,0
Flavonoids	5-10
Polyphenols	2-4

Lycopene is highly effective at neutralizing reactive oxygen species, which helps to protect cells from oxidative stress. This makes it a powerful protective agent that positively impacts skin health, supports cardiovascular function, and reduces the risk of certain cancers [8, p. 71-77]. In addition, lycopene has been shown to lower cholesterol levels and prevent the oxidation of low-density lipoproteins (LDL), an important factor in the prevention of atherosclerosis.

Lycopene's Impact on Skin Health. Lycopene has gained popularity in the cosmetics industry due to its strong antioxidant and anti-inflammatory properties. It provides protection against photoaging caused by UV radiation, and helps reduce the appearance of wrinkles and pigmentation [9, p. 84-90]. By penetrating deep into the skin, lycopene boosts the production of collagen and elastin, aiding in the restoration of skin structure and enhancing elasticity.

One of lycopene's key mechanisms is its ability to neutralize free radicals generated by UV exposure, which can otherwise damage skin cells [10, p. 279-281]. As a result, it helps prevent skin thinning, the formation of wrinkles, and hyperpigmentation. Additionally, lycopene's inclusion in skincare products has been shown to reduce the risk of skin issues like acne and rosacea, owing to its anti-inflammatory effects [11, p. 230].

Regular use of creams and serums infused with lycopene improves the skin's barrier function, which is essential for those with dry or dehydrated skin. By restoring the skin's hydrolipidic balance, lycopene helps alleviate dryness, flaking, and irritation, while increasing the skin's resilience to environmental stressors [7, p. 400]. It also helps regulate sebaceous gland activity, reducing excess sebum production and preventing the formation of comedones [12, p. 242].

Lycopene Extraction and Stabilization Techniques. To extract lycopene from plant sources like tomatoes, various methods are employed, including supercritical carbon dioxide extraction, solvent extraction, ultrasound-assisted methods, and microwave extraction. Among these, supercritical carbon dioxide extraction is considered one of the most efficient techniques, as it eliminates the need for toxic solvents while preserving lycopene's beneficial properties [13, p. 317-331].

Stabilizing lycopene in cosmetic and pharmaceutical formulations is crucial due to its sensitivity to oxygen and light. To enhance its stability and bioavailability, lycopene is often encapsulated in liposomes or nanosomes. This method not only improves its stability but also facilitates deeper skin penetration, enhancing its antioxidant benefits [14, p. 737-741].

Application of Lycopene in Different Fields. Lycopene's role goes beyond cosmetology, extending its benefits to medicine and dietetics as well. Thanks to its antioxidant properties, lycopene helps lower the risk of cardiovascular conditions and alleviates issues related to high cholesterol and atherosclerosis. Including lycopene-rich foods in your diet can help regulate cholesterol levels and boost vascular elasticity, which plays a key role in preventing heart diseases.

In the pharmaceutical industry, lycopene is often used as a supplementary ingredient in products aimed at combating oxidative stress and inflammation-related conditions. Lycopene is also a common component of dietary supplements and functional foods like juices, yogurts, and energy bars, all of which aim to improve overall health and enhance the immune system [15, p. 1663].

Lycopene in Anti-Aging Skincare. Lycopene-based anti-aging products are highly popular because of their ability to reduce the depth of wrinkles, even out skin tone, and promote skin regeneration. This compound is particularly effective in reducing water loss from the skin, smoothing its texture, and promoting faster healing [16, p. 1140-1149].

Lycopene stimulates the production of collagen and elastin, the essential proteins that give skin its firmness and elasticity. As a result, it strengthens the skin's structure, reducing the appearance of fine lines. Due to its antioxidant properties, lycopene also protects these proteins from damage caused by free radicals, thus slowing down the visible signs of aging [17, p. 53-57].

Using lycopene in skincare products also boosts the skin's barrier function, which is key for keeping the skin hydrated. It helps increase the regeneration of skin cells, making the skin look and feel denser and smoother [15, p. 1663].

Lycopene's Role in Disease Prevention and Treatment. Lycopene's powerful antioxidant and anti-inflammatory effects make it valuable for the treatment and prevention of numerous diseases. Research is particularly focused on its application in cardiovascular and oncological conditions. Studies have linked lycopene consumption to a decreased risk of prostate, stomach, lung, and breast cancers. Lycopene has been shown to inhibit tumor cell growth and prevent metastasis [18, p. 317-331].

When it comes to heart health, lycopene plays a role in reducing cholesterol and enhancing blood vessel flexibility. It also helps to lower blood pressure and prevent atherosclerosis by minimizing oxidative stress and inflammation in the blood vessels [14, p. 737-741].

Additionally, lycopene is incorporated into antioxidant complexes aimed at protecting eye health. By shielding the retina from UV damage and oxidative stress, it helps lower the risk of age-related macular degeneration and cataracts [15, p. 1663].

Lycopene's Future in Dietetics and Functional Nutrition. Lycopene is widely used in dietetics as part of dietary supplements and functional food products. Regular consumption of lycopene can help protect cardiovascular health, boost the immune system, and reduce the risk of cancer. It is also beneficial for improving skin condition by reducing inflammation and slowing the aging process [16, p. 1140-1149].

Functional foods enriched with lycopene include tomato-based products such as juice, pastes, sauces, and even yogurts and energy bars. These products are gaining popularity as natural sources of antioxidants and are recognized for promoting overall health [19, p. 37-44]. Interestingly, the bioavailability of lycopene increases with the thermal processing of tomatoes, making processed tomato products particularly beneficial [20, p. 737-741].

Economic Potential of Lycopene Production. The production of lycopene is a promising industry for the agricultural and pharmaceutical sectors. Kazakhstan, as a leading tomato producer in Central Asia, has great potential for developing lycopene production and related industries. Utilizing locally grown tomatoes helps lower production costs and enhances competitiveness in global markets.

The growing demand for lycopene-enriched products is boosting production and exports, creating a significant source of revenue for the national economy. Lycopene production from tomatoes grown in Kazakhstan's favorable climate also stimulates job creation and attracts investment into the agro-industrial and pharmaceutical sectors.

The inclusion of lycopene in cosmetics and functional foods expands market opportunities, increases consumer demand, and drives profit growth, ultimately boosting production volumes [18, p. 317-331]. Lycopene is becoming not only a crucial ingredient for medical and cosmetic products but also an economically important asset capable of generating substantial revenue for the country.

Conclusion. Lycopene is a potent antioxidant known for its wide array of health benefits. It plays a crucial role in medicine, skincare, and nutrition due to its antioxidant, anti-inflammatory, and protective properties. Lycopene helps shield cells from oxidative damage, enhances skin health,

lowers the risk of heart disease, and may help prevent certain cancers.

In cosmetics, lycopene is valued for its ability to slow the aging process, improve skin texture, and reduce the formation of wrinkles and pigmentation. It is also frequently included in antioxidant blends aimed at maintaining eye health and preventing age-related vision problems.

Lycopene's potential applications across diverse industries, such as functional foods and pharmaceuticals, open new avenues for economic growth and innovative product development. Advances in lycopene extraction and stabilization techniques will further enhance its quality and effectiveness, making it an increasingly valuable ingredient in medicine, cosmetics, and food production.

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ЛИКОПИН – ТЕРІНІ ҚОРҒАУ ЖӘНЕ ҚАЛПЫНА КЕЛТІРУ ҮШІН ТИІМДІ ҚҰРАЛ

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Аңдатпа. Ликопин - бұл күшті антиоксиданттық және қабынуға қарсы қасиеттерімен танымал табиғи каротиноид. Ол теріні қорғауда және жөндеуде, тотығу стресінен және ультракүлгін сәулелену мен ауаның ластануы сияқты қоршаған ортаның зақымдануынан туындаған жасуша зақымдануының алдын алуда маңызды рөл атқарады. Косметика өнеркәсібінде ликопен қартаюға қарсы және күннен қорғайтын препараттарда кеңінен қолданылады, себебі ол коллаген өндірісін ынталандырады, терінің серпімділігін жақсартады және қартаю процесін баяулатады. Ликопені бар өнімдерді үнемі пайдалану әжімдердің пайда болуын азайтуға, пигментацияны жеңілдетуге және тері құрылымын жақсартуға көмектеседі. Бұл компоненттің белсенді қасиеттерін сақтау үшін ликопенді экстракциялау және тұрақтандыру үшін көміртегі диоксиді суперкритикалық экстракция және ультрадыбыстық экстракция сияқты жетілдірілген әдістер қолданылады. Сонымен қатар, ликопен көбінесе липосомаларда немесе нанобөлшектерде инкапсулирленген, бұл оның терінің терең қабаттарына жақсырақ енуін жеңілдетеді және косметикалық өнімдерде тұрақтылықты қамтамасыз етеді. Ликопенді косметикада қолдану терінің сыртқы түрін жақсартып қана қоймайды, сонымен қатар оны қоршаған ортаның теріс әсерінен қорғайды, бұл оның жастығын және денсаулығын ұзақ жылдар бойы сақтауға көмектеседі.

Сондай-ақ, ликопен терінің табиғи тосқауыл функцияларын нығайтады, ылғалды сақтайды және оның жоғалуын болдырмайды, бұл оны құрғақ және зақымдалған теріге күтім жасауда таптырмас компонент етеді. Пилинг немесе лазерлік терапия сияқты процедуралардан кейін ликопен өнімдерін пайдалану емдеу процесін жылдамдатады. Болашақта зерттеушілер ликопеннің басқа белсенді ингредиенттермен өзара әрекеттесуін зерттеуге және максималды әсерге қол жеткізу үшін косметикалық формулалардағы оның оңтайлы концентрациясын анықтауға ниетті.

Түйін сөздер: ликопин, антиоксидант, каротиноид, қызанақ, косметология, фотостарение, биожетімділік.

ЛИКОПИН КАК ЭФФЕКТИВНОЕ СРЕДСТВО ДЛЯ ЗАЩИТЫ И ВОССТАНОВЛЕНИЯ КОЖИ

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Аннотация. Ликопин — это природный каротиноид, известный своими мощными антиоксидантными и противовоспалительными свойствами. Он играет ключевую роль в защите и восстановлении кожи, предотвращая повреждение клеток, вызванное окислительным стрессом и вредным воздействием окружающей среды, таким

как ультрафиолетовое излучение и загрязнение воздуха. В косметической индустрии ликопин широко используется в составах средств против старения и защиты от солнца, поскольку он стимулирует выработку коллагена, улучшает эластичность кожи и замедляет процессы старения. Регулярное использование продуктов с ликопином помогает уменьшить выраженность морщин, осветлить пигментацию и улучшить текстуру кожи. Для извлечения и стабилизации ликопина применяются передовые методы, такие как сверхкритическая экстракция углекислым газом и ультразвуковая экстракция, которые позволяют сохранить активные свойства этого компонента. Кроме того, ликопин часто инкапсулируется в липосомы или наночастицы, что способствует его лучшему проникновению в глубокие слои кожи и обеспечивает стабильность в косметических продуктах. Применение ликопина в косметике не только улучшает внешний вид кожи, но и защищает её от негативного воздействия окружающей среды, что способствует сохранению её молодости и здоровья на долгие годы.

А также, ликопин укрепляет естественные барьерные функции кожи, удерживая влагу и предотвращая её потерю, что делает его незаменимым компонентом в уходе за сухой и поврежденной кожей. Использование продуктов с ликопином после таких процедур, как пилинги или лазерная терапия, ускоряет процесс заживления. В будущем исследователи намерены изучить взаимодействие ликопина с другими активными компонентами и определить его оптимальные концентрации в косметических формулах для достижения максимального эффекта.

Ключевые слова: ликопин, антиоксидант, каротиноид, томат, косметология, фотостарение, биодоступность.