A REVIEW ON SWEET POTATO BETA CAROTENE: A NATURAL KERATIN BOOSTER FOR SKIN HEALTH

Rupali Prakash Dube,Priya Anil Chaudhari,Disha Santosh Kavhale, Shital Ramdas Satpute,Pooja Purbhaji Tuppekar.
Gajanan Maharaj College Of Pharmacy, Chh.Sambhajinagar.
rupalidube001@gmail.com
Prof. Manisha Vikar (M.Pharm) Department of Pharmaceutics**,**
Dr.Kavita Kulkarni (PhD,M.Pharm) Department of Quality Assurance, Gajanan Maharaj College Of Pharmacy, Chh.Sambhajinagar

ABSTRACT

Sweet potatoes are rich in beta-carotene, which the body converts into vitamin A. This nutrient is crucial for skin health as it helps maintain skin integrity, promotes cell turnover, and can improve skin texture. Serve as a natural booster for skin health, offering numerous benefits attributed to their antioxidant properties. Beta-carotene, a precursor to vitamin A, plays a critical role in skin maintenance and repair by promoting cell turnover and protecting against oxidative stress. This review explores the mechanisms through which sweet potatoes enhance skin health, including their role in reducing inflammation, improving skin hydration, and preventing photoaging. Additionally, the bioavailability of beta-carotene from sweet potatoes and its impact on skin pigmentation and overall appearance are discussed. Evidence from clinical studies highlights the positive effects of dietary beta-carotene on skin health, suggesting that regular consumption of sweet potatoes may contribute to a healthier, more resilient complexion. The potential of sweet potatoes not only as a nutritious food source but also as a functional food for enhancing skin vitality and longevity.

Keywords:*antioxidants, uv radiation, sweet potato, health benefits, skin, beta-carotene.*

INTRODUCTION

SWEET POTATO

Ipomea batatas (L.) commonly known as Sweet potatoes are considered as the second most staple food crop in many developed and underdeveloped countries due to its immense role in human diet. The different coloured flesh of sweet potatoes found naturally as white, yellow, purple, and orange are rich of nutrition. The orange-fleshed sweet potato has been set as a centre of attraction among many food technologists and nutritionists due to its high content of carotenoids and pleasant sensory characteristics with colour while the purple fleshed sweet potato is full of anthocyanin content. Due to various health benefits reported in orange sweet potato, most of the countries like Uganda, Mozambique, Kenya, and Nigeria use orange-fleshed sweet potato used as their staple food. Sweet potato is the most amply grown tuber crops in Africa. Sweet potato is considered to be the principal source of natural products and development of medicines against variable diseases including production of industrial products.

sweet potato (Ipomea batatas (L.) belongs to family Convolvulaceae, a resourceful and appetizing vegetable which contains high nutritional value. It was originated in Central America is now extensively cultivated and consumed throughout the world. China is the leading producer of sweet potato followed by Nigeria and

Tanzania, Indonesia, and Uganda. The production and consumption of sweet potato in Africa, Asia, South American continents, and Caribbean islands are increased tremendously in recent times. In India, a total stock of 36 improved sweet potato varieties has been released for cultivation in Kerala, Andhra Pradesh, Maharashtra, Orissa, Jharkhand, Chhattisgarh, Bihar, Assam, West Bengal, Karnataka, Tamil Nadu and North Eastern region. Out of 36 varieties, six varieties (BhuSona, BhuKanti, BhuJa, Gouri, Kamala Sundari and CO-5) rich in carotene content and highest carotene content found in variety BhuSona (14.0 mg/ 100 g). Sweet potato variety Bhu Krishna is a rich source of anthocyanin's

Systematic Position of Sweet Potato

Kingdom: Plantae

Division: Tracheophyta

Subdivision: Spermatophyta

Class: Magnoliopsida

Order: Solanales

Family: Convolvulaceae

Genus: Ipomoea

Species: batatas (L.) Lam

The sweet potato plant is an herbaceous perennial vine, bearing alternate heart-shaped or palmately-lobed leaves and medium sized sympetalous flowers (Figure 1). The edible tuberous root is long and tempered with smooth skin. It is considered as the food security crop due to its low agriculture input requirements and high yields in wider climatic conditions. This crop is recently changing from a sustainable low-input, low-output crop to a significant cash crop. It is valued for its short growing period of 90 to 120 days, high nutritional content and sweetness. It is a major conventional crop, growing traditionally in limited area for domestic consumption purpose. The sweet potato is praised as a "poor man's crop" as it characteristically grown and consumed by inadequate communities especially by womenheaded families. As a food security crop, it can be harvested at the point of demand as gradually, also contributing to a reliable source of food and revenue to pastoral farmers who are frequently susceptible to regular crop damages. The sweet potato possesses medicinal qualities which contain anti-diabetic, anti-cancer and antiinflammatory properties which play chief role as an energy and phytochemical source in human nutrition. In regions of Japan, Kawagaa variety of sweet potato has been eaten raw to treat anemia,hypertension and diabetes.

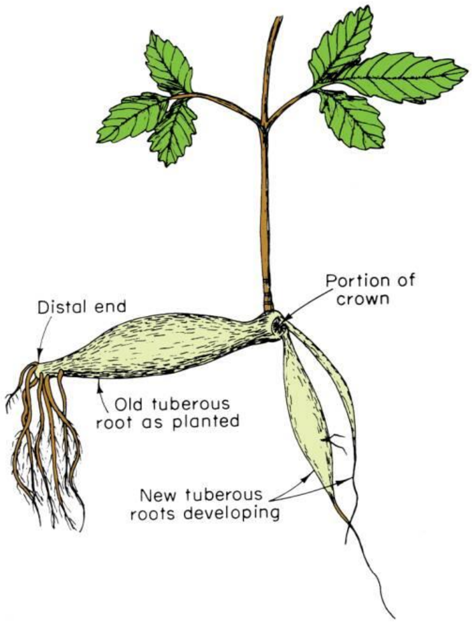

figure 1:Tuberous root of sweet potato

Nutritional Factors of Sweet Potato

T he Sweet potato is a magnificent source of vitamin C, vitamin A and potassium. The Orange-fleshed sweet potato is rich in beta-carotene whereas the Purplefleshed are richer in anthocyanins (Figure 2). The sweet potato(180 g) provides various nutritional compounds which are healthful for consumption are listed below:

- Energy: 162 kcal
- Fat: 0.1 g
- Sodium: 71 mg
- Carbohydrates: 37 g
- Fiber: 3.9 g
- Sugars: 5.4 g
- Protein: 3.6 g
- Vitamin A: 730 mg
- Vitamin C: 35.3 mg
- Potassium: 855 m

A

B

Figure no 2: The beta carotene rich orange fleshed sweet potato [A],Anthocyanins rich purple fleshed sweet potato[B]

Health Benefits OF SWEET POATATO

s weet potato may offer a variety of health benefits. Here are some of the ways in which they may be beneficial to a person's health:

• Improving digestion and regularity: The fiber content in sweet potatoes can help prevent constipation and promote regularity for a healthy digestive tract.

• Protects Vision: Beta carotene, which is essential for eye health, is plenty in sweet potatoes. Eating foods rich in betacarotene, such as orange-fleshed sweet potatoes, may help prevent this condition. Purple sweet potatoes also known to have vision benefits.

• Supports Cardio vascular health: The anthocyanins present in sweet potatoes are also associated with anti-inflammatory effects that reduce the risk of heart disease. Additionally, the fiber in any vegetable reduces cholesterol, while the high potassium levels of sweet potatoes keep blood pressure down.

• Reduced oxidative damage and cancer risk: Diets rich in antioxidants, such as carotenoids, are associated with a lower risk of stomach, kidney, and breast cancers. The sweet potatoes potent antioxidants may reduce your risk of cancer. Purple potatoes have the highest antioxidant activity.

Sweet potatoes are rich source of vitamin A and potassium. They also provide some calcium, iron, magnesium, and folate. The health benefits of vitamins and minerals present in sweet potato are as follows:

• Vitamin C: This antioxidant may decrease the duration of the common cold and improve skin health.

• Potassium: Important for blood pressure control, this mineral may decrease risk of heart disease. • Vitamin E: This powerful fat-soluble antioxidant may help protect your body against oxidative damage.

• Vitamin B6: Plays an important role in the conversion of food into energy.

• Vitamin B5: Also known as pantothenic acid, this vitamin is found to some extent in nearly all foods.

• Manganese: This trace mineral is important for growth, development, and metabolism.

β-CAROTENE

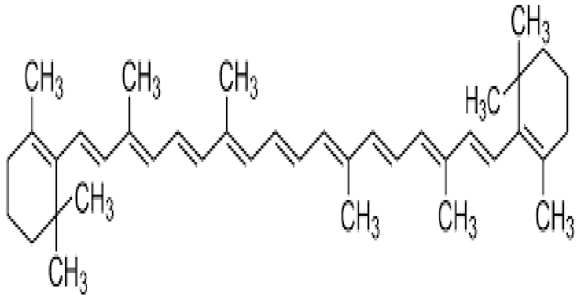

Figure 3: β-carotene

β-carotene is a potent antioxidant: it possesses a high antiradical activity and the ability to neutralize singlet oxygen. Due to these, it can slow down skin ageing processes and prevent sun damage. In living tissues it is partly oxidized to retinal, thus constituting a source of vitamin A. Due to the mechanisms that limit its transformation, β-carotene intake does not pose any danger, even at high doses.

The most important function of β-carotene is the protection against oxidative stress, as the compound constitutes a significant part of non-enzymatic protective mechanisms of the body. It protects the immune system from the damaging activity of the UVA radiation and reduces the risk of developing skin cancer. Additionally, it stimulates the melanogenesis process, at the same time reducing the risks of sun induced irritations, while additionally having anti-ageing properties. In vitro studies have revealed that β-carotene protects liquid crystal lipid structures from UV radiation, lowers the lipid oxidation level and inhibits proline oxidation in collagen, induced by UV radiation. Applied topically, β-carotene protects lipids in the intercellular matrix from oxidation.

Cosmetic applications of β-carotene offer multiple benefits, as approximately 16% of this ingredient permeates the skin. However, its use is limited due to a well-established common belief that this pigment permanently changes skin tone when applied topically

β -Carotene is widely used as an oral sun protectant but studies on its protective effects are scarce. b-Carotene supplements are widely used as so-called oral sun protectants. However, studies on the protective effect of oral bcarotene supplements against skin responses to sun exposure are scarce. The protective effects are thought to be related to the antioxidant properties of the carotenoid. With ultraviolet (UV) irradiation, skin is exposed to photooxidative damage induced by the formation of reactive oxygen species such as singlet molecular oxygen (1 O2), superoxide radical anion (O2 ˙ –), and peroxyl radicals. Photooxidative damage affects cellular lipids, proteins, and DNA and is considered to be involved in the pathobiochemistry of erythema, premature aging of the skin photodermatoses, and skin cancer. b-Carotene, other carotenoids, and tocopherols are efficient scavengers of reactive oxygen species.

Along with the tanning effect, exposure to the UV radiation may adversely affect the skin and the whole body in various ways. The effects of excessive irradiation include among others the loss of skin firmness and the development of wrinkles, as well as the increased risks of developing various forms of skin cancer, in addition to phototoxic and photoallergic reactions. It is therefore crucial to prevent photoageing and to mitigate the results of exogeneous oxidative factors using e.g. the inhibitors of radical reaction. It has been established that this compound is very effective in preventing skin damage and irritation caused by electromagnetic radiation in the range 380-560 nm. The compound inhibits radical reactions without any damage to the cells and tissues. Most probably, its activity is connected with the change in the direction of the energy of radiation through cis-to-trans isomerisation of the carotenoid. A number of studies testify to the fact that no other antioxidants neutralize singlet oxygen to such a degree as β-carotene does. Due to this, the compound is often termed as an "extra sunscreen". The highest SPF of a preparation that contains β-carotene is no higher than 2, yet in combination with typical UVA and UVB filters it can contribute to a very high overall protection against irradiation. The consequences of the exposure to stress factors can be prevented not only through using cosmetics with antioxidants, but also thanks to appropriate oral supplementation. It has been established that β-carotene administered orally has the ability to accumulate in the epidermis and has a significant impact on skin condition, both due to its anti-ageing activity and the capability to reduce skin irritations. It has been proved that the best results are obtained when topical application of this compound is combined with its oral ingestion.

β-carotene antioxidative properties

Ultraviolet radiation (UVA (320-400 nm), UVB (290-320 nm) and UVC (200-290 nm) is the primary environmental factor that seriously affects human skin. Its effects are both positive, such as the vitamin D synthesis, and negative. The major consequences of the exposure to the UV radiation include mutations and the formation of neoplasms, sun-induced irritations, chronic inflammations, and the deterioration in skin immune response.

Due to the action of the UV radiation, DNA in skin cells might be damaged, most often as a result of thymine-to-cytosine transition or the formation of thymine dimers. Accumulated mutations may activate proto-oncogenes or inactivate anti-oncogenes, thus leading to the development of cancer.

Ultraviolet radiation initiates photo-oxidation reactions in the body, harmful for the biologically significant molecules, such as DNA, proteins, enzymes and lipids. It affects the integrity and stability of subcellular structures, and induces such reactions, as inflammatory processes in the skin, epidermal hyperproliferation, the acceleration of cross-linking of collagen fibres, as well as morphological changes in keratynocytes and other skin cells. The first visible reaction to UVB irradiation is an erythema developing several hours after the exposure.

Those properties define the effectiveness of incorporation and the ability to adjust carotenoids to lipid bilayers. Specific interactions with membranes may occur in the presence of both non-polar carotenoids, such as β-carotene and lycopene, as well as more polar ones, such as lutein and zeaxanthin. It has been established that antioxidant abilities of these two classes of compounds are dependent on their different location in phospholipid bilayers

Carotenoids can be regenerated in skin phospholipid bilayer, and due to that, they can participate in the neutralization of skin phospholipid bilayer in the area of high ROS prevalence, while at the same time they are being regenerated in another area through the reduction of ascorbic acid from the side of the cell membrane cytosol, where the level of ROS is low.

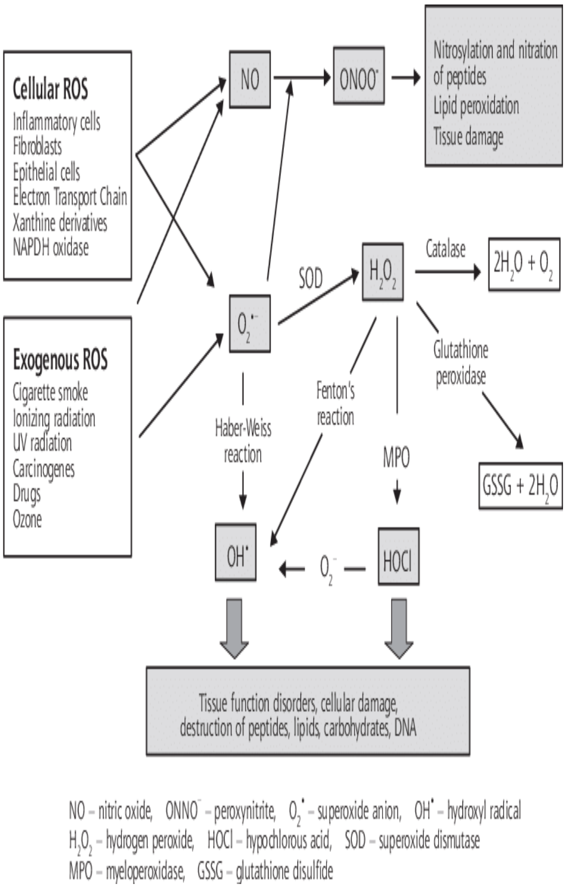

Figure 4: Biological changes evoked by reactive oxygen species.

SUPPLEMETATION OF β-carotene

Diet supplementation with preparations containing β-carotene and other carotenoids has become very popular in recent years. Oral supplementation with carotenoids gives particularly interesting effects due to their ability to accumulate in the skin supplements with β-carotene are not recommended for cigarette smokers, people who abuse alcohol and are exposed to toxic substances in their place of work. The baseline level of β-carotene in the skin is usually rather low, and it has been estimated as 0.03 to 0.4 nmol/g of tissue. The scope of the conducted research varies as far as dosage and supplementation period are concerned. After the application of 24 mg or 30 mg β-carotene daily for the period of 10 or 12 weeks, skin susceptibility to sunlight, measured in terms of erythema intensity, lowers considerably Supplementing the diet with a carotenoid mixture, including three major carotenoids: β-carotene, lutein and lycopene in the dose 24 mg/24 h (8 mg of each/24 h) also provides protection from irritations induced by the exposure to the UV radiation. The effect was comparable with β-carotene used in the same dosage (24 mg/24 h). Simultaneously, a synergistic effect was obtained through the application of topical sunscreens. With the β-carotene supplementation in the amount 24 mg/24 h erythema underwent visible reduction only after 8 weeks. The effect was even more visible after 12 weeks. Similar results were obtained in natural conditions with UV lamps substituted with sunlight It has been observed that in patients with dysplastic nervous syndrome (approximately 6% of the population) the number of nevi grows in the period of adolescence and after the exposition to UV ight. Research findings show that β-carotene applied both orally and topically reduces the frequency of solar-induced melanocytic nevi. Since melanocytic lesions very frequently turn into skin cancer, including melanoma, preventing their occurrence reduces the risk of developing this kind of condition.

Cosmetic applications of β-carotene

After applying carotenoids topically, their distribution in the skin is uneven and shows a significant gradient, with the highest concentration located near the surface (about 4-8 µm deep). β-carotene tends to accumulate more in the epidermis than in the dermis.

For a long time, it was believed that carotenoids, particularly β-carotene which is a key precursor of vitamin A were only converted to vitamin A in the liver and red blood cells. This suggested that applying carotenoids to the skin wouldn't increase vitamin A levels there. However, further experiments were conducted to investigate whether topical β-carotene could be converted to vitamin A directly in the skin.

These studies were done on human skin ex vivo and on mice in vivo. They found that 24 hours after a single application on human skin, the β-carotene level increased by 160 times, compared to a 17-fold increase after 12 weeks of daily oral supplementation. The research also highlighted that β-carotene can effectively penetrate the outer layer of skin (stratum corneum), resulting in a tenfold increase in retinyl esters in the epidermis. Overall, topical application of β-carotene effectively penetrates the epidermis in both humans and mice. Topical application of β-carotene leads to a tenfold increase in the level of epidermal retinyl esters in humans and a threefold increase in mice. This suggests that when β-carotene is applied to the skin, it begins to convert into retinyl esters right in the epidermis.

Ex vivo studies have shown that β-carotene in the human epidermis is first converted to retinal. Then, retinal is reduced to form retinol, which is subsequently combined with fatty acids to create retinyl esters. Therefore, the final products of the conversion of β-carotene into retinoids in human skin are retinyl esters. Similar results were found in studies conducted on hairless mice. The enzyme that converts β-carotene into vitamin A in the epidermis is called β-carotene-15,15'-dioxygenase. As mentioned above, in the group of subjects whose diet had been enriched with β-carotene supplementation for 10 weeks considerably fewer cases of solar-induced irritations were noted than in the control group. Similar effects can be achieved using topical preparations with pro-vitamin A. It is by about 50% that applying 5% β-carotene solution 15 minutes prior to the exposure to the UV radiation reduces the formation of thiobarbituric acid reactive substances (TBARS) in the skin (such as malondialdehyde and other compounds that form thiobarbituric acid coloured derivatives), considered lipid peroxidation markers. The presence of rotenoid indispensable for the optimal protection was 0.40 nmol/mg protein. Corneometer testing revealed that the β-carotene emulsion raised the stratum corneum moisture level by about 20%. Introducing β-carotene into washing agents and hand care creams prevents irritations, itching and skin thinning. Thanks to pro-vitamin A roughness is also reduced, which has a positive effect on skin appearance. As a natural colorant, β-carotene has wide application in colour cosmetics. Recently, natural dyes and pigments have become increasingly popular. β-carotene is treated similarly to other colorants, including anthocyanins, chlorophyll and indigo, and can be used in all cosmetic products. As the majority of natural dyes and pigments that are non-soluble in water, β-carotene is used in such cosmetics as face powders, moisturizers, bath liquids and capsules, cleansing products (lotions, liquids), face and neck care preparations, lipstics, soaps, blushes, bronzers, selftanning products, body and hand care preparations, eye makeup preparations, eyebrow pencils, skin protection products, sunbathing oils, toners, and preparations for hair care and protection One of the methods to improve β-carotene solubility in water is to use cyclodextrins that form inclusion complexes with hydrophobic compounds. The most characteristic property of the altered pigments is their increased hydrophilicity and higher stability in O/W and Si/W emulsions. Due to these, the colour of preparations does not change once applied to the skin.

Anticarcinogenic properties of β-carotene

β-carotene functions as an immunostimulant by enhancing the ability of macrophages to target cancer cells and by increasing the number and activity of T and B lymphocytes. It may influence cancer development by boosting the immune response and can help modulate cancer processes by reducing lipid peroxidation in human skin, acting both as a free radical scavenger and as an inhibitor of lipoxygenase. Lipoxygenase acts on polyunsaturated fatty acids, especially n-6 fatty acids like linoleic and arachidonic acid.

While excessive UV exposure can cause skin aging and increase the risk of skin cancer, β-carotene has been recognized as an anticancer agent. However, further studies have not conclusively shown that it protects against skin cancer. Research found that taking β-carotene orally at a daily dose of 30 mg for four years does not lower the risk of developing basal cell or squamous cell carcinoma, unlike using sunscreen. Interestingly, the incidence of non-melanoma skin cancers shows an inverse relationship with β-carotene levels in blood plasma, suggesting that this carotenoid may have some protective effects against UV-induced skin cancer.

Chemistry and isolation of β-carotene

Carotene is a type of isoprenoid compound and is one of about 600 fat-soluble carotenes found in plants. It's a pigment that gives many fruits and vegetables their orange, yellow, or red color. Carotene is also important for human health, as it can be converted into vitamin A in the body, which is essential for vision, immune function, and skin health and micro-organisms The compound has the chemical formula C40H64 and a molecular weight of 536.88. It is produced through a process where two molecules of geranyl-geranyl diphosphate link together tail-to-tail. This creates a basic carbon structure from which various individual forms can be derived. β-carotene is known for its antioxidant properties, helping to prevent cellular damage and can neutralize up to 1,000 free radicals per molecule. It appears as red to brownish-red or violet crystals or a crystalline powder, primarily in the all-trans form, though it can also contain varying amounts of cis-isomers depending on the formulation.

The all-trans form of β-carotene is quite unstable and can easily change into cis-isomers. When exposed to oxygen, light, and high temperatures during processing and storage, trans-β-carotene quickly undergoes thermal and chemical oxidation, isomerization, and photosensitization. Some key characteristics of β-carotene are detailed in Table 1.

S. No	Characteristics	Description
1	*Structure/chemistry*	
	Molecular formula	$C_{4}0H_{56}$
	Molecular mass	536
	Double bonds	11
	Beta-ionone ring	Present
	Solubility	Highly lipophilic
2	Activity	
	In vitro antioxidant	Modest
	In vitro prooxidant	Yes, at high concentrations and partial pressures
	In vivo antioxidant	Circumstantial evidence for lipids
	Smoking oxidation products	Yes
	Conversion to retinoids	Substantial, by multiple routes
	Immune function	Enhanced
	Cell-to-cell communication	Enhanced
	Cell cycle progression	Circumstantially inhibits
	Carcinogen metabolism	Can modulate
	Animal cancer studies	Antitumor
3	Exposure sources	
	Diet	Dark green, yellow, and orange fruits and vegetables, red palm oil, food colorant
	Dominant source	Carrots, cantaloupe, broccoli, spinach, and mixed greens
	Supplements	Multivitamins, single-source supplements, and food/beverage fortification
4	Metabolism	
	Bioavailability	Poorly available from greens and carrots
		Cooking enhances
		Dietary fat enhances
		Highly available from supplements
	Isomerization	All *trans*-in circulation
	Tissue accumulation	Found in all human tissues
		Supra-accumulation in testes and adrenal glands
	Major storage pool	Adipose tissue and liver
	Circulation half-life	< 12 days
	Plasma concentrations	Multifactor dependency: Diet, Lipoprotein concentrations, Adiposity, and Smoking

Table 1: Some of the characteristic feactures of Beta-carotene

Bioavailability of β –carotene

Overall, the bioavailability of β-carotene is often limited by the other components found in the food. This means that how well the body can absorb and use β-carotene can vary depending on what else is in the meal.. Many studies have been conducted to explore how well β-carotene is absorbed in different model systems. These studies help researchers understand the factors that affect its bioavailability. Fruits and vegetables, along with their by-products, are the main dietary sources of β-carotene. In plant tissues, β-carotene is found in cellular plastids, where it is linked to light-harvesting complexes or forms crystalline structures.

The absorption of β-carotene in humans depends on several factors, including the amount consumed, the conversion of provitamin A carotenoids to vitamin A, and the rate at which it is absorbed and transported. Other factors include the individual's nutrient status, genetics, age, interactions between these factors, the fat content of the diet, and how β-carotene is released in the gastrointestinal tract during digestion.

Encapsulation of β -carotene

The use of β-carotene as a nutraceutical ingredient or natural colorant in foods is limited by several challenges. These include its poor solubility in water, high melting point, chemical instability, tendency to dissolve in fats (lipophilic nature), and low bioavailability, meaning the body has difficulty absorbing it effectively. β-carotene is quite unstable and can easily break down during food processing and storage. This degradation happens because of various factors, including chemical reactions, physical handling, and heat exposure. Because β-carotene is prone to degradation, it can lose its beneficial properties. Its low solubility in water and crystalline form at room temperature mean that it needs to be dissolved in oils or mixed into suitable materials before it can be effectively used in different food products.

Encapsulation techniques can help improve the bioavailability, water solubility, and stability of hydrophobic carotenoids like β-carotene. These methods can protect the carotenoids and make them easier for the body to absorb. To tackle issues related to stability, handling, and bioavailability, β-carotene is often encapsulated. This process opens up opportunities for creating new forms of β-carotene for dietary supplements and food fortification. Microencapsulation, in particular, has been shown to improve the stability of carotenoids, making them more effective in these applications. It is the technique by which sensitive ingredients are packed within a coating or wall material. Different methods for encapsulation of β -carotene in appropriate delivery system, such as nanoemulsion microemulsion, liposome, solid lipid nanoparticles, and complex assemblies with macromolecules are reported. Effectiveness of microencapsulation depends on the method employed. The method of encapsulation has a big impact on factors like moisture content, water activity, particle size, the shape of the microcapsules, and how well the nutrients are encapsulated. Oil-in-water nanoemulsions are seen as an effective, affordable, and easy way to improve the dispersibility, stability, and bioavailability of nutraceuticals. Although nanoemulsions offer better thermal stability, they can still be affected by environmental stresses like heat, freezing, and thawing. Changes in pH can also make the encapsulated compounds less stable.

Physiological benefits of β -carotene

Carotenoids, like β-carotene, lycopene, lutein, and zeaxanthin, are found in various foods and are thought to support bodily functions and help prevent diseases. β-carotene is particularly important because it serves as a source of provitamin A. Vitamin A is a fat-soluble vitamin that plays several critical roles in the body. It is essential for good vision, helping to prevent conditions like night blindness and dry eyes. Additionally, it strengthens the immune system, supports proper growth and development, aids gastrointestinal health, and is important for reproductive system function. Humans lack the ability to synthesize vitamin A de novo and, therefore, must get proper amounts of it from the dietary sources, rich in β -carotene, like dork green leafy vegetables (e.g. spinach), fruits, and vegetables (e.g. carrot, orange, and mango). Growing awareness of the health benefits of β-carotene has led to the creation of functional foods that are enriched with this nutrient.

Beta-carotene can have specific effects on skin health. Here are the advantages and disadvantages of beta-carotene related to the skin:

Advantages

1. Antioxidant Protection: Beta-carotene helps neutralize free radicals, protecting the skin from oxidative stress and reducing signs of aging.

2.Sun Protection: Some studies suggest that beta-carotene can help protect the skin from UV damage, potentially reducing the risk of sunburn.

3. Improved Skin Appearance: Regular intake may lead to a more radiant complexion and a healthy glow, as it can enhance skin color.

4.Wound Healing: It may support skin repair processes and contribute to faster healing of wounds and injuries.

5.Moisturization: Beta-carotene can help maintain skin hydration and overall skin health.

Disadvantages

1.Hypercarotenemia: Excessive consumption can lead to a yellow-orange discoloration of the skin, though this condition is generally harmless.

2.Not a Substitute for Sunscreen: While it may offer some UV protection, beta-carotene should not replace sunscreen or other protective measures against sun exposure.

3.Variable Effectiveness: The benefits may vary among individuals based on factors like skin type, diet, and overall health.

4.Sensitivity: Some individuals may experience sensitivity or allergic reactions to beta-carotene supplements.

5.Dietary Imbalance: Relying too heavily on beta-carotene without a balanced diet may lead to deficiencies in other essential nutrients that are important for skin health.

Material and Methods

Plant material

The study used the sweet potato variety Resisto, known for its dark orange flesh and high β-carotene content, which ranges from 11,987 to 20,525 µg per 100 grams of fresh roots. This variety is also well-liked by consumers for its taste.For the research at the institute, the vine cuttings were grown in a field multiplication block at the Agricultural Research Council (ARC) in Roodeplaat. In the community trial, the vine cuttings came from a local nursery that sourced its planting material from the ARC. Sweet potatoes were cultivated under optimal conditions with high agricultural input for the study. In a rural village in KwaZulu-Natal, South Africa, sweet potatoes were grown with low agricultural input, similar to what is often seen in food-based intervention projects. Soil samples were taken from two different sites and analyzed at the ARC-Institute for Soil Climate and Water using a specific method (ICP-AES).

For sweet potatoes grown under optimal conditions at the research institute, fertilizers were applied before planting and during the growing season, providing 149 kg/ha of nitrogen, 0 kg/ha of phosphorus, and 115 kg/ha of potassium, based on the soil analysis. The soil was prepared using machinery. Three blocks of 60 plants each were established, and overhead irrigation was used when the soil moisture dropped to 40% of what the plants could use. A total of 480 mm of water was supplied, in addition to 150 mm of rainfall during the growing season. Weeds were controlled with chemicals before planting and then managed by hand weeding. Insect pests were controlled using Deltametrin and Chlorpyrifos at specific times after planting, and Folicur was applied to manage a fungal disease.

In the village, vine cuttings were planted in a similar layout to the research site. However, soil preparation was done by hand, and the community applied compost before planting. Water was provided daily using buckets, and no chemical treatments were used for weeds, pests, or diseases.

Samples were harvested at four, five, and six months after planting from both locations. For each harvest, a block of 60 plants was uprooted, and 25 medium-sized roots were randomly selected. From each batch of 25 roots, eight roots (about 3 kg total) were chosen for analysis of total β-carotene content. These fresh roots were taken directly to the Nutritional Intervention Research Unit at the Medical Research Council for preparation and analysis.

Determination of total β-carotene content

From each batch of eight sweet potatoes, the five that were in the best condition were peeled and washed. Then, the roots were cut into quarters, and the two opposite quarters were combined. This mixture was homogenized, and small samples were weighed and stored at -20°C for later analysis. The β-carotene content in about 2 grams of these fresh homogenized sweet potato samples was measured in duplicate using high-pressure liquid chromatography (HPLC), following a previously established method.

Conclusion

sweet potatoes are a powerful source of beta-carotene, which plays a vital role in skin health by promoting cell regeneration, enhancing skin tone, and providing antioxidant protection. Their natural ability to boost keratin production helps improve skin elasticity and overall texture. Incorporating sweet potatoes into your diet not only nourishes your skin from within but also supports a radiant complexion. By embracing this nutrient-rich food, you can enhance your skincare routine and contribute to long-term skin vitality. In conclusion, our study demonstrates that sweet potato beta-carotene is a potent natural keratin booster, promoting skin health through enhanced keratin expression, collagen production, and improved skin elasticity. The findings suggest that sweet potato beta-carotene:

1. Stimulates keratin production, strengthening skin's barrier function.

2. Enhances collagen synthesis, reducing fine lines and wrinkles.

3. Improves skin elasticity, restoring radiant and youthful appearance.

Sweet potato beta-carotene is a natural and effective keratin booster for skin health. Rich in antioxidants and vitamins, sweet potatoes promote:

1. Collagen production

2. Cell turnover and renewal

3. Hydration and elasticity

4. Improved skin texture and tone

5. Enhanced natural barrier function

6. Protection against sun damage and photoaging

References

1. *Chauhan, V.B.S., Behera, S., Pati, K., Bansode, V.V., Nedunchezhiyan, M., 2021. Breeding for drought tolerance in sweet potato (Ipomoea batatas L.). In: Recent Advances in Root and Tuber Crops, (Eds.) More, S.J., Giri, N.A., Suresh, K.J., Visalakshi, C.C. and Tadigiri, S.. Brillion Publishing House, New Delhi, India, pp. 65-87*
2. *Pati, K., Chauhan, V.B.S., Bansode, V.V., Nedunchezhiyan, M., 2021. Biofortification in sweet potato for health and nutrition security. In: Recent Advances in Root and Tuber Crops, (Eds.) More, S.J., Giri, N.A., Suresh, K.J., Visalakshi, C.C. and Tadigiri, S. Brillion Publishing House, New Delhi, India, pp. 21-30*
3. *Ziska, L.H., Runion, G.B., Tomecek, M., Prior, S.A., Torbet, H.A., Sicher, R., 2009. An evaluation of cassava, sweet potato and field corn as potential carbohydrate sources for bioethanol production in Alabama and Maryland. Biomass and Bioenergy 33(11), 1503-1508*
4. *Ndolo, P.J., Mcharo, T., Carey, E.E., Gichuki, S.T., Ndinya, C., Malinga, J., 2001. Participatory on-farm selection of sweet potato varieties in western Kenya. African Crop Science Journal 9(1), 41-48*
5. *Tairo, F., Mukasa, S.B., Jones, R.A.C., Kullaya, A., Rubaihayo, P.R., Valkonen, J.P.T., 2005. Unravelling the genetic diversity of the three main viruses involved in sweet potato virus disease (SPVD), and its practical implications. Molecular Plant Pathology 6(2), 199-211.*
6. *Darr D, Fridovich I. Free radicals in cutaneous biology. J Invest Dermatol 1994;102:671–5*
7. *Taylor CR, Stern RS, Leyden JJ, Gilchrest BA. Photoaging, photodamage and photoprotection. J Am Acad Dermatol 1990;22:1–15.*
8. *Sies H, Stahl W. Vitamins E and C, b-carotene, and other carotenoids as antioxidants. Am J Clin Nutr 1995;62(suppl):1315S–21S.*
9. *Draelos ZD. Cosmetic dermatology. Wiley & Sons, 2015.*
10. *Karr HK. Efficacy of β-carotene topical application in melasma: An open trial. Indian J Dermatol Venereol Leprol 2003, 69: 92-4.*
11. *Morganti P. The photoprotective activity of nutraceuticals. Part II. Nutraceuticals 2009, 27:166-74.*
12. *Rona C, Berardesca E. Aging skin and food supplements: the myth and the truth. Clinics in Dermatology 2008, 26:641-7.*
13. *Harry RG, Rosen M. Harry's cosmeticology. Chemical Publishing Company, Los Angeles 2015.*
14. *Johnson J. Do carotenoids serve as transmembrane radical channels? Free Radical Biol Med 2009, 47: 321-3*
15. *Rutkowski R, Pancewicz SA, Rutkowski K, Rutkowska J. Znaczenie reaktywnych form tlenu i azotu w patomechanizmie procesu zapalnego. Pol Merkur Lek 2007, 23: 131-6*
16. *Woodside J, McGrath A, Lyner N, McKinley M. Carotenoids and health in older people. Maturitas 2015, 80: 63-8.*
17. *Coetzee V, Di Perrett. Effect of beta-carotene supplementation on African skin. J Biomed Opt 2014, 19: 25004.*
18. *Gruber BM, Anuszewska EL. Czy uzasadniona jest suplementacja diety β-karotenem? Prz Lek 2002, 7: 42-7.*
19. *Stahl W, Krutmann J. Systemische Photoprotektion durch Karotinoide. Hautarzt 2006, 57: 281-5.*
20. *Heinrich U, Gartner C, Wiebusch M, Eichler O, Sies H, Tronnier H, Stahl W. Supplementation with beta-carotene or a similar amount of mixed carotenoids protects humans from UV-induced erythema. J Nutr 2003, 133: 98-101.*