Dietary Substances that Influence Aging

Green Tea

Tea is the most widely consumed beverage in the world, after water. Many published studies have shown that green tea’s anti-oxidants, mainly epigallocatechin-3-gallate (EGCG), can help prevent UV-induced skin cancer. In fact, a large review, published in 2012 in the journal Oxidative Medicine and Cellular Longevity, concluded that “Green tea is an abundant source of plant polyphenols that exhibit significant antioxidant, chemopreventive, and immunomodulatory effects in protecting the skin.”

In the Journal of Nutrition (2011), researchers found that green tea polyphenols provide photoprotection, increase microcirculation, and modulate the skin properties in women. In a 12-week, double-blind, placebo-controlled study, 60 women were given either 1 liter of green tea providing 1402 total catechins per day, or 1 liter of a control beverage. At the end of 12 weeks, the women in the green tea group experienced 25% less erythema from UV light and had improved skin structural characteristics, including elasticity, roughness, scaling, density, and water homeostasis.

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The transcription factor that stimulates the cell’s endogenous production of anti-oxidant and detoxification pathways through its effects on nearly 100 different genes, 20 of which are found in the Phase II detoxification system. More recently, Nrf2 has been shown to inhibit NF-kB. In addition, Nrf2 activation provides the skin protection against both UV-A and B radiation.

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In the next installment of this series, we will look at a number of other dietary substances that help to slow down the process of skin aging. These include pomegranate, curcumin, olive oil, fish oil, lycopene, and pomegranate.

Epigenetics

Epigenetics refers to modifications in gene expression caused by heritable changes in DNA methylation and chromatin structure that don’t affect the DNA sequence itself. These changes are potentially reversible and are considered promising new targets for prevention and treatment of certain diseases, as well as helpful for facilitating healthy aging. In terms of skin health, diet and lifestyle are the top 2 epigenetic triggers. It is already well recognized that certain lifestyle choices (e.g., smoking) and excess sun exposure prematurely age the skin. This article explores the more positive impacts that dietary choices can make on the skin.

Skin Aging & Epigenetics

Many theories of aging have been proposed, such as cellular senescence, telomere shortening, mitochondrial DNA single mutations, and free radicals. This paper will focus on the free radical/inflammatory model of aging, which characterizes skin aging by matrix metalloproteinase (MMP) activation, enzymatic degradation of collagen, and the pro-inflammatory transcription factor nuclear factor kappa B (NF-kB), all of which contribute to the observed structural changes involved in skin aging, including wrinkles and loss of elasticity (Figure 1).

Extrinsic aging includes UV damage from the sun, and environmental factors such as pollution, smoking, poor nutrition, and stress. These extrinsic factors deplete antioxidants from our skin, thus increasing free radical formation. Transcription factor AP-1, induced from our skin, thus increasing free radical activity, is the proinflammatory transcription factor that stimulates the cell’s proinflammatory responses.

Studies have shown that it’s possible to delay skin aging and improve skin conditions through the use of antioxidants, which would address the first step in the common pathway of skin aging. The most well-known systemic antioxidants shown to be beneficial in the skin are vitamins C, E, the carotenoids, and the trace elements copper and selenium.

As a counterbalance to the oxidative stress-induced aging process, Nrf2 (nuclear factor [erythroid-derived 2]) like 2) counteracts inflammation and free radical formation. Nrf2 is a transcription factor that stimulates the cell’s endogenous production of anti-oxidant and detoxification pathways through its effects on nearly 100 different genes, 20 of which are found in the Phase II detoxification system. More recently, Nrf2 has been shown to inhibit NF-kB. In addition, Nrf2 activation provides the skin protection against both UV-A and B radiation.

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Figure 1. Factors Involved in Skin Aging

The skin is a complex organ that serves multiple functions, including protection, sensation, and thermoregulation. It is composed of two main layers: the epidermis and the dermis. The epidermis is the outermost layer, responsible for barrier function, while the dermis contains collagen, elastin, and other structural proteins that give skin its strength and elasticity.

### Factors Involved in Skin Aging

**External/Extrinsic Aging**
- Environmental insults (e.g., sun exposure)
- Smoking
- Stress
- UV exposure

**Internal/Intrinsic Aging**
- Genetics
- Oxidative metabolism
- Glycation

### Factors Contributing to Skin Aging

1. **Cumulative Damage**
   - UV radiation, particularly UVA, causes significant damage to skin cells.
   - Other environmental factors can also contribute to skin aging.

2. **Collagen Degradation**
   - Collagen is a major protein in the skin, responsible for its strength and elasticity.
   - Degradation of collagen can lead to skin laxity and wrinkles.

3. **Elastin Loss**
   - Elastin, another structural protein, contributes to skin elasticity.
   - Loss of elastin can result in sagging skin.

4. **Inflammatory Response**
   - Inflammation plays a role in skin aging through the production of cytokines and other mediators.

5. **DNA Damage**
   - UV radiation can cause DNA damage, leading to mutations and skin cancer.

### Nutritional and Functional Ingredients

#### Green Tea Polyphenols
- **Green tea** is rich in antioxidants, including polyphenols, which have been shown to protect skin from UV radiation and reduce inflammation.
- **Bilberry** (Vaccinium myrtillus) and **myrtillus** (Vaccinium vitis-idaea) are rich in anthocyanins, which can protect skin from oxidative stress.

#### Berries
- **Blueberries** are high in antioxidants and can help protect skin from UV damage.
- **Raspberries** are another berry known for their benefits on the body, downregulating inflammation pathways.

#### Pomegranate
- **Pomegranate** is rich in phenolic compounds, such as ellagic acid, punicalagin, and punica nigra.
- **Pomegranate extract** has been found to have a strong anti-inflammatory effect on skin.

#### Cruciferous Vegetables
- **Broccoli** is the richest source of glucoraphanin, the precursor to sulforaphane.
- **Sulforaphane** is a powerful antioxidant that can help protect skin.

#### Pomegranate
- **Pomegranate extract** contains antioxidants that protect skin from UV-induced DNA damage and reduce inflammation.
- **Pomegranate** is also rich in polyphenols that can protect skin from UV damage.

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thereby increasing the minimum level of UV exposure required to induce erythema. Its efficacy to prevent UV-induced skin damage, and thus prevent premature photaging, has been demonstrated in various clinical studies.36

In a 90-day study involving women older than 50, randomised supplemented β-carotene at a dose of either 30 mg/day or 90 mg/day.37 Assessment included measures of facial wrinkles, elasticity, UV-related damage, and procollagen I gene expression. The results demonstrated that the low-dose group, elasticity and wrinkling improved, UV-related damage improved, and procollagen I gene expression was increased.

The carotenoid family decreases reactive oxygen species (ROS) and is considered the most efficient singlet oxygen-quencher in biological systems.38 In another randomized controlled study, women were given either 55g of tomato paste (containing 16 mg lycopene) in olive oil, or olive oil alone, daily for 12 weeks.39 The women ingesting lycopene experienced a reduction in MMP-1, less decrease in fibroelastic and an increase in procollagen I deposition after exposure to UV radiation. In addition to its ROS-scavenging properties, lutein has been found to strongly inhibit MMP-1, IL-6, cyclooxygenase (COX)-2, and MMP-9 in keratinocytes, thus suggesting its value in the prevention of collagen breakdown and wrinkles formation.6

Fats
The first study of its kind that looked at dietary sources of nutrients, not supplements, showed that women with a higher intake of healthy fats (linoleic acid) had fewer wrinkles and firmer skin tone.40 More specifically, “Women with a wrinkled appearance had significantly lower intakes of protein, total dietary cholesterol, phosphorus, potassium, vitamin A, and vitamin C than did women without a wrinkled appearance. Women with senile dry skin had significantly lower intakes of linoleic acid and vitamin C than did women without senile dry skin. Women with skin atrophy had a significantly lower intake of linoleic acid than did women without skin atrophy.”

In a cross-sectional study that included 1264 women and 1655 men between 45 and 60 years old, severity of facial skin photoaging was graded by trained investigators at the beginning of the trial and about 8 years later.41 For both sexes, higher intake of monounsaturated fatty acids (MUFA) provided by vegetable oils was associated with a lower risk of severe photoaging. Within the MUFA group, which included sunflower, olive, and peanut oil, a higher intake of olive oil was found to be significantly associated with a lower risk of severe photoaging.42 Another study, this time with 716 Japanese women, found that higher intakes of total fat, saturated fat, and monounsaturated fat was significantly associated with increased skin elasticity.43 The same study also found that a higher intake of green and yellow vegetables was associated with a decreased wrinkling score.

Fats assist in the absorption of protective, fat-soluble antioxidants like vitamin E, β-carotene, and lycopene. Adding avocado (150 g, or a whole one), for example, to a salad was found in a human trial to increase the absorption of β-carotene by 15 times.44 Avocado's highly bioavailable lutein and zeaxanthin also protect the skin from UV damage by preventing UV-induced inflammation and enhancing DNA repair.45

Eating fish and fish oil also keeps the skin radiant, supple, and less wrinkled. The omega-3 fatty acids found in fish, especially wild salmon and other cold-water fish, are anti-inflammatory, enhance elasticity, protect collagen, and limit UV-induced skin damage. For example, eicosapentaenoic acid (EPA) from fish oil has been shown to inhibit MMPs (MMP-2 and MMP-9) and inflammatory markers such as IL-6, and PGE(2) in a trial of dyslipidemic patients.46 EPA has also been shown to inhibit MMP-1 in human dermal fibroblasts stimulated by UV radiation.47 In addition, a recent study demonstrated that omega-3 fatty acid concentrate from algae inhibited NF-κB in peripheral blood mononuclear cells.48 This blockade of NF-κB has also been shown in previous animal and cellular studies.

And what about loss of elasticity? A study in the Journal of Dermatological Treatment showed a 10% improvement in skin elasticity among women who consumed just over 1 gram of EPA-rich fish oil for 3 months.49 This is not a very large dose of fish oil!

Conclusion
Certain dietary foods and spices are able to mitigate the pernicious effects of skin aging. By supplying necessary antioxidants, which in increased decrease activation of AP-1, blunt the collagen-degrading effect of the MMPs, inhibit the inflammatory effects of NF-κB, and turn on the body’s own endogenous source of antioxidants and detoxifying enzymes, diet can be used epigenetically to retard intrinsic and extrinsic aging.

A prudent epigenetic diet for healthy skin aging would include wild salmon and other fatty fish, blueberries, raspberries, pomegranate and cherries, cruciferous and green leafy vegetables, tomatoes, sweet potatoes, carrots, organic vegetable juice, olive oil, raw nuts and seeds, and green tea.

References available online at ndnr.com

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