

# Anti-aging cosmetics and its efficacy assessment methods

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**Abstract.** The mechanisms of skin aging, the active ingredients used in anti-aging cosmetics and evaluation methods for anti-aging cosmetics were surmised in this paper. And the mechanisms of skin aging were introduced in the intrinsic and extrinsic ways. Meanwhile, the anti-aging cosmetic active ingredients were classified in accordance with the mechanism of action. Various evaluation methods such as human evaluation, in vitro evaluation were also summarized.

## 1. Introduction

As skin ages, it loses its natural elasticity and becomes thinner, more fragile and laxer, taking on a wrinkled appearance. The aging process of the skin generally has two kinds of forms: natural aging and light aging. The former mainly refers to the growth with the age, aging from within the body caused by such as genetic, gravity, endocrine and immune function of irresistible factors; while the latter is mainly due to the role of ultraviolet light, a series of changes in the weather and environmental pollution etc. which aggravates the natural aging process.

According to the mechanism of the senescence of skin, three kinds of methods can be summarized, basically including: protecting the skin from external environmental stimuli; scavenging intracellular free radicals; repair, supplement nutrition to skin cells. The use of some categories of personal care products to improve the appearance of aging is necessary.

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## 2. The mechanisms of skin ageing

Aging of the skin has been attributed to two processes referred to as intrinsic or extrinsic processes. The intrinsic process

### 2.1. The intrinsic process

The intrinsic process occurs through the passage of time, and appears as fine wrinkles on the skin. The endogenous mechanism of skin aging is very complex, and representatives of the aging theory mainly

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include: the free radical theory, theory of genetic gene, mitochondrial DNA damage theory and other theories.

*2.1.1. The theory of free radical.* The free radical theory was introduced by Harman in 1956, its core includes: free radicals are common intermediates in the life of organisms with high chemical activity; On the normal physiological conditions, generation and elimination of free radicals are in dynamic equilibrium in the body; Once this balance is disrupted, resulting in excessive production of free radicals; The excessive free radical toxicity can cause the aging body by attacking on the chromosome, mitochondria, cell membrane and connective tissue and other biological tissues [1].

*2.1.2. The theory of genetic gene.* The theory of genetic gene, mainly analyzes the aging phenomenon from the chromosome and gene level. The doctrine said that, aging is the phenomenon of life determined by a genetic program. Along with the growth of the age, the modified gene loss, DNA methylation and phosphorylation reaction decreases, telomere shortens, DNA self-repair ability drops, oncogene and tumor suppressor gene regulation can result in chromosome mutation, normal cell differentiation [2, 3], all of these can lead to skin aging.

*2.1.3. The theory of mitochondrial DNA damage.* In 1980, Miquel and Cowiker [4] proposed the hypothesis of aging mitochondrial, they thought that mitochondrial DNA damage is the molecular basis of cell aging and death. At the perspective of cell biology, 90% of the energy is produced by mitochondria, which is needed for cells life. While mitochondrial DNA is damaged, the energy producing is reduced, affecting the energy supply of cells, causing a recession of cell, tissue, organ function. Therefore, mitochondria degeneration, rupture and leakage are important reasons for the aging.

### *2.2. The extrinsic process*

The extrinsic process is often referred to as the effects of the environment (such as sun) and other exposures (such as weather) on the skin.

## **3. The active ingredients in anti-aging cosmetics**

According to their functions or effects, anti-aging cosmetics can be divided into three categories: moisturizing cosmetics, antioxidant cosmetics and the biological activity of cosmetics. Active ingredients of different kinds of cosmetics are different. As the study on the bioactive components of knowledge continues to improve, the active ingredients used in anti-aging cosmetics are increasing. The ingredients of scavenging free radicals, cell repairing, moisturizing and UV absorption are discussed here.

### *3.1. The ingredients of scavenging free radicals*

Oxidation is the greatest threat to skin ageing, unhealthy diet, sun, stress, environmental pollution, can make skin free radicals overflow, resulting in looking bleak, and water lack. Therefore, it's necessary to pay attention to the antioxidant in daily life for the health skin.

Vitamin E, vitamin C, superoxide dismutase, coenzyme Q10, zinc sulfate, ferulic acid, green tea, idebenone, polyphenols and carotenoids are the types of scavenging free radicals ingredients.

Djerassi D [5] found that vitamin E can penetrate into the skin and continue to accumulate, so that the skin becomes soft and smooth. Vitamin E is a good active substance to prevent light aging. The effect of sunscreens with vitamin E is more effective, and when the vitamin E and vitamin C are used in combination, the effect is better. In addition, vitamin E also has effects on anti-aging, inhibiting erythema solare, reducing wrinkles and anti-inflammatory.

Pinnell S R [6] conducted the skin penetration absorption experiment and found that any form of vitamin C can be identified and play a role in the body after being converted to ascorbic acid. Hoppe U, Bergemann J et al. [7] found that a concentration of 0.3% ubiquinone can significantly reduce eye

wrinkles depth. There are also documents said, by UV ray irradiation, coenzyme Q10 can inhibit human fibroblast collagenase expression.

### 3.2. *The ingredients of cell repairing*

The decrease of dermal collagen will lead to the decline of skin elasticity and the appearance of wrinkles. Therefore, promoting the growth of collagen can also alleviate the aging of the skin. Vitamin A, retinoic acid, tartaric acid, cell growth factor, collagen protein, beta hydroxy acid, beta glucan are this kind of materials.

Oblong JE, Bissett D L [8] mentioned in their book, retinol and retinyl propionate can effectively reduce facial wrinkles at low concentrations. Duell E A [9] through the skin permeation experiments found, retinol skin permeation effect is better than retinol esters, even better than acid. Djerassi D also found that vitamin A can enhance the skin elasticity, improve complexion and skin texture. Study of Kafi R, Kwak H S et al. [10] shows that, vitamin A has a good repair capacity of natural aging skin. Yaar M, Gilchrist B A [11] proved that all trans retinoic acid can improve the fine wrinkles, pigmentation and depigmentation, facial nevus. Rabe J H, Mamelak A J, McElgunn P J et al. [12] said that the reason that retinoic acid has the efficacy may be due to the fact they have the ability to promote the synthesis of collagen.

Bermann P E [13] found that retinoic acid may contribute to the retention of water to increase the skin. Robert L [14] proved that, long-term use of alpha hydroxy acids (such as glycolic acid, lactic acid, citric acid, malic acid and so on) can improve the skin wrinkles, roughness and color due to light, and may also increase the thickness of epidermis, dermis, collagen synthesis induced by the increased water retention, thereby improving the elasticity of the skin and appearance.

### 3.3. *The ingredients of moisturizing*

The decrease of moisture content of the skin will lead to the decline of protease activity, causing the skin peeling, so moisture is an essential part of anti-aging.

The ingredient of moisturizing is a kind of agent which can lead to the water being attracted to the horny layer so as to increase the skin moisture content. Moisturizing agents currently used in anti-aging cosmetics mainly include: pyrrolidone carboxylic acid salt, sorbitol, glycerol, polyethylene glycol, cholesterol and oleic acid, hyaluronic acid, lactic acid and some microbial fermentation metabolites. Hyaluronic acid is one of the most widely used.

### 3.4. *UV absorption*

The effect of UV radiation on skin can lead to DNA damage directly, the apoptosis or growth arrest. The light aging and natural aging together, cause the skin barrier degradation and the formation of wrinkles and pigmentation, which may cause malignant change and other changes. Therefore, a sunscreen for anti-aging is very necessary. Using ultraviolet light scattering agent or UV absorber can reduce skin damage caused by the sun.

## 4. The efficacy evaluation of anti-aging cosmetics

### 4.1. *In vitro evaluation*

Determination of free radical scavenging capacity and fibroblast proliferation ability of detection are in vitro evaluation.

According to the free radical damage theory, the free radical is the main cause of natural aging and photo-aging skin. Therefore, it's one of the most important indexes that whether the anti-aging cosmetics (raw material) have the ability of scavenging free radicals. At present, the free radical scavenging ability evaluation indexes mainly include: the ability of cleaning 2, 2-diphenyl-1-picrylhydrazyl hydrate (DPPH), the ability of scavenging hydroxyl free radical and superoxide anion.

Can Xin, Zhenyu Wang et al. [15, 16] measured black water extract and *Lonicera edulis* ethanol elution effect on scavenging superoxide anion free radical, hydroxyl radical, DPPH radical,

respectively, and confirmed that black bean water extract and ethanol elution of *Lonicera edulis* have a good ability of scavenging free radicals, and thus can be used in cosmetics.

#### 4.2. *In vivo* evaluation

Methods of human evaluation include: expert evaluation, high-quality image analysis, transepidermal water loss, horny protein changes and clinical data of erythema and dryness and so on [17].

Fu J J J and Hillebrand G [18] through an 8-week, randomized, parallel-group study to compare the efficacy of a cosmetic moisturizer regimen vs. a prescription regimen with 0.02% tretinoin for improving the appearance of facial wrinkles, they found that the cosmetic regimen significantly improved wrinkle appearance after 8 weeks relative to tretinoin, with comparable benefits after 24 weeks. The cosmetic regimen was significantly better tolerated than tretinoin through 8 weeks by all measures.

Watson S, Ogden L F [19] conducted a randomized controlled experimental study on photo-aging effect of anti-aging cosmetics on skin using a baseline assessment, showing that, 43% of the volunteers who used testing products for 6 consecutive months, have an improvement on facial wrinkles. The study also shows that, fibrinogen is the effective biomarkers to repair the leather damaged by the light.

Liu Xiaoying [20] verified that the brown algae extract have effects on improving wrinkles and skin elasticity through the methods of using a high resolution UVA camera measuring the optical properties of skin, the cutometry instrument measuring the elasticity, smoothness, the appearance of wrinkles of skin .

Lerong Zhao [21] used a cream with green plum-blossom extract for 30 volunteers for 4 weeks, by measuring the roughness and elasticity of the skin, and found that cream with green plum-blossom extract can decrease the roughness and the depth of shallow wrinkles of the skin, and strengthen skin elasticity.

## 5. Conclusion

As our knowledge and technology continue to grow, more and more active ingredients are found and used in cosmetics. The mechanism of anti-aging cosmetics according to its active ingredients can be roughly classified into four kinds, moisturizing, removing free radicals, cell repair and UV absorption type. For evaluation of the efficacy of anti-aging cosmetics method, it mainly includes in vitro evaluation and in vivo evaluation. Determination of free radical scavenging capacity and fibroblast proliferation ability of detection are in vitro evaluation. Methods of human evaluation include: expert evaluation, high-quality image analysis, transepidermal water loss, horny protein changes and clinical data of erythema and dryness, etc. It will be an important task to improve the existing evaluation methods and to develop the new model in the field of anti-aging cosmetics in the future.

## References

- [1] Bemstein E F 2002 *Dermatol Surg* **28** 132-5
- [2] Lin Fang 2010 *People's Military Surgeon* **53** 149-52
- [3] Zou Y, Song E and Jin R 2009 *Skin Res. Technol.* **15** 399-406
- [4] Juhong Wang 2003 *Journal of Hexi University* **2** 94-8
- [5] Djerassi D 2001 *Cosmetics and Toiletries Manufacturers Worldwide* **10** 22-25
- [6] Pinnell S R 2001 *Dermatol Surg* **27** 137-42
- [7] Hoppe U, Bergemann J and Diembeck W 1999 *Biofactors* **9** 371-8
- [8] Oblong J E and Bissett D L 2005 *Procedures in Cosmetic Dermatology* **2** 35-42
- [9] Duell E A 1997 *J Investig Dermatol* **109** 301-5
- [10] Kafi R, Kwak H S and Schumacher W E 2007 *Arch Dermatol* **143** 06-12
- [11] Rabe J H, Mamelak A J and McElgunn P J 2006 *J. Am. Acad. Dermatol.* **55** 1-19
- [12] Bermann P E 2007 *NursClin North Am* **42** 485-500
- [13] Robert L, Bronaugh, Linda M, et al.2010 *Textbook of Aging Skin* (Berlin: Springer) 1063-8

- [14] Can Xin 2012 *Journal of Hebei United University (Natural Science Edition)* **34** 115-8
- [15] Zhenyu Wang 2012 *Science and Technology of Food Industry* **33** 163-74
- [16] Griffiths T W 2010 *British Journal of Dermatology* **162** 469-71
- [17] Fu J J J, Hillebrand G and Raleigh P 2010 *British Journal of Dermatol* **162** 47-54
- [18] Watson S and Ogden L F 2009 *British Journal of Dermatology* **16** 419-26
- [19] Xiaoying Liu, et al. 2012 *Detergent & Cosmetics* **35** 33-7
- [20] Lerong Zhao 2012 *Flavor Fragrance Cosmetics* **4** 33-6