Bioactive compounds from natural product extracts in Taiwan cosmeceuticals—Mini review.

Chien-Hsing Lee¹, Guan-Cheng Huang²*, Chung-Yi Chen³*

¹Department of Pharmacology, Graduate Institute of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan
²Department of Internal Medicine, Division of Hematology and Oncology, Yuan’s General Hospital, Kaohsiung, Taiwan
³Department of Nutrition and Health Science, School of Medical and Health Sciences, Fooyin University, Kaohsiung, Taiwan

Abstract

Botanicals (herbal materials and extracts) are primarily added to the formulations due to different related properties such as antioxidant, anti-inflammatory, antiseptic and antimicrobial effects. The bioactive compounds from natural product extracts have been successfully utilized in various applications of the skin care. The bioactive compound from natural product extracts does not possess any side effects on the human body instead of providing the body with nutrients and other useful minerals. The cosmetic industry takes the advantages of natural extracts for cosmetics products to promise a gentler, less side effects to beauty compared to synthetic cosmetics. Therefore, the market of bioactive compounds from natural product extracts is increasing rapidly in cosmeceuticals. This review attempts and emphasizes the natural product extracts in Taiwan cosmeceuticals.

Keywords: Botanicals, Cosmeceuticals, Natural product extracts.

Accepted on May, 27, 2017

Introduction

In recent years, alternative medicine and complementary have become increasingly popular and even considered a highly acclaimed practice in the world. Botanicals, which by definition are plant-derived products, play an important role in the market for natural remedies. They are extremely ancient and have been used in various cultures for centuries, representing the earliest medications used by humans. The current popularity of bioactive compound from natural product extracts has occurred for several reasons, and is based on a greater public access to health information, which has led to the formulation of wild selection and assumptions of allopathic medicine as well as concerns about the side effects of chemical drugs. In contrast, the opinion of bioactive compound from natural product extracts is introduced by patients into a “natural” source, which they associate with safety.

Several of the available products derived from bioactive compound from natural product extracts have been applied for their dermatologic benefits, especially in cosmetics. The natural-based cosmetics are collectively referred to as “cosmeceuticals” introduced by Albert Kligman two decades ago [1]. Cosmeceuticals are defined as intermediary substances between drugs and cosmetics. They do not require Food and Drug Administration (FDA) approval before being marketed. A discussion of all the currently available bioactive compounds from natural product extracts used in dermatology and dermatologic formulations would far exceed the scope of this article. Therefore, we focused on a select group of the most popular bioactive compounds from natural product extracts in Taiwan cosmeceuticals in the review.

Bioactive compounds from natural product extracts

The term “botanicals” subsumes numerous preparations derived from herbs, roots, stems and other materials of botanical origins. Botanicals are used for cosmetic purposes in the form of fresh plants or extracts. The use of plant extracts and herbs has roots in ancient times, with the earliest records coming from ancient China and Egypt. The cosmetic industry is taking good advantages of this trend by introducing plant extracts from seeds, herbs, flowers and fruits to their products, promising a gentler approach to beauty. The guiding principle of bioactive compounds from natural product extracts is that the naturally occurring mixture of active compounds in plants is more effective and safer than individual molecules and manufactured combinations of synthetic molecules [2]. These products with active compounds are referred to as “cosmeceuticals” [3].

Bioactive compounds from natural product extracts are focused on improving the total “body condition”. Botanical sales in 2002 in the United States exceeded $4.3 billion and grew by
one-third over only 6 years. Taiwan’s online cosmeceuticals market is worth around NT$36 billion (US$1.2 billion) a year, with sales showing steady year-on-year growth. Bioactive compounds from natural product extracts growth has increasing to now consume 25% of all health- and lifestyle-related dollars [2]. Now over 60 various bioactive compounds from natural product extracts are formulated into cosmeceuticals. Most bioactive compounds from natural product extracts possess several effects and often display different simultaneously, such as antioxidant, anti-inflammatory, anticarcinogenic, and pigment-lightening activity. Various herbal crude drugs with their parts used for cosmeceuticals are given below. This article mainly reviews the bioactive compounds from natural product extracts in Taiwan cosmeceuticals.

**Botanical antioxidants**

**Soy:** Soy belongs to the pea family (Leguminosae) can be obtained by eating tofu or soybeans and drinking soymilk. It has been used for food and medicinal purposes for 5000 years in East Asia. The soybean trypsin inhibitor and Bowmann-Birk inhibitor, derived from soymilk, can induce skin depigmentation by inhibiting protease-activated receptor-2 (PAR-2) activation, which is responsible for the regulation of the ingestion of melanosomes by keratinocytes [4-6]. In large randomized, double-blind, vehicle-controlled study, a novel soy moisturizer containing nondenaturated soybean trypsin inhibitor and Bowmann-Birk inhibitor, demonstrated a significant improvement in mottled pigmentation, blotchiness, dullness, fine lines, overall texture, skin tone and appearance [7-9]. Furthermore, several preliminary *in-vivo* human studies have demonstrated that the skin-lightening effect of nondenatured soy extracts [10,11].

**Silibinin:** Silibinin, also known as silybin or silibin in literature, is a polyphenolic flavonoid or flavonolignan compound that can be extracted from the seeds of the milk thistle plant *Silybum marianum* and also in artichoke (*Cynara scolymus*). It is used clinically as an antihepatotoxic agent and a supplement. Silibinin has antioxidant, anti-inflammatory, and anticarcinogenic properties [12-14]. Several studies have demonstrated photoprotective effects of topical applied silibinin prior to, or immediately after, ultraviolet (UV) irradiation [15-17]. They showed a reduction in thymine dimer-positive cells and an up-regulation of p53-p21/Cip1, which they believe may ultimately inhibit cell proliferation and apoptosis [18-20], suggesting that mechanisms other than sunscreen effects are integral to the efficacy of silebinin against UV-induced skin damage [21]. Silibinin is included in various antiaging and sun-protective skin care products [22]. In addition, silymarin/silibinin is found in a number of high-end moisturizers to prevent cutaneous oxidative damage and photoaging. RosaCure+, is sold as an anti-redness cream with silymarin, decreases the appearance of facial redness as in rosacea-prone skin, sooth reactive skin and even out skin tone [15].

**Pycnogenol:** Pycnogenol is extracted from the bark of the French maritime pine tree *Pinus pinaster*. The extract is rich with flavonoids and monomeric phenolic compounds, such as catechin, epicatechin, taxifolin, and procyanidins, also called proanthocyanidins. Proanthocyanidins are well-known potent free radical scavengers, and the free radical-scapenging effects of pycnogenol have been well documented [23,24]. Oral supplementation with pycnogenol has been shown that photoprotection in humans was demonstrated by a significantly increased UV radiation level needed to reach one minimal erythema dose. The mechanism is through the inhibition of nuclear factor-κB-dependent gene expression by pycnogenol has also been discussed [25]. Pycnogenol can also be used as a depigmentation agent. In clinical trial, 30 women showed a significant decrease in the average surface area of melasma with melasma supplemented with 25 mg of pycnogenol in three meals a day [26]. Pycnogenol is included in sunscreens and various other skin care products.

**Curcumin:** Curcumin is native to India and other Asian countries, which is the active compound in turmeric. Turmeric is widely applied in various fields such as cooking, medicine, beauty, and health products [27-33]. In South Indian, women used turmeric for skin care owing to its multibeneficial activities including in natural beauty products with yellow pigments, moisture retention, antiaging, and antioxidant activity [34-39]. In addition, turmeric has been improved to enhance the bioavailability in cosmeceutical product and increase antioxidant activity owing to nanodelivery techniques such as solid lipid nanocarriers, nanoliposomes, nanoniosomes, and nanoemulsions [40-42].

**Ginseng:** Ginseng is a representative medicinal herb belonging to the Araliaceae family, which is seven major species of ginseng distributed throughout East Asia, Central Asia, and North America [43]. Several reports have been shown that ginsenosides as potential cosmeceutical agents due to their beneficial effects on skin health. Ginsenosides have been used for 1000 years and are one of the safest and most potent natural antiaging agents for skin in terms of skin cosmetology. Several works of traditional literature have mentioned that ginsenosides possesses the skin protective and improving effects [44-47], antiwrinkle formation, as well as protection against excessive sun exposure using *in vitro* [44,48] and *in vivo* models [47,49,50]. Among the various ginsenosides, ginsenoside Rd and compound K, in particular, have received increased attention for their natural antiaging effects to as cosmeceutical ingredients.

**Botanical anti-inflammatories**

**Ginkgo biloba:** Ginkgo biloba is the last member of the Ginkgoaceae family, which grew on earth some 200 to 250 million years ago. The plant leaves contain unique polyphenols including in terpenoids (ginkgolides, bilobalides), flavonoids, and flavonol glycosides with anti-inflammatory effects. In experimental fibroblast models, the antiradical and antiperoxidant effects have been demonstrated to associate with the anti-inflammatory effects [51]. Furthermore, Ginkgo
flavonoid fractions such as quercetin, kaempferol, scidopitysin, ginkgetin, and isoginkgetin have been shown to induce human skin fibroblast proliferation in vitro \cite{52,53}. Thus, ginkgo extracts are applied to many cosmeceuticals as antioxidants and promoters of collagen synthesis after resurfacing based on nonhuman models of oxidative damage.

**Green tea:** Green tea originates in China and has been consumed as a popular beverage in Asia for many years. It recently has gained great popularity in the West resulted from its antioxidant and anticarcinogenic effects \cite{54}. Green tea is derived from the Camellia sinensis plant through special preparation of the tea leaves in the short steaming and no fermentation situation which preserve the antioxidant activities of polyphenols. The active ingredients identified in the leaves are flavanols, commonly known as catechins consists of four major polyphenolic catechins \cite{55,56}. (-)-Epigallocatechin-3-O-gallate (EGCG) is the most abundant and biologically active component, and is mainly responsible for the antioxidant effects, down-regulate UV-induced expression of AP-1 and NF-kB, as well as suppress metalloproteinase \cite{57-60}.

In human skin, the photoprotective effects of polyphenols have been demonstrated to decrease in UV-induced erythema, a decline in the number of sunburn cells, protection of epidermal Langerhans cells and decrease in DNA damage \cite{61}. The molecular mechanisms involved in Ras and activator protein-1, both of which are a part of the mitogen-activated protein kinase pathway \cite{62}. In addition, EGCG has been shown to reduce interleukin-10 production and increase interleukin-12 production, two major cytokines mediating UV-induced immunosuppression, thus reducing UV-induced immunosuppression \cite{63}. Meanwhile, the augmentation of interleukin-12 further leads to increase synthesis of enzymes repairing UV-induced DNA damage \cite{64}. EGCG also seems to reduce collagen degradation, which leads to photodamage by down-regulating the UV-induced expression of activator protein-1, nuclear factor-kB and the suppression of metalloproteinases \cite{65}. Green tea polyphenols administered orally pre-exposure were shown to inhibit UV-B-induced protein oxidation and expression of matrix-degrading matrix metalloproteinases in vivo \cite{59}. These data support the role of green tea polyphenols as a potent antiphotoaging compound. Meanwhile, the over-the-counter skin care products of green tea are included in shower gels, toothpastes, depilatories, shampoos, perfumes, and popular soft drinks.

**Botanical skin-soothing agents**

**Aloesin:** Aloesin is a C-glycosylated chromone derived from Aloe vera \cite{66}. It acts as a competitive tyrosinase inhibitor, reducing both the hydroxylation of tyrosine to dihydroxyphenylalanine and oxidation of dihydroxyphenylalanine to dopachinone \cite{67}. Aloesin showed a dose dependent decrease in tyrosinase activity in cultured normal melanocytes \cite{68}. When administered four times a day for 15 days for hyperpigmentation in human skin after UV radiation, aloesin suppressed pigmentation by 34% compared with the control \cite{69}.

**Allantoin:** Allantoin is approved by the German Commission E to treat blunt injuries owing to the activity of triterpene saponins, tannins, and silicic acid, as well as allantoin \cite{2}. Allantoin has been extracted from the comfrey root and leaves but is now commercially manufactured. Allantoin is an antiphlogistic, antioxidant, and soothing keratolytic that has an antitrichomonal effect and induces cell proliferation. It is listed in the FDA over-the-counter monograph as a safe and effective skin protectant at 0.1 to 2.0% \cite{2}. Allantoin and/or comfrey-based products are used to treat wounds, ulcers, burns, dermatitis, psoriasis, impetigo, and acne. When formulated with surfactant and benzalkonium chloride, allantoin is an effective hand sanitizer and onychomycosis therapy \cite{70}. Allantoin formulated with onion (Allium cepa) extract in a proprietary topical formulation improved the signs and symptoms of scars and keloids \cite{71}. No photoaging clinical trials using topical allantoin have been published.

**Camphor:** Camphor ((1R)-1,7,7-trimethylbicyclo[2,2,1]heptan-2-one) is obtained from turpentine oil or extracted naturally from the oil distilled flower and leaves of Camphor tree belong to Cinnamomum camphora family Lauraceae \cite{72,73}. It has a long-valued history for a traditional medicine in treatment of sprains, swelling, and inflammation \cite{74}. In addition, camphor is used commercially as a moth repellent and as a preservative in pharmaceuticals and cosmetics \cite{75}. A recent study has shown that the benefit of camphor in skin health through inducing fibroblast proliferation, maintaining or recovering collagen and elastin production in UV exposed skin, and preventing thickening of the epidermis and subcutaneous fat layer \cite{74}. Therefore, camphor is a potent antiwrinkle agent with considerable potential for use in cosmeceuticals.

**Discussions**

Synthetic ingredients in cosmetics effected skin even faster than bioactive compounds from natural product extracts. Therefore, manufacturers are striving to develop natural products containing all natural ingredients. Plant materials may be a viable alternative owing to a significant source of active constituents with a high level of antimicrobial activity compared to synthetic ingredients. Consumers consider these materials more beneficial to the body and less toxic than synthetics. Meanwhile, this use is concordant with the all-natural concept ingredients the personal care and cosmeceutical industries. However, plant derived ingredients are limited. The plants produced toxic metabolites, the plants grow too slow as a result of a seasonal harvesting and the concentration of plant constituents is unstable due to the different harvest or the unpredictable factor such as climate and pests.

**Conclusion**

This discussion of bioactive compounds from natural product extracts has reviewed some of the currently popular botanicals in Taiwan cosmeceuticals, their biologic effects, and currently available scientific data. What all discussed bioactive
compounds from natural product extracts have in common is a need for controlled clinical trials in humans to prove what has been shown so far in vitro or in animal models. Furthermore, scientific data obtained on the respective bioactive compounds from natural product extracts in vitro and/or in vivo should also be estimated in the final cosmetic formulation.

References

28. Balasubramanian S, Roselin P2, Singh KK3, Zachariah J4, Saxena SN5. Postharvest Processing and Benefits of Black...
Bioactive compounds from natural product extracts in Taiwan cosmeceuticals - Mini review


57. Wei H, Zhang X, Zhao JF, Wang ZY, Bickers D, Lebwohl M. Scavenging of hydrogen peroxide and inhibition of


63. Katiyar SK, Challa A, McCormick TS, Cooper KD, Mukhtar H. Prevention of UVB-induced immunosuppression in mice by the green tea polyphenol (-)-epigallocatechin-3-gallate may be associated with alterations in IL-10 and IL-12 production. Carcinogenesis 1999; 20: 2117-2124.


*Correspondence to
Chung-Yi Chen
Department of Nutrition and Health Science
School of Medical and Health Sciences
Fooyin University
Taiwan
Guang-Cheng Huang
Department of Internal Medicine
Division of Hematology and Oncology
Yuan’s General Hospital
Taiwan