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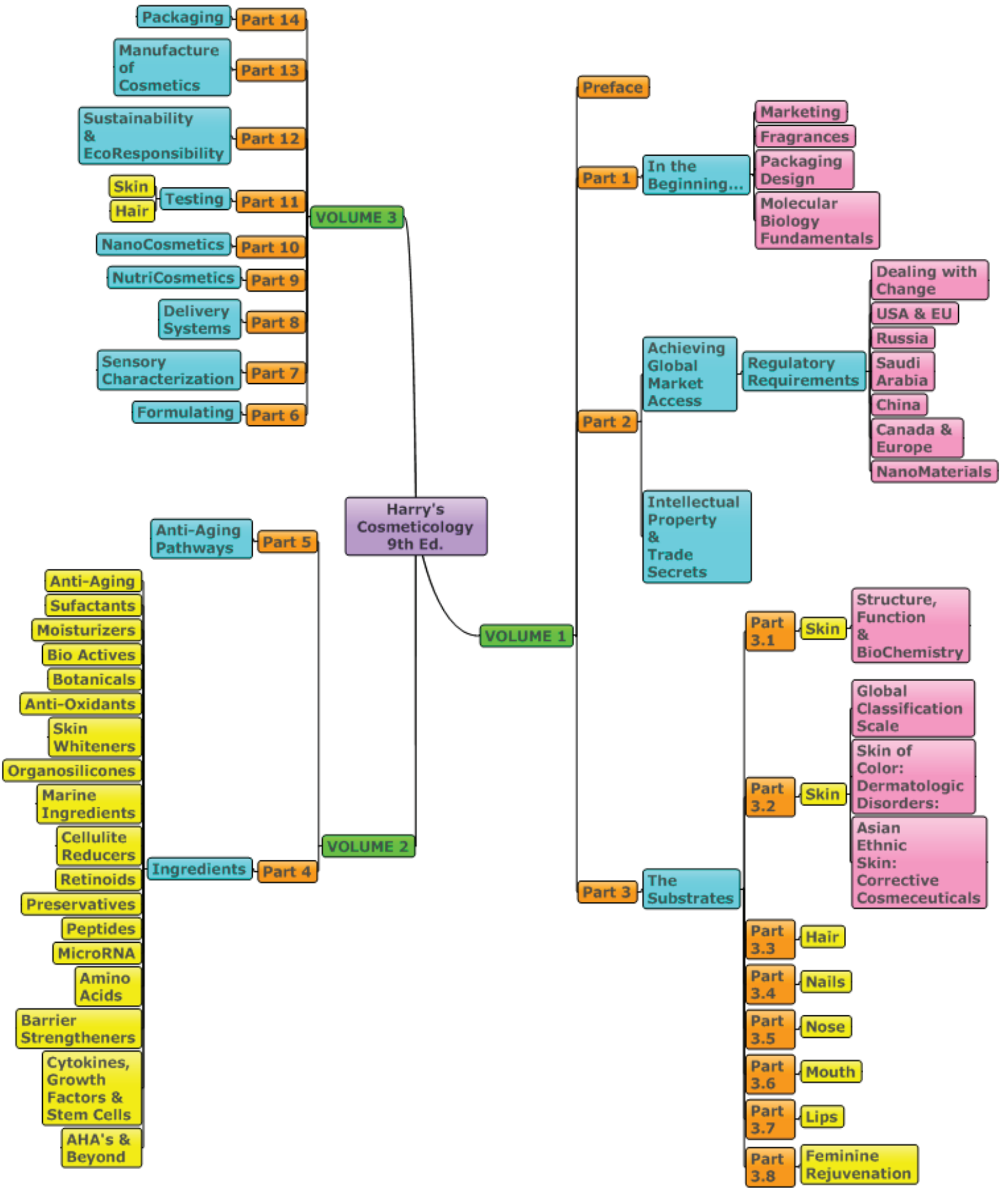
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MULTI-FUNCTIONAL BOTANICALS FOR NUTRICOSMETICS APPLICATIONS

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ABSTRACT:

The statement “Beauty from within” perhaps best describes the field or purpose of Nutricosmetics. Though considered a niche market in the West, the realization that skin health is affected by inner health is not new. The skin is the largest organ of the body and it not only provides cover and protection to inner organs, it also acts as a secondary organ of elimination. Whatever we eat or enters through the gastrointestinal tract is in some way expressed on the skin, hence the phrase “We are what we eat” makes sense. Even ordinary skin problems such as acne, rashes, dryness, or oily skin can be traced back to the food we eat. Today Nutricosmetics is viewed as a hybrid field of Cosmeceutical and Nutraceuticals. In this chapter we will be discussing the nutricosmetic potential of selected botanicals, their activities, and the formulation of concepts using these botanicals.

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9.2.1 INTRODUCTION

Though the concept of nutricosmetics is quite old, the idea of capitalizing on the concept of beauty foods is relatively new. One of the first nutricosmetic products introduced in the market was Imedeen, by Swedish biochemist Ake Dahlgren in the 1980s. The product contained certain marine extracts for restoring the structure and function of skin (F. Heule et al. 1992). Since then the nutricosmetic market has come a long way, with new innovative products getting launched into the global market every year.

9.2.2 GLOBAL MARKET

Emphasis on skin care and healthy aging has been a prime driving force for the sales of nutricosmetics. Greater appreciation of role of nutrition in the skin's health is one of the causes of a booming market in Japan. The beauty market of the cosmetics and nutricosmetic industry has been showing a steady growth, with beauty food accounting for almost 19% of dietary supplement sales there. Total sales for 2010 were estimated to be 1.3 billion U.S. dollars.

Japan dominates the nutricosmetic market, with sales of over a billion dollars in 2010. Being an aging society, Japanese consumers are more concerned about skin beauty and aging.

Not far behind is China, with sales of 813 million U.S. dollars as reported by Eurometer (*Nutraceutical World* 2011).

The driving force for the growth of nutricosmetics is customized solutions provided to consumers, as in cosmetics. There has been a growing trend of segmenting the products based on requirement for skin health. Hence one can find products that are age, skin-condition, and even gender specific.

9.2.3 AYURVEDA AND NUTRICOSMETICS

The concept of beauty in Ayurveda, or “science of life,” is not limited to external beauty but also to inner beauty. The use of herbs both externally and internally has been advised in Ayurveda for good skin health. Ayurveda also believes in customized skin care, based on the fact that there is more than one kind of skin, depending on the constitution of the person. “One-size-fits-all” solutions don’t exist.

According to Ayurveda, skin health and youthfulness are dependent on a number of factors such as balance in the three *doshas*—Kapha, Vata, and Pitta. Doshas are primal metabolic forces as conceptualized for understanding the action of five basic elements (earth, water, fire, air, and ether) and for therapeutic application in diagnosis and treatment. The term *doshas* itself means “fault,” and represents the ways that a particular energy is out of balance. Skin can also be classified on the basis of doshas into three types—Vata, Pitta, and Kapha skin (K.P.S. Khalsa and M. Tierra 2008).

Thus for a youthful skin there should be a harmony in these three doshas—proper moisture balance (Kapha balance), proper functioning of metabolic mechanisms that coordinate all the chemical and hormonal reactions of the skin (Pitta balance), and efficient circulation of blood and nutrients to the different layers of skin (Vata balance).

9.2.4 MULTIFUNCTIONAL NUTRICOSMETICS

In the following section we will be discussing a few of the potential nutricosmetic ingredients obtained from nature or nature-derived resources. Apart from their nutricosmetic benefits, they also affect the health when administered orally as food or dietary supplements. For example, Indian gooseberries are well known for their digestive, detoxifying, and immune-boosting health benefits.

a. Amla

Amla or *Emblica officinalis* is one of the most revered fruits in Ayurveda. It is regarded as one of the best rejuvenating herbs in the Ayurvedic tradition and has been used as an adaptogen in several Ayurvedic formulations. Amla can also be used as a nutricosmetic for its antioxidant and anti-aging potential.

Emblica officinalis has been used for a variety of health conditions in Indian folk medicine such as metabolic disorder, liver diseases, stomach ulcers, and also skin disorders. *Emblica officinalis* has also been studied for its collagen-promoting action as well as its inhibitory action on matrix metalloproteinase enzyme in the human skin.

Amla has shown to increase pro-collagen type I C-peptide and tissue inhibitor of metalloproteinase-1 (TIMP-1) production and to decrease MMP-1 production, concomitant with elevated mitochondrial activity in the fibroblast in a concentration-dependent manner (Fuji et al. 2008). This activity has potential in both cosmetic and nutraceutical applications.

In a 2010 study, its efficacy to inhibit UVB-induced photo-aging was studied in human skin fibroblast cells. *Emblica officinalis* not only stimulated fibroblast proliferation, but also protected the pro-collagen-1 against UVB, and inhibited inflammatory enzymes such as hyaluronidase. The study results showed that *Emblica officinalis* can effectively inhibit photo-aging in human skin fibroblasts (M.D. Adil et al. 2010).

Anticarcinogenic activity of *Emblica officinalis* on DMBA (7,12 – dimethylbenz(a) anthracene)-induced skin cancer was studied in Swiss albino rats. Results showed that antioxidant activity of *Emblica officinalis* can help to restore the imbalance between oxidative stress and antioxidant defense and limit oxidative tissue damage (G. Sancheti et al. 2005).

Saberry®, a biostandardized extract of Amla, has been developed with high ORAC activity, which is also a measure of antioxidant activity. The results from the ORAC assay on Saberry® are given in Table 1.

Table 1: ORAC activity assay on Saberry®

ORAC Hydro ($\mu\text{mol TE/g}$)	ORAC Lipo ($\mu\text{mol TE/g}$)	ORAC Total ($\mu\text{mol TE/g}$)	HORAC ($\mu\text{mol CAE/g}$)	NORAC ($\mu\text{mol TE/g}$)	SORAC (Kunits SODeq/g)	SOAC ($\mu\text{mol VitE/g}$)
2678	4	2682	345	904	102	1351

Saberry®, a light-colored extract standardized for beta glucogallin, is obtained from a proprietary extraction process enabling the preservation of natural actives in the amla.

Saberry® is a completely water-soluble and light-beige-colored extract, making it a suitable ingredient for **Beauty Beverages**. When dissolved in water it imparts sweetness to the beverage. Saberry® is also a good constituent to be added in collagen beauty supplements because of its MMP-1 inhibitor activity, which assists the pro-collagen formation.

Saberry®, with self-affirmed GRAS status, can also be added into the beauty food or beverages. It is stable in beverages as well as solid-dosage formulations. Saberry® is completely soluble in water and gives a sweet aftertaste to beverages. The recommended dosage range is between 100 and 500 mg daily.

b. Green Tea

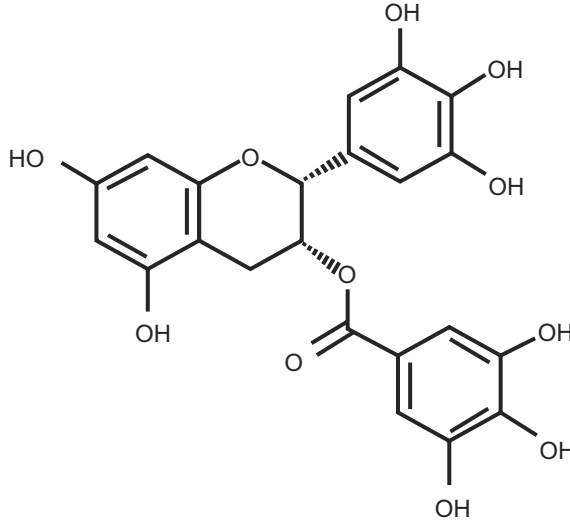


Fig 1.: Epigallo catechin gallate

Green tea, consumed as a beverage around the world, has many health benefits associated with it. Green tea is produced by steaming fresh leaves at high temperature, thereby inactivating the oxidizing enzymes and leaving the polyphenolic content intact (F. Liudong et al. 2011). Polyphenols such as epigallo catechin gallate (Fig. 1) present in green tea are regarded as active constituents and are used for standardization of green tea extracts. Green tea is also known to possess anti-inflammatory, antioxidant, and anticarcinogenic qualities (S.K. Katiyar 2003). Green tea has potential application as an anti-aging as well as a photo-protective ingredient in nutricosmetics.

It was observed that oral consumption of green tea polyphenols inhibits chemical carcinogens or UV radiation-induced skin carcinogenesis in animal models (S.K. Mantena et al. 2005); green tea is thus advocated for its UV protective action. Based on the results of the study, it was suggested that daily oral consumption of green tea may provide protection against the harmful effects of UV radiation on skin.

In a 2005 study on 40 women subjects with moderate photo-aging, both topical and oral supplementation with green tea were studied for their effect on photo-aging skin. In the study, subjects were randomized to either a combination of 10% green tea cream and a 300-mg green tea supplement twice a day. The results showed that subjects who were treated with a green tea regimen of both topical and oral supplementation had improved elastic tissue content in the skin. The results suggest that green tea polyphenols (catechins) could help to mitigate UV radiation damage in skin (Chiu et al. 2005).

In a very recent study done on humans, it was found that metabolites of green tea catechins are actually incorporated into human skin upon consumption of green tea extract, and can protect the skin against UV radiation-induced cutaneous inflammation. A study performed at the photobiology unit of Manchester University, UK, found that green tea catechins were able to reduce the UV radiation-induced 12-HETE (hydroxyeicosatetraenoic acid). However, the PGE2 levels were unaltered.

This study was carried out on 16 healthy human subjects who were given 540 mg of green tea catechins and vitamin C (50 mg) supplement daily for 12 weeks. The buttock skin was exposed to UV radiation both pre- and post-supplementation of green tea, and resultant erythema and inflammatory markers were quantified.

The study results show that oral consumption of green tea catechins may contribute to protection against sunburn, erythema, and perhaps even long-term UV radiation-induced damage to skin (L.E. Rhodes et al. 2013).

The above studies show us that green tea catechin has a potential role as a nutraceutical for protecting skin against harmful UV damage. Green tea supplements along with green tea-based topical products can provide essential antioxidant benefits and protect skin from UV damage. Green tea extracts are available in several strengths and are standardized to polyphenols or specific catechins. The HPLC analysis is more dependable, as it provides information on the specific catechin content and is not interfered with by the presence of other green tea components. Green tea extracts are also available as decaffeinated products to avoid the side effects of excess caffeine intake. As water-soluble extracts, they can be formulated in a variety of ways and supplements such as RTD tea, or in dry formulations such as tablets, caplets, or stick packs.

c. Ellagic acid (Pomegranate)

Pomegranate is considered a superfruit in India. It is also cultivated in Iran, the Mediterranean belt, the Middle East, tropical Africa, North Africa, and the Indian subcontinent. It is also extensively grown in China and Southeast Asian countries. Though not native to Japan, pomegranate is used for bonsai because of its unusual twisted stem. It is mentioned in several ancient texts such as Ayurveda, the Book of Exodus, and the Quran. In the Ayurvedic system of medicine, pomegranate fruit has been the source of traditional remedies since ancient times against diarrhea, for toning skin, treating hemorrhoids, and as a tonic for yjr heart (Ch. Murli Manohar 2002). Even the flowers of pomegranate are used as antidiabetic remedies in Ayurveda (J. Wang et al. 2012).

Pomegranate is often standardized for ellagic acid, which is a polyphenolic compound present in fruits.

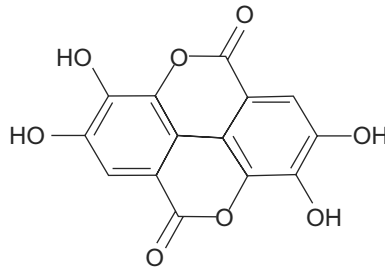


Fig. 2: Ellagic acid structure

Ellagic acid is commonly found in red raspberries, walnuts, strawberries, and pomegranate. Ellagic acid is the principal polyphenolic compound in fruits of pomegranate (Bell and Hawthorne 2008). Ellagic acid is a polyphenolic acid that is formed as lactonization of hexahydroxydiphenic acid of ellagi tannins (H. Akiyama et al. 2001).

Ellagic acid is well known for its antioxidant activity (Bell and Hawthorne 2008), antibacterial, and antiviral properties (H. Akiyama et al. 2001). It has shown anti-proliferative or anti-cancer activity in preclinical models (Y. Hagiwara et al. 2010). A small clinical test has shown cholesterol-reducing activity in patients with metabolic syndrome (Basu et al. 2009).

Ellagic acid has also shown potential for providing benefits to the skin, when taken orally.

Based on previous studies that demonstrated the topical benefits of ellagic acid on chemically induced skin tumorigenesis (P. Lesca 1983; R. Chang et al. 1985), H. Mukhtar et al. (1986) designed a study to investigate whether the parental administration of ellagic acid in drinking water can provide protection against 3-methylcholanthrene-induced skin tumor in BALB/c mice. Oral administration of ellagic acid showed protective effect against tumor induction, perhaps due to inhibition of metabolic activation of polycyclic aromatic hydrocarbons (PAH) by ellagic acid. Results suggested that dietary supplementation of ellagic acid was able to reduce the risk of skin carcinogenesis in the test animals.

Ellagic acid was found to have a photoprotective effect on collagen breakdown and inflammation in the skin induced by UVB irradiation. In this study, the human dermal fibroblast cells were used to study collagen degradation in skin cells. Ellagic acid was able to block the matrix metalloproteinase production in the UVB-exposed cells (J.Y. Bae et al. 2010).

In 2006, in a human clinical trial performed in Japan with ellagic acid (supplied by Sabinsa Corporation), researchers found that ellagic acid extract can have an inhibitory effect on UV-induced pigmentation on skin.

In this four-week study, 13 volunteers were randomized to three groups—control, low dosage of ellagic acid (100 mg/day), and high dosage of ellagic acid (200 mg/day). Each volunteer was exposed to 1.5 MED (minimum erythema dose) of UV irradiation.

The whitening or protective effect of ellagic acid against UV-induced pigmentation was studied using a spectro-colorimeter for luminance in skin and a mexameter for measuring melanin and erythema in the skin.

Results showed that oral consumption of ellagic acid-rich pomegranate extract has an inhibitory effect on slight pigmentation in human skin caused by UV irradiation.

Ellagic acid is well known for skin-lightening activity when applied topically. It is used as a quasi-drug in cosmetics in Japan for treating hyperpigmentation on the skin. 0.5% ellagic acid-containing cream was shown to be effective against the UVB-induced hyperpigmentation (R. Kamide et al. 1995).

d. Curcumin C3 Reduct® (Turmeric)

Turmeric has been traditionally used since ancient times for its health benefits. The powdered rhizomes of turmeric are commonly used in preparation of curries. It has also been used in Ayurveda and other Asian medicine for generations for management of disorders such as inflammation, skin wounds, hepatic and biliary disorders, and certain tumors (Lazaro 2008). Turmeric's role as anti-aging agent and antioxidant is worth exploring for its nutricosmetic benefits. The benefits of turmeric come from its active molecules—curcuminoids. The Curcuminoids are natural phenols in structure (Fig. 3) and contain two α , β unsaturated ketonic structures. Curcuminoids are present as a mixture of three related structures. Curcumin is the main curcuminoid compound and the other two derivatives are demethoxycurcumin (DMC) and bisdemethoxycurcumin (BDMC). Following are the structures of curcuminoids.

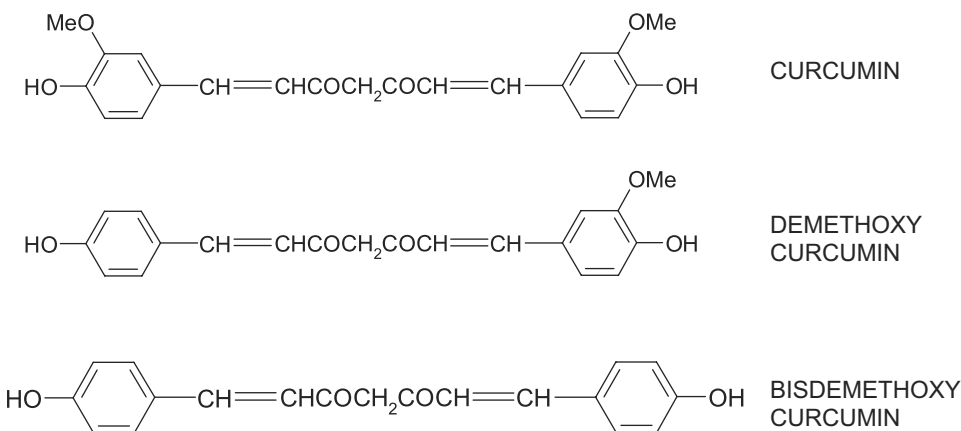


Fig. 3: Structure of Curcuminoids

Curcuminoids and curcumin in particular are very strong antioxidants. Osawa et al. (1994 and 2004) isolated a hydrogenated derivative of curcumin—tetrahydrocurcumin. The studies have also revealed that the tetrahydrocurcumin derivative of curcumin possessed the strongest antioxidant activity among all the curcuminoids (Fig. 4). The tetrahydrocurcuminoids are also known as white curcuminoids as they do not have a characteristic yellow color and lack the dyeing nature of curcuminoids.

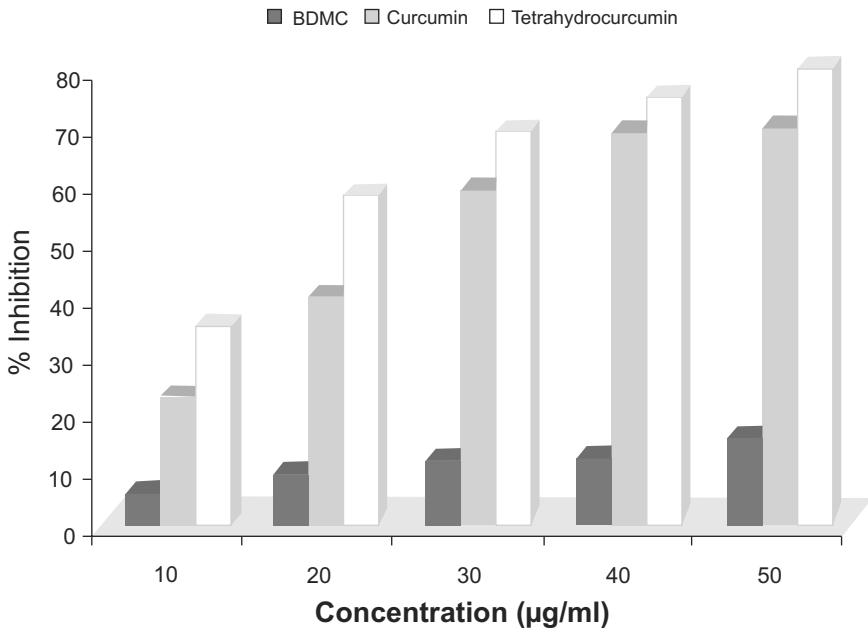


Fig. 4: Antioxidant activity of curcuminoids

Curcumin and its derivatives, including tetrahydrocurcuminoids, can be supplemented to prevent aging, as they may work in the form of dietary intervention with externally applied cosmeceuticals to slow the skin's aging process. As natural antioxidants, they quench free radicals in the system and may help to potentially inhibit visible signs of aging and photo-aging.

Studies on curcumin have shown its protective effect against skin melanoma. The study done on mice with skin tumors induced by 7,12 dimethylben[a]anthracene (DMBA)-initiated and 12-O-tetradecanoylphorbol-13-acetate showed that dietary curcumin significantly reduced the number and volume of tumors in the mice (Limtrakul et al. 1997).

In a recent animal study, the protective effects of oral and topical forms of curcumin were compared against skin squamous cell carcinoma. The skin squamous carcinoma is the most common type of cancer in the USA, which has also

been associated with the use of tanning booths causing photo-damaged skin. In this study, Sabinsa's Curcumin C₃ Complex® was used to prepare both topical and oral formulation. Curcumin at 15 mg dosage was able to suppress tumor growth in the mouse skin cancer model, emphasizing the use of oral or topical curcumin in preventive care for skin-related conditions due to increased skin exposure. This protective effect of curcumin was related to its anti-inflammatory activity (K. So-navane et al. 2012).

In a similar study performed on SKH-1 mice, curcumin showed inhibition of skin cancer formation when administered orally or topically. SKH-1 mice were pretreated with curcumin either in topical or oral form for 14 days. The UVB radiation was then given to them to induce skin cancer. It was noted that the time for tumor onset was longer in mice taking oral or topical curcumin as compared to control group animals. Fewer tumors were formed in the topical and oral curcumin group as compared to their controls. The study result thus showed that curcumin not only inhibits skin cancer formation but also prolongs the time for tumor onset when administered topical or orally (J. Phillips et al. 2013).

The Sabinsa Corporation provides curcuminoids as Curcumin C₃ Complex®, and tetrahydrocurcuminoids are available as Curcumin C₃ Reduct®.

e. Cococin™ Coconut Water

Coconut water or the liquid endosperm of green coconuts (*Cocos nucifera*) is a refreshing and natural rehydration medium for the body. Coconut water offers higher amounts of electrolytes such as potassium and magnesium, and can be considered as a natural isotonic drink.

Coconut water in tender green coconuts is rich in proteins, amino acids, sugars, vitamins, minerals, and growth factors that play a pivotal role in supporting tissue growth (M. Majeed et al. 2009).

Coconut water can help to regain the water lost from the body and also rehydrate the skin. This rehydrating property of coconut water can be explored for its nutricosmetic function. The intrinsic rehydration with coconut water can also help to augment the function of topical moisturizers. Coconut water is an excellent rehydration solution, as it provides electrolytes such as potassium and magnesium in an isotonic form.

Sabinsa provides Cococin®, a stable preparation of coconut water obtained from a proprietary lyophilization process that conserves the inherent biological activity of coconut water. The lyophilization process ensures that protein and other environment-sensitive actives are protected.

The coconut water solids in Cococin® can support cell growth, and hence can be used for supporting growth of tissues such as hair follicles and fibroblast cells; it also supports healthy aging (M. Majeed et al. 2009).

In 2008, Cococin® received a self-affirmed GRAS status as determined by an independent panel of scientists and toxicologists. The GRAS status allows the use of Cococin® in foods and beverages. Cococin® is available in both oral grade as well as beverage grade, and hence can be used in preparing yogurts, tea, and other beverages with beauty functions.

CONCLUSION:

Nutricosmetics is still a new concept in the market, which holds a lot of potential for growth. Newer ingredients are coming into the market, which is a welcome sign for the industry. This is a segment that needs self-regulation in terms of claims one can make on the product. It is important that new ingredients coming into the market should be able to substantiate their claims with proper studies.

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