Plant Stem Cells and Skin Care

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Stem cells are pluripotent and can differentiate into many different structures. Their ability to differentiate and remain differentiated is key to the survival of complex multiorgan life forms such as humans. For instance, liver stem cells must remain liver cells, kidney stem cells must remain kidney cells, and skin stem cells must remain skin cells once they are differentiated, which is accomplished through epigenetic changes that repress certain gene sequences that should no longer be transcribed. If these gene sequences are mistakenly available for transcription, cancer may develop. In the cosmetics industry there is tremendous interest in stem cells as a source of materials for replenishing the aging body.

Stem cells are present in all organisms, including plants. It is thought that antiaging skin care products might work through the use of stem cells from plants, such as berries. These ingredients might be effective in reducing oxidative stress on the skin, thereby reducing inflammation. This article examines the role of plant stem cells in skin care, including how stem cells are used to obtain plant extracts, how these products are tested, and how they are relevant to dermatologists.

Berry Extracts

Berry extracts from raspberries, blueberries, and strawberries have become an area of intense research in the cosmetics industry because they contain high levels of anthocyanins, representing a new category of highly potent antioxidants with anti-inflammatory activity. Berry extracts also contain other beneficial ingredients such as resveratrol, a polyphenol purported to modulate sirtuins, and ellagic acid, a purported antiviral and anticancer agent. Wild cultivars contain higher levels of these active ingredients than domesticated varieties. Extracts can be obtained from many different parts of the plant.

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Preparation of Plant Extracts

Stem cells are used in the preparation of many extracts included in skin care products and can be obtained from a variety of plant parts (ie, berries, leaves, stems, twigs, roots). Plant leaves commonly are used because they are especially high in antioxidants, as they are the sites of photosynthesis and require excellent oxidative stress protection. Stem cells are cultured under controlled laboratory conditions to obtain the purest extract possible.

Plant materials obtained from outdoor cultivation may contain a variety of contaminants, such as heavy metals, pesticides, and fungal toxins. When plant material is concentrated, so are the contaminants. For example, one of the biggest concerns with frequent consumption of green tea is the potential for pesticide intake because pesticides are used to prevent leaf damage in the fields. It is impossible to completely remove the pesticides from leaves and tea represents concentrated use of the dried leaves; however, utilizing stem cells eliminates this concern.

The contents of stem cell-derived materials also are more consistent. The plant materials are cultured under optimal conditions to yield a more standard composition than those grown outdoors, which can vary based on weather and soil conditions, fertilizer application, and other factors. Consistency is key in obtaining a reliable extract for reproducible results.

Stem Cell Cultivation

It often is mistakenly thought that entire stem cells are added to skin care products, which is not the case. Rather stem cells are used to obtain the extract that is then included in the formulation. Osmotic conditions, lack of suitable growth media, and preservatives make it impossible to maintain live stem cells in cosmetic emulsions.

Before stem cells can be obtained from plant leaves, they must be sterilized in 70% ethanol for 15 minutes and 1% bleach for an additional 15 minutes; then they are washed 3 times with sterile water. The original plant material for culture must come from outdoors, but all contaminants must be removed for a successful culture. The leaves then are cut into thin, 0.5-cm pieces and

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COSMETIC CONSULTATION

placed on an agar culture plate containing plant growth hormones, such as kinetin; plant callus then is formed and can be collected. The callus is cultured to form single cells, which are recultured in a liquid media. These cells then are filtered for removal from the media and homogenized. The mixture is centrifuged to remove the soluble components and lyophilized to obtain the cosmetic ingredient in powder form.

Ultimately, the cosmetic ingredient that is obtained is not the viable stem cell itself but rather the substances contained within the stem cell. These chemical entities then are added to the antiaging products. The Table includes a list of raspberry extract constituents—all potent antioxidants—that can be obtained using this process.¹

Assessing Antioxidant Properties

Assessment of the antioxidant properties of stem cell extracts relies on techniques developed to evaluate the efficacy of food preservation. It is unlikely that these assays are directly applicable to antioxidant efficacy of the product on the skin, but these assessment techniques the total antioxidant capacity and oxygen radical absorbance capacity assays—currently are considered state of the art in the cosmetics industry.

The total antioxidant capacity assay is used to measure the reducing ability of a substance and is performed by mixing the test compound with copper II. If copper II

Raspberry Extract Constituents

Phenolic Acids

Caffeic acid Coumaric acids Ellagic acid pentose derivatives Ellagitannins Ferulic acid Gallic acid Protocatechuic acid

Flavonoids

Kaempferol glucoside Quercetin Quercetin glucoside Quercetin rhamnoside

Anthocyanins

Pelargonidin Pelargonidin glucoside Resveratrol glucoside is converted to copper I through a reduction reaction, the ingredient is considered an effective antioxidant.² This technique is different from the oxygen radical absorbance capacity assay, which examines the ability of the ingredient to inhibit the oxidation of fluorescein in the presence of a potent oxidant (2,2'-azobis [2-amidinopropane] dihydrochloride).³ These tests indicate that a material can function in vitro as an antioxidant, but the most substantial oxidative damage occurs in the skin and not on the stratum corneum where the ingredient is applied. Therefore, in vitro testing is predictive but not confirmatory.

Relevance to Dermatology

Stem cell technology is the first step in standardizing botanical cosmetic ingredients and achieving the dose consistency that is mandatory in drug development. Stem cells also provide for purity that was previously not achievable; however, stem cell technology does not mean that plant cells can somehow interact with human cells to induce a slowing or reversal of aging.

Summary

The use of stem cells to obtain better quality ingredients with consistent composition is a step forward in cosmetic technology. Variability of plant extracts has been a key source of concern. Drugs must allow consistent delivery every time they are used, and cosmetic ingredient suppliers are searching for ways to improve this consistency. Stem cells offer an opportunity for consistency but also ingredient purity. Contamination is one of the reasons botanical extracts previously have been denied approval by the US Food and Drug Administration as drugs. Stem cell technology minimizes this concern.

It is key for the dermatologist to realize that stem cell ingredients are obtained from stem cells but are not the stem cells themselves, which may be misleading. The successful use of stem cells for reversing aging continues to remain elusive.

References

- Barbulova A, Tito A, Carola A, et al. Raspberry stem cell extract to protect skin from inflammation and oxidative stress [published online ahead of print June 28, 2010]. *Cosmetics & Toiletries*. 2010;125:38-45.
- Yildiz L, Başkan KS, Tütem E, et al. Combined HPLC-CUPRAC (cupric ion reducing antioxidant capacity) assay of parsley, celery leaves, and nettle [published online ahead of print June 27, 2008]. *Talanta*. 2008;77:304-313.
- Huang D, Ou B, Hampsch-Woodill M, et al. High-throughput assay of oxygen radical absorbance capacity (ORAC) using a multichannel liquid handling system coupled with a microplate fluorescence reader in 96-well format. J Agric Food Chem. 2002;50:4437-4444.

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