

Green Chemistry 2017

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The cosmetic industry continues to look for new market niches and to improve its image, which is often seen as frivolous and wasteful. This has driven the trend into natural and organic products and going “Green” by sourcing sustainable materials, avoiding the use of harsh solvents, using low energy processing and supporting Fair Trade.

Ever ready to satisfy changing demands ingredient suppliers have been expanding their material portfolios to embrace “Green” principals and that is the focus of this feature.

Green Chemistry Awards

The winner in the ingredient’s category at the 2016 Sustainable Beauty Awards was **L’Oréal Group** with quinoa husk, which previously was a waste material. Quinoa husk contains saponins and polyphenols that makes it an interesting renewable cosmetic ingredient with proven exfoliating properties. A green chemistry-based extraction method was developed by **Chimex**, a L’Oréal subsidiary, which specialises in designing and developing eco-responsible processes. The material was sourced by Andean Valley, a Bolivian company that works directly with quinoa growers, Proinpa, a Bolivian foundation, which promotes the conservation and responsible use of natural resources in Bolivia and EcoTerra, a responsible importer.

The runner-up was **TRI-K Industries** with Baobab Tein NPN [Hydrolyzed adansonia digitata seed extract], which is a 5-in-1 multifunctional active for hair care with anti-aging effects that protects hair from environmental stress such as heat and UV radiation. Baobab is called the “tree of life” in Africa and often lives more than 2,000 years. Ancient folklore suggests water infused with baobab seeds gives strength, good health and good fortune. Tri-K obtains the seeds in partnership with a local company dedicated to promoting the responsible and sustainable development of African businesses and bringing much needed economic opportunity to local families. The baobab seeds yield a protein with specific benefits directly correlated to the amino acid composition and trials on all types of human hair demonstrated its protective and repairing properties.

Finalists at the 2016 Sustainable Beauty Awards were **IBR Ltd** with IBR-CalmDeAge and **Croda/Sederma** with Majestem. IBR-CalmDeAge [Phoenix dactylifera (date) seed extract] is from date seeds that are a waste material from the food industry. The seeds are crushed and extracted with water and glycerin and no harsh solvents are used. The extract is filtered to remove solids and is not chemically modified in any way and all waste produced is completely biodegradable. The date growers benefit from supplementary income by selling the seeds, thereby providing a new revenue source. Using this local product ensures a minimal carbon footprint and reduces its environmental impact. The extract improves vasoconstriction and microcirculation and is recommended for the relief of rosacea and dark circles under the eyes.

In answer to what makes Majestem unique **Croda/Sederma** replied that it comes from edelweiss [Leontopodium alpinum] and is the first natural product proven to provide consumers with a high-performance alternative to aesthetic surgery to remedy skin sagging. It helps recreate dermal matrix tension through mitochondrial dynamism repair and provides extracellular matrix maintenance by neutralising the oxidative stress caused by pollution and irradiation. In answer to a question on sustainability Croda reported that it cultures plant cells from a small piece of edelweiss to produce undifferentiated cells, which are then activated to

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produce specific active molecules and a high concentration of leontopodic acid. 1kg of culture cells produces the same number of active molecules as 5,000 edelweiss flowers and, with plant cell culture, cells grow in a sterile medium and no pesticides and fertilisers are used.

IBR took bronze in the Green Award category at In-Cosmetics 2016 Paris with **IBR-Pristinizer**. Constant exposure to environmental toxins leads to accumulated damage to DNA and to chronic inflammation, both leading to premature signs of aging. **IBR-Pristinizer** is an aqueous extract of the desert plant, *Asteriscus graveolens*, that assists in protecting cells from air pollution. It has antioxidant properties that reduce oxidative stress and protects cells from inflammatory response following exposure to air pollution. **IBR** carried out studies of air pollutants using cigarette smoke as a model for urban air pollution and found that **IBR-Pristinizer** significantly reduced the concentration of fine particulates labelled PM2.5. In its application for a green award **IBR** said it developed the cultivation protocols used by local farmers in growing *Asteriscus graveolens* for its historic use as tea. This opened a completely new market to the growers, creating industrial, commercial and financial benefits for the local population.

Seppic took first place at In-Cosmetics 2016 Green Awards for **Ephemer**, which is a gametophyte extract taken from macroalgae cells grown in a laboratory and harvested at an ephemeral stage in the life cycle of *Undaria pinnatifida* seaweed. Gametophytes are cells liberated by the sporophytes in the reproductive lifecycle but are unstable in the ocean. **Seppic** cultivates stable gametophytes under laboratory conditions in photobioreactors. During the growth stage, the macroalgal cells accumulate anti-oxidant molecules that protect the skin by acting on the mitochondria, causing a reduction of free radicals. In-vitro and in-vivo tests show that after 8 days of application, **Ephemer** preserves mitochondrial DNA and there is an increase of catalase, as a detoxifying enzyme that contributes to fight against a large spectrum of free radicals.

Culturing cells

Culturing cells in laboratory conditions instead of harvesting from the environment is approved under green chemistry principals. **Vytrus Biotech** specialises in this and has developed its Plant Cell Biofactories (PCB) technology platform as a new efficient and eco-sustainable way to obtain a new generation of plant extracts. This technology uses plant stem cells as biofactories and only a few seeds or even a single plant is needed to establish a bank of plant stem cells and "clone" the plant. Once the culture is established there is a complete independence from natural resources, saving up to 99.9% of water consumption compared to using arable soil with a drastic reduction of the carbon footprint. PCB technology allows the use of plant species that currently have completely unknown applications because of their scarcity. **Vytrus Biotech** has launched multi-active ingredients from cotton, carrot and pomegranate with antiaging, sun protection and skin brightening properties and has isolated a number of active plant peptides from turmeric and centella to slow hair loss and for wound-healing and antiaging.

Amyris promotes itself as an integrated renewable products company and its mission statement is to apply inspired science to deliver sustainable solutions for a growing world. It achieves this by industrialising biotechnology to not only deliver cosmetic ingredients but

polymers, adhesives, solvents, lubricants and fuel for industrial applications. Amongst its many ingredients Neossance Squalane is featured as an example of its achievements and as an exceptional emollient. It is produced from plant sugar grown on depleted land in Brazil; it requires no irrigation and is processed on site with energy required being supplied by burning the waste material. Squalane is a non-polar hydrocarbon naturally present in the skin lipid barrier, preventing moisture loss while restoring skin's suppleness and flexibility. Squalane provides a silky, smooth and luxurious touch, without a greasy, heavy after-feel.

Fermentation is being increasingly used to provide ingredients with a low environmental impact. Examples include **Jungbunzlauer** that uses fermentation to yield xanthan gum, lactates, gluconates and citrates. Exopolysaccharides are obtained by **Lucas Meyer** in French Polynesia by mimicking a natural fermentation process that occurs in the shallow waters found along atoll rims and in large ponds inside islets. Exo-P by Lucas Meyer is a biomimetic protective exopolysaccharide that, by creating a film at the surface of the skin, it decreases the skin adhesion of PM2.5 to reduce pollution-induced damage.

The goal of **Active Micro Technologies** research was to take the remnants of the coconut that would have otherwise been discarded after the extraction of the fruit's water and develop an environmentally-friendly, sustainable and effective cosmetic ingredient. After extraction of its water content to satisfy consumer demand for coconut milk Active Micro Technologies has successfully extracted and fractionated the oil from the coconut meal of *Cocos nucifera*. The medium chain triglycerides in coconut oil, particularly lauric acid, have natural antifungal properties and are also capable of normalising epidermal lipids to enhance barrier function and increase moisture content. AMTicide Coconut is created by fermenting the fractionated coconut oil with lactobacillus, resulting in antimicrobial peptides with strong antifungal activity. AMTicide Coconut was one of the five finalists for "Best Ingredient Made from Recycled Material Award" announced at In-cosmetics North America 2016.

Fermentation of RSPO palm oil by **Cosphatec** yields propanediol and pentalene glycol is produced by Cosphatec from sugar cane and corn cobs. **Givauden** uses fermentation technology to provide hyaluronic acid for its PrimalHyal Gold, which enables the incorporation of hydrated hyaluronic acid in oil-based formulas such as lipstick, lip glosses and balms, in sun care oils and in anhydrous compositions and pressed powders.

Solabia utilises fermentation in the production of biosaccharide gums. Pollustop [Biosaccharide gum-4] is a deacetylated, branched polysaccharide with a high molecular weight that forms a non-occlusive film on the skin and hair. This provides a protective barrier against the types of pollution that make up our daily environment. Fucogel 1.5P [Biosaccharide gum-1] is an anionic polysaccharide that is rich in fucose, which soothes, moisturises and restructures the skin and Rhamnosoft HP 1.5P [Biosaccharide gum-2] is an anionic polysaccharide with anti-inflammatory properties. It has a branched saccharide structure that is rich in rhamnose, galactose and glucuronic acid and limits the propagation of inflammatory reactions in skin cells.

Biovitis is a subsidiary of **Greentech** and develops biofermentation systems to yield cosmetic actives. It claims to select specific ferments and by optimisation of the fermentation process it is able to deliver the best activity from a specific plant. As well as the active molecules from the plant the microorganisms possess their own set of enzymes that can release or modify

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molecules to give new activity. Examples of these ingredients are Protection Ferment'Active Goji with a polyphenol content three times higher than a simple goji extract. Brightening Ferment'Active Raspberry has a lactic acid content 38 times higher than a simple raspberry extract and Anti-ageing Ferment'Active Pomegranate with improved antioxidant content. A second subsidiary of **Greentech is Greensea**, which specialises in the culture of microalgae that are sourced from salt water, fresh water and thermal water environments around the world. Its portfolio of ingredients includes single plant extracts and complex mixtures

Sustainable Harvesting

Green chemistry is very much about sourcing sustainable materials from natural environments, which often are in areas of great poverty. The Amazon is a rich source of natural materials and the cosmetic industry has done much to encourage fair trade and ethical practices and environmental protection. A good example of this is Symrise that has developed a sustainable partnership with local communities providing farmers and their families access to better health and quality of life by promoting the economic and social development of the region. The Symrise “Amazonian Collection” is based on the traditional knowledge and use of the individual oils and butters including cacao, cupuaçu and murumuru butters and andiroba and Brazil nut oils. Symrise claims these oils and butters have multiple cosmetic benefits and enhance the sensorial feeling for a unique caring experience.

As demonstrated by Symrise, responsible harvesting of cosmetically useful materials in areas of poverty can provide much needed income for indigenous populations. Other examples from around the world are Andean Q Ultra from **Desert King** in Chili; shea and shea derived products by **AAK** in West Africa, Inca Inchi oil from Peru by **Greentech** and Gatuline Renew by **Gattefossé** from the island of La Réunion.

Andean Q Ultra [Quillaja saponaria wood extract] is a purified natural aqueous extract of the **Chilean** soap bark tree that works as a gentle foaming and cleansing agent. It's cultivation and harvesting is highly sustainable and the by-product of the extraction process is used to fuel the production facility, thus making the manufacturing process carbon negative. The Chilean Ministry of Forestry recognises **Desert King** for its ecologically friendly and sustainable production methods.

Inca Inchi oil [Plukenetia volubilis seed oil] by **Greentech** is the result of a partnership with a **Peruvian** farmer's association formed in 2003. Following the principals of sustainable development and fair trade there is now 2,000 hectares of plantations and two extraction plants resulting in 8,000 new direct and indirect jobs benefitting 10,000 families. The oil is rich in Omega 3 (48%), Omega 6 (35%), Omega 9 (9%), proteins (33%) and antioxidants (50%) plus iodine and vitamins A and E. It is described as a light oil that absorbs quickly, is an excellent emollient and can help improve moisture retention in the skin.

Gattefossé has recognised the rich composition of skin-stimulating active molecules in buds of *Cryptomeria japonica* (Japanese cedar) and identified a highly sustainable and ethical source of the plant's buds. The trees are grown in plantations situated above 1000m on the island of **La Réunion** in the Indian Ocean and the buds harvested by the local populace during the austral summer, from mid-December to end of January. Only the lower branches are cut to protect the trees for the future years. Gatuline Renew smooths, hydrates and softens the skin, giving it a visibly younger appearance.

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The Natural Products Association awarded **AAK Personal Care** the 2015 “Industry Champion Award” for outstanding contributions to the success of the natural products industry. It was recognised as a leading example of advancing technology to make natural products that are also sustainable. Shea is a wild growing tree so no land is cleared for plantations and AAK follow Fair Trade principles, supporting the people who harvest the shea kernels for them in **West Africa**. Besides shea butter AAK also provides Lipex Shea Light [Shea butter ethyl esters] described as an eco-designed shea butter that combines high functionality in skin care formulations with a light skin feel and a good sustainability profile. It has great pigment wetting and oil-solubilising properties. The ethanol used to synthesise the ester is from renewable agricultural sources and biodegradable catalysts enable the use of lower temperatures and shorter processing times than traditional ester syntheses.

Argan oil is very much on trend (Marketing speak) but the area in **Morocco** where the trees grow is under threat from continuous degradation through over-exploitation, soil erosion and advancing desertification and excessive grazing makes it more difficult for the argan trees to grow properly. Targanine is an Economic Interest Group (EIG) composed of 6 cooperatives and argan oil is produced in Targanine cooperatives with the intention of providing employment to women in rural areas, sharing ownership of the cooperative and decision-making. The EIG Targanine supplies argan oil and its by-products to **BASF Beauty Creations** under fair-trade conditions, ensuring that benefits from the utilisation of argan-based materials are shared with the local communities. Sixteen argan by-products, botanical and essential oils and bee products are now marketed by the cooperatives and 50% of the price paid for the oil-cakes and pulp by BASF is allocated to social funds in the cooperatives. In an interview a female member said that “the cooperative is for us our hope, our future and our life, it allows us to live in dignity”

Staying Green

Avoiding volatile solvents is one of the principals of green chemistry and cosmetic material suppliers have developed various techniques to achieve this, often improving recovery of the active ingredient. **Crodarom** uses Eco-sound extraction, which is an extraction method based on the principle of sonoporation or ultrasound-mediated cell membrane permeability. Ultrasonic waves create cavitation bubbles formed near vegetable membranes that swell throughout compression / dilatation cycles to reach a critical size and implode. Plant cells disintegrate and their metabolites are released in the solvent. This technology makes it possible to obtain high quality extracts rich in active ingredients, which feature in Crodarom’s range of “Les Délices” extracts and it has recently launched Phytessence Peach Flower to prove the interest of this technology for active ingredients.

Other examples of green chemistry are super-critical extraction of extracts; cold-process emulsifiers; the enzymatic synthesis of emollient esters and biocatalytic solvent-free transesterification to give plant oil derived esters, many of which are promoted as alternatives to silicone oils such as those from **Seppic**. Material waste from other industries is often used to provide cosmetic ingredients. Good examples are Gosulin RAO and Gosulin BUO from **Gova**. These are high purity raspberry and blueberry oils respectively that are extracted from the seeds contained in the waste pulp left over from juice pressing. The pulp left over from the oil extraction is carefully ground to different mesh sizes to obtain a series of raspberry and blueberry exfoliating scrub particles.

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NOTE: Only the principal active is identified by INCI name in this feature and the material may also include other ingredients. The majority of natural materials discussed are approved by COSMOS but those interested are urged to confirm this with the suppliers.

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