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Advances in bio-derived cosmetic ingredients

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ABSTRACT: Nature is rich in biologically active molecules of interest to the cosmetics industry. Brands are *leveraging these "natural" chemicals to tap into the growing market for organic and "natural" products. Advances in* chemical analysis and extraction technology were recently discussed in a symposium organized by Dr. Richard Blackburn, University of Leeds, at the 21st Annual Green Chemistry & Engineering Conference.

The organic personal care market is expected to grow to USD 25.1 Billion by 2025 (1). Fueling this demand are consumers whom are anxious to avoid problematic chemicals and interested in products that contain natural ingredients. Likewise, brands are interested in reducing their environmental footprint by using renewable raw materials, greener processes and more sustainable packaging.

Unlike other industries, where biobased chemicals have to "drop into" existing processes seamlessly—cosmetics and personal care products often leverage the novel ingredient as a selling point.

Humans have been using natural products to color hair, oil skin and heal wounds for eons. But new naturally derived products are not the same as yester years. Advances in chemical analysis and extraction technology help scientists identify and locate the "good stuff"—say an antioxidant—while removing other compounds that may have adverse impacts—for example, that cause inflammation. This precision helps companies know exactly what is in their product and improves the uniformity of natural products.

Another hurdle chemists are helping us jump is to ensure that bioactive ingredients remain available in the final product and last on the shelf. Every cook knows there is a world of difference between a fresh vegetable and a vegetable that has been sitting around for too long. The same concept holds true with plants heading towards a cosmetic formulation.

MAXIMIZING BIOACTIVE COMPOUNDS

Michael Koganov, Ph.D., Vice President of BioMaterials, Ashland Specialty Ingredients, presented how Ashland is approaching the issue with their mobile plant processing units which can be driven directly to the field so that plants can be harvested and processed in one step—minimizing the loss of active compounds. These units, which use a solvent-free Zeta Fraction Technology, can process up to 10 tons of living plants at a time (2).

Ashland has already been developing and using its technology, acquired from AkzoNobel in 2015, to provide brands with exclusive natural ingredients. This year, Ashland has begun putting some of their botanical ingredients on the open market. Their first product, derived from the sacred lotus flower (Nelumbo nucifera), has been tested against a placebo to provide benefits such as a 20 percent reduction in appearance of wrinkles, 14 percent increase in skin hydration and a 25 percent increase in a measure of skin softness (3).

Another trend in producing greener cosmetics looks beyond agricultural sourcing, where concerns about competing for land use with food production worry some. Luckily, there are other rich sources of biomass such as waste from food and beverage production and ocean life.

Algae and orange peels

Keracol (www.keracol.co.uk), a business spun out of the University of Leeds, has recently developed a line of naturally-derived hairstyle products. Hair sprays and gels contain a film-forming polymer that provides the shine and hold required. Options are limited for consumers looking for a bio derived hair spray or gel that performs, washes out easily and is flexible enough to use on damp or dry hair.

Meryem Benohoud, Ph.D., Lead Product Development Scientist at Keracol, has been working with two biopolymers that are plant-sourced, renewable, and biodegradable: alginic acid and pectin. Alginic acid is an anionic

polysaccharide found in brown algae. Pectin is a heteropolysaccharide found in plants; in this case sourced from waste material, e.g. orange peels, from the beverage industry.

Keracol's patented formula takes advantage of alginic acid and pectin's natural gel forming properties while overcoming their limitations—namely, both biopolymers don't naturally dissolve in ethanol, a significant problem for hair sprays that are typically 55% ethanol. They have managed to overcome this problem through formulation and can now achieve >75% ethanol-based products.

Pinot noir, port, blackberries and blackcurrants

Grape skins, along with other red or blue berries contain antioxidants and water-soluble pigments called anthocyanins. Research has shown that anthocyanins have many bioactive properties such as free radical scavenging, metal-chelating, antimicrobial, wound healing and chemopreventive activities, and their ability to prevent oxidative damage makes them of interest in skin care products (4,5). As a result, several projects are looking at different using the waste (skins, seeds, damaged berry, etc.) from wine and port production as well as juice and fruit industry to recover these valuable compounds for cosmetic applications.

In 2015, Keracol partnered with Marks & Spencer to bring to market a set of skincare products containing antioxidants and anti-inflammatory compounds extracted from the waste stream of pinot noir production. The resulting "Pure Super Grape" was favorably received in the marketplace, winning several cosmetic industry awards (6).

Sannia Farooque, University of Leeds, has also been looking at blackcurrant waste from drink processing in the U.K. as a source of anthocyanins and antioxidants. Similarly, Nuno Mateus, Ph.D., from the University of Porto is systematically researching uses of waste from port and blackberry production—big business in Portugal. Both of these researchers are bringing a chemists eye to understanding the composition of the active compounds, assaying their potential positive qualities, and developing processes to extract, preserve and use them in a cosmetic formula.

As the demand for "natural" and safer cosmetics grows, it will be up to chemists to seek the most sustainable approaches to supplying natural ingredients—whether it be by using byproducts of food industry as raw material or by developing solvent-free extraction technologies that bring the chemistry lab to the field. Green chemistry is not black and white. There is and will always be a sliding scale from somewhat better to groundbreaking—with new innovation and technology pushing us towards the more sustainable end of the equation over time.

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