locus™
performance ingredients

Surfactants:

Everything to Know About Popular, But Problematic Personal Care Ingredients

Washing away oil and grease from skin is a paramount challenge for personal care formulators. Since oil and water do not mix, there is little value in cleaning with water alone. Instead, a water-soluble ingredient is needed to provide the oil-removing cleansing that consumers expect from personal care products. These ingredients are called surfactants.

What is a surfactant?

Surfactants are amphipathic molecules, which means that their structure is composed of distinct hydrophilic (water-loving) and lipophilic (oil-loving) regions. Their hydrophilicity allows them to be formulated into water-based products hand soaps, face washes, and body wash, while the lipophilicity makes these products effective at dissolving and washing away oils, greases, and dirt.

Typically, surfactants are one of the top five ingredients in a consumer cleansing product. Sodium laureth sulfate (SLES) is a common surfactant used in many consumer products such as shampoos, body washes, and personal cleansers. SLES is capable of dissolving many types of skin soils and is compatible with nearly all personal care product ingredients. It's also bio-based, with the majority of the carbon atoms in the structure coming from palm kernel or coconut oil (Carli 2017). As bio-based products are gaining interest from consumers, SLES has become a popular choice for personal care formulators.

The Challenges

While SLES is mostly bio-based, it is not considered environmentally friendly or non-toxic. Palm kernel oil comes from palm plants; their growth is far from sustainable and their use causes severe deforestation issues in tropical regions (Young 2019). SLES is produced through ethoxylation, which creates the toxin 1,4-dioxane as a byproduct. Due to health concerns, New York has passed legislation regulating the amount of 1,4-dioxane in consumer products down to the parts per billion (ppb) level, and other states such as California and Oregon are expected to follow (Hogue 2019). SLES is also a sulfate surfactant, which is an ingredient of concern in personal care formulations due to skin irritation. Because of these issues, there is a growing trend for sulfate-free personal care products.

Alternative ingredients

What other choices are available to personal care formulators for high-performing personal cleansing products?

Alkylpolyglucosides (APGs) are one option. However like SLES, they get their carbon from plant-based sources, including palm kernel oil, and are made through carbon-intensive synthetic chemical conversions. On the performance side, APGs' functionality varies greatly depending on the fatty acid used in the production (Deckner 2013).

Biosurfactants been highly sought after as a top green ingredient choice for their multifunctionality and ability to replace palm oil-based and petrochemical ingredients, eliminate aquatic toxicity, reduce carbon footprints and maximize product performance (Hayes and Smith 2019). The problem is they weren't able to be produced at the costs and scale needed for use in personal care products due to the limitations of standard production techniques. That is until **Locus Performance Ingredients (Locus PI)** developed production technology enabling the creation of biosurfactants with superior performance and versatility, and lower in-formula usage rates at commercially viable prices—making them viable for use in personal care formulations.

Locus PI's biosurfactants alleviate the concerns consumers, formulators and marketers have with SLES, other ethoxylated surfactants and APGs. These biosurfactants are made with a microorganism, not synthetic chemistry, which greatly diminishes the carbon-intensity of the production process. The feedstocks used in the process are also flexible, allowing for nearly any sugar and vegetable oil-source to be used as raw materials for the biosurfactant production.

Biosurfactant classifications

There are many classes of biosurfactants, but the most common biosurfactants belong to a class called glycolipids. Glycolipids are composed of two distinct parts: a hydrophilic sugar and a lipophilic fatty acid. Variation in both parts allow glycolipids to be a diverse classification of biosurfactants, with each variant having their own distinct properties.

Class	Products
Glycolipids	• **Sophorolipids** • Trehalolipids • Rhamnolipids • Mannosylerythritol (MEL-A, MEL-B)

Locus PI's initial ingredient launch, Ferma™ S, is a line of pure sophorolipids. Sophorolipids are glycolipid biosurfactants that are composed of the disaccharide sophorose (an unusual glucose dimer) and a fatty acid, typically a C18 such as oleic or steric acid (Kulakovskaya and Kulakovskaya 2014). Unique to sophorolipid biosurfactants is the linkage of the fatty acid to the sugar portion of the molecule. In sophorolipids, the fatty acid is connected to the sophorose at the alkane terminus of the fatty acid. This is the first step in the biosynthesis of sophorolipids and creates a hydrophilic biosurfactant. In this linear form, the fatty acid is accessible for esterification enzymes to create an intramolecular ring between the carboxylic acid of the fatty acid and a hydroxyl of the sophorose (Kulakovskaya and Kulakovskaya 2014). This masks the polarity of the carboxylic acid, creating a lipophilic biosurfactant. Control of the fermentation and downstream processing steps can control the extent to which this lactonization occurs and thus allows producers of sophorolipids the ability to tune the hydrophilic-lipophilic balance (HLB) of the final biosurfactant product.

Locus PI's **Ferma™ S** line offers a full range of customized solutions for **personal care** formulations, ranging from lipophilic to hydrophilic. Lactonic sophorolipids are lipophilic, have fast wetting times, good degreasing properties, create water-in-oil emulsions and are stable for long periods of time at slightly acidic (~6.5) pH's, making them ideal ingredients for body lotions, hand creams, and slow-release fragrances. Linear sophorolipids are hydrophilic, produce a robust foam profile, are excellent cleansers, produce oil-in-water emulsions and are stable at all pH's—valuable attributes for use in shampoos and hand soaps. Lactonic and linear sophorolipids are perfectly compatible with one another and can be blended to achieve optimal performance for unique formulations. Each distinct form has multifunctionality and the ability to blend these sophorolipids together multiplies the formulation possibilities.

Locus PI's **Ferma™ S** biosurfactants are powerful solutions for formulators looking to remove petrochemicals, palm oil ingredients and sulfates from their products. As multifunctional ingredients, **Ferma™ S** sophorolipids can be used in diverse and distinct applications to provide remarkable performance. From body washes and shampoos to lotions and serums, Ferma™ S sophorolipids can replace traditional and partially bio-based surfactants in nearly all personal care applications.

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