

Understanding natural ingredients and mildness

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Nature is full of wonders, yet only a small fraction of its plants are suitable for human consumption. In a society living far from nature, there is a real longing for naturals, often with the accompanying romantic idea that everything natural is safe, and even though I am an advocate of using plant derived cosmetic ingredients myself, I wish things were that simple. Formulating with naturals requires a lot of background knowledge, frequently updated information and constant investigation; it is an endless learning curve.

Before I dive into the topic, I need to define what I mean by naturals and skin mildness.

Naturals, what are they? Free from chemicals?

A century ago, this would have been a question with a simple answer: materials made by Mother Nature, either plant/animal or mineral, that could have possibly undergone some physical refining process.

Today this simple definition would not suffice. Thanks to the widespread use of chemistry, materials undergo all sorts of chemical processes. They get broken down into 'bits' and rearranged to create different molecular shapes. Sometimes they even get combined with petrochemical components, and at other times petrochemicals get modified to copy the molecular structure of natural molecules. This is all quite confusing! The fact that consumers are not aware of this complexity means that they end up thinking that naturals do not contain any chemicals, when in reality they do.

What they really mean when they use the term "natural", I believe, is "free from synthetic chemicals", one extra word that makes a big difference for us within the industry.

To unravel this complexity and to make sense of the world of 'naturals', we can distinguish four different categories associated with the term, based on the origin of the material/materials used, the processing involved (chemical or physical) and the molecular structure.

Firstly there is what I term "Forest Green Naturals", where no chemical modification has been made at all, the product is only subjected to physical processing. This can



Aloe.

be stylised as products that are as "Mother Nature intended". Examples of this category are vegetable oils, essential oils and tinctures. They can be easily recognised by their Latin names, behind which there will be several compounds whose concentration may vary from batch to batch

"Pine Green Naturals" (natural derived); here there is chemistry involved, to create a man-made molecule completely from natural sources. Examples are glyceryl stearate, sodium coco-sulfate and decyl glucoside. They have a defined and much more consistent chemical composition.

"Olive Green Naturals" (hybrid natural derived); here natural components are bonded with petrochemical ones to create molecules of hybrid origin. Examples are cocoamidopropyl betaine, PEG-40 hydrogenated castor oil, cellulose gum.

"Lime Green Naturals" (synthetic nature identical), these are synthetically derived substances with a "natural" molecular structure. This is as Mother Nature intended but without using natural resources. Examples are sodium benzoate, potassium sorbate, benzyl alcohol (this can also be naturally occurring in essential oils).

Mildness is a minefield

In scientific terms, cosmetic safety is a really complex topic that needs to be broken down into several parameters, each with the

relevant data attached to them. Cosmetic safety is not an absolute, it is an evaluation based on exposure to the particular substances used as well as the type of person and the state of the skin barrier.

Mildness is part of the family of parameters used to assess cosmetics safety, and is the one consumers are most familiar with because they can see it and feel it. In fact, in scientific terms "mildness" is a factor of skin irritation and sensitization, with all the symptoms attached to it, such as skin redness, itching, swelling etc. At present there are *in vivo* and *in vitro* data available as well as old data derived from animal testing, all of which are used by safety assessors to evaluate cosmetic ingredients and finished products.

Because of the increase of cosmetics popularity and use, consumers' exposure to chemical substances has increased over the years, and this is reflected in skin reaction statistics. It is estimated that over 50% of the female population and about a third of the male population have experienced at least one adverse effect as a result of using cosmetics.¹

On top of this, more and more people are becoming prone to food allergies (this may also be caused by food additives as well as the allergens present in food) which can affect the skin in one way or another. For example trigger substances such as

proteins can induce a skin reaction via a topical route² and people suffering from peanut allergy may suffer an allergic reaction via topical application depending on the refining of the peanut oil.³

The EAACI (European Academy of Allergy and Clinical Immunology) is a great resource for those who wish to know further about this important topic.

Residues and the importance of purity

Aloe barbadensis leaf juice, a forest green natural, is the most common organic ingredient I have come across. It is rich in amino acids and polysaccharides, and has calming and soothing properties. The juice coming from the part nearer the outer leaf contains aloin. If ingested it has a laxative effect; if applied topically it may cause irritation in some individuals. For this reason, it is important to use the aloe vera juice from the inner leaf for topical applications.

Hydrogenation is a chemical modification often used in the food and cosmetic industry to achieve fats with higher stability to oxidation and interesting textures. The process of hydrogenation requires a catalyst, which often happens to be nickel, a metal linked to allergic contact dermatitis.⁴ Despite the fact that the nickel is removed after the processing, there may still be residues left behind, something that needs to be clarified with the supplier. It is quite interesting to come across so many cosmetics that have the claim "Nickel tested".

Lanolin, is a forest green ancient ingredient once used by the Romans and Greeks, a great by-product of the wool industry (you may call it 'waste free' these days), with a wonderful series of skin barrier properties and a rich skin-feel. Unfortunately, as sheep get exposed to higher level of pesticides from dips, these chemicals have migrated into the lanolin, which can cause quite bad skin reactions. The realisation of this was a major learning process, but the industry acted on it, and developed high purity grades of lanolin restoring this natural wonder to its safe spot.⁵

Oxidation and essential oils safety

Natural essential oils are full of terpenes with very interesting properties. Some of the most famous and common ones are limonene and linalool. These terpenes are found in most essential oils and are also on the allergens list and therefore subject to labelling declaration according to their content and application. Even if these substances are on the allergens list, in their original unoxidised state they do not tend to cause skin reactions, however when they oxidise it is a different matter.⁶ They form hydroperoxides that give a high rate of skin reaction. This means it is essential to purchase essential oils with a low peroxide content, use special storage conditions as



Lanolin.

well as using additional ingredients in the formula to help preventing the oxidation of the essential oils.

Microbial contaminants and products safety

Forest green naturals are the ones that are closest to nature and because of that the ones with the highest microbial hazard potential, in the form of high microbial counts and spores. Contaminated hydrolats and vegetable oils are common natural ingredients that can compromise the finished product, particularly its preservative system and therefore its safety. For this reason it is good practice to select quality suppliers that take good care of the microbial content of the ingredients they supply.

Sulfates

This class of anionic surfactants (some 'pine green' naturals, some 'olive green'), have got quite a reputation with consumers who think that "sulfate free" equates to "mild". On the other hand, many formulators love them as they are cheap, easy to thicken and foam like a dream. This is quite an emotional gap!

In my opinion, the gap comes from misunderstandings as to how sulfates are used and the data available. Data shows SLS affinity for the NMF^{7a}, and the resultant potential to disrupt proper barrier function and mildness. However when SLS is used as a primary surfactant and in combination with the right secondary surfactants and in the right proportions, its irritation potential is reduced.^{7b} Was the sulfate fear caused by formulas containing sulfates without, or without enough, irritation 'antidotes' or by a particular consumer with very sensitive skin?

In my opinion the answer lies with data. New data is needed from further research to understand how surfactants interact with skin sebum and skin proteins and to see how such interaction evolves over time as consumer exposure to cosmetics increases.

Ironically ethoxylated sulfates ('olive

green' natural) are milder than the non-ethoxylated sulfates, as they score much lower on the Zein test, however they contain residues such as 1,4 Dioxane, which is classified as a likely carcinogen by the EPA, and which has been found in drinking water supplies. This has led to legal restrictions in the state of New York.^{7c}

Preservatives

Sodium benzoate (found as benzoic acid in many plants) and potassium sorbate (found in rowan berry, from *Sorbus aucuparia*) are common preservatives present in the Annex V. They are lime green naturals, or nature identical ingredients, and often used in soft drinks and certified cosmetics, mainly as a blend. Several people within the industry, including myself, have experienced at some point the irritation potential linked to these ingredients, especially in face products, and that is with using them within the permitted level of use. This does not mean they need to be avoided, only that they might need combined with other ingredients to reduce their level of use and increase mildness depending on the application.

Conclusions

This is a complex topic with a lot of detail involved, so I hope I have given a good sense of best practice when it comes to naturals and mildness. The key message is that safe and mild naturals depend very much on the suppliers and formulators. Suppliers play a key role in delivering plant derived ingredients with good specifications, while formulators need to design formulas protecting natural ingredients from oxidation and selecting suitable preservatives and surfactants for mild positioning of the formula.

To know more about the Cosmos standard and preserving cosmetics with multifunctional ingredients, check my online course on the Specialchem platform or for a one to one technical support, contact me directly on my website. I will also be speaking at the workshop on preservation and skin sensitivities at in-cosmetics Global in Barcelona. PC

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