

Information Requirements for Botanical Cosmetic Ingredients

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Abstract

The amount of information currently required by cosmetic manufacturers for botanicals can seem quite daunting, especially when a supplier can have over one thousand plants in their product range. The types of information needed are very diverse ranging from geographical origins, traditional properties of plants, actives present, suggestions for the use of plants in different applications, safety and quality information, including the 26 fragrance allergens, analytical information, formulation help, to traceability, environmental and social responsibility, fair trade etc. As a botanical extract manufacturer we are a buyer of plants and in this article I would like to describe first what the drivers are for our customers and how this impacts on the information that we need from our plant suppliers.

There are generally three levels of information requirement for botanicals when used as cosmetic ingredients, ranging from the most basic set to more sophisticated and detailed data:

- Basic
- Fantasy and Trends
- Function and Activity

1. Basic Data Requirements

Let us start by looking at the basic data requirements for all customers which fall into one of the following broad groups:

- Formulation
- Safety
- Environmental and Social Responsibility
- Traceability and Fair Trade

1a. Formulation

Formulators require basic information from their supplier such as:

- Stability
 - Freeze-thaw cycles
 - High & low temperatures / storage recommendations
 - Centrifugation (for emulsions)

- Consistency in certain quality parameters
- Incompatibilities
- Manufacturing recommendations

which allows them to incorporate botanical ingredients into their formulations without problems in manufacturing, transport or product end-use

1b. Safety

The amount of information that is required under the umbrella of safety has increased dramatically in the last 5 years:

- Toxicological information
 - Skin & eye irritation, sensitization
 - Fragrance allergens (Fig. 1 shows an example of a fragrance allergen declaration certificate)
 - Not tested on animals
- Pesticides and heavy metals
- Microbiological specifications
- Long lists of impurities
- GMO (genetically modified) – free certificate

Many plant extracts already have a wealth of toxicological data available for them and the ideal situation would be to do toxicological testing only after a thorough risk assessment and not to repeat tests when data are already available. It also means looking for alternative tests to those on animals when possible. In addition, the arrival of the declaration of fragrance allergens has put extra demands on plant extract manufacturers to produce certificates for all of their extracts – a not insignificant amount of analytical work.

1c. Environmental Responsibility

Sustainability must be the corner stone of sourcing of plants and is information that is requested by customers. Sustainability means that the sourcing of a plant will not affect its future existence and so plants have to be either cultivated, wild harvested under strict controls and not on the CITES list of endangered species unless grown commercially.

Fragrance ingredients proposed for cosmetic labelling⁽¹⁾

Cranberry Herbasol® Extract PG (Art. N° X10445.01.X)

Below is the list of 26 fragrance ingredients proposed for labelling on cosmetics products in Europe and their presence in **Cranberry Herbasol® Extract PG** as sold.

| INCI Name (natural origin) | CAS N° | Results (mg/kg) |
|---------------------------------------|------------|-----------------|
| Anise Alcohol | 105-13-5 | <10 |
| Benzyl Alcohol | 100-51-6 | <10 |
| Benzyl Benzoate | 120-51-4 | <10 |
| Benzyl Cinnamate | 103-41-3 | <10 |
| Benzyl Salicylate | 118-58-1 | <10 |
| Cinnamal | 104-55-2 | <10 |
| Cinnamyl Alcohol | 104-54-1 | <10 |
| Citral | 5392-40-5 | <10 |
| Citronellol | 106-22-9 | <10 |
| Coumarin | 91-64-5 | <10 |
| Eugenol | 97-53-0 | <10 |
| Evernia Prunastri (Oakmoss) Extract | 90028-68-5 | <10 |
| Evernia Furfuracea (Treemoss) Extract | 90028-67-4 | <10 |
| Farnesol | 4602-84-0 | <10 |
| Geraniol | 106-24-1 | <10 |
| Isoeugenol | 97-54-1 | <10 |
| Limonene | 5989-27-5 | <10 |
| Linalool | 78-70-6 | <10 |

| INCI Name (synthetic origin) ² | CAS N° | Results (mg/kg) |
|--|------------|-----------------|
| Amyl Cinnamal | 122-40-7 | <10 |
| Amylcinnamyl Alcohol | 101-85-9 | <10 |
| Butylphenyl methylpropional | 80-54-6 | <10 |
| Hexyl Cinnamal | 101-86-0 | <10 |
| Hydroxycitronellal | 107-75-5 | <10 |
| Hydroxyisohexyl 3-Cyclohexene Carboxaldehyde | 31906-04-4 | <10 |
| Alpha-isomethyl ionone | 127-51-5 | <10 |
| Methyl 2-Octyloate | 111-12-6 | <10 |

⁽¹⁾ presence of these substances must be indicated on list of ingredients when its concentration exceeds 10 ppm in leave-on products and 100 ppm in rinse-off products (2003/15/EC Annex III of 27. February 2003)

⁽²⁾ these compounds are not found naturally in plants

Figure 1. An Example of a Fragrance Allergen Declaration

1d. Traceability, Fair Trade and Social Responsibility

Consumers are increasingly interested in the “world behind the product” and so traceability, fair trade and social responsibility are becoming more and more important. Ensuring that farmers who grow or gather the plants are not exploited and have a fair deal is often a major target and this includes particularly the use of children as slave labour.

Currently it is challenging to document this requirement for all plants because of the complex supply chain and the extensive number of raw materials but this should remain a valid objective for all raw materials. Although this is currently not a basic request from all customers, it could well become one in the future.



Fantasy or Function

After the basic data set, what is the next level of data requirement? Information that needs to be provided is dependent on the reason why a plant extract or active is being used. Botanicals have the unique position of being used in cosmetic products both for reasons of fantasy and as functional raw materials. The majority of botanical extracts are still used for label copy, although there is now a gradual trend towards the use of botanicals as functional actives. There is a very delicate line between cosmetics and so-called cosmeceuticals. Claims, however, usually only hint at causing real changes in the skin in order to avoid any scrutiny by regulators for making drug claims.

2. Fantasy & Trends

2a. Fantasy

Let us continue by looking at information required when plants are used for the purposes of fantasy. Plants are often used in cosmetics and more recently in household products to create a “natural” story, as “natural” is still an important consumer demand. Regional themes for product

launches are often used, so suggestions of plants from specific geographical regions is a common request e.g.

- India
- China / Japan / Asia
- Amazon
- Deserts/ Alpine regions/Plants from extreme environments

Other trends may include the use of plants in different parts of the world in traditional herbal medicine or the use of plants to create a feeling or to address a very specific customer product brief. A more recent trend is products for “metrosexuals” and here a supplier really has to dig into the depths of fantasy to come up with some suitable botanicals.

Providing comprehensive marketing documents for individual plants makes it easier for customers to make the ideal choice of plant for the application, or to address the marketing brief which requires a product to create a specific fantasy. It also provides customers with references that can be used for claims support. Fig. 2 shows an example of the type of document that is provided for all plant extracts.

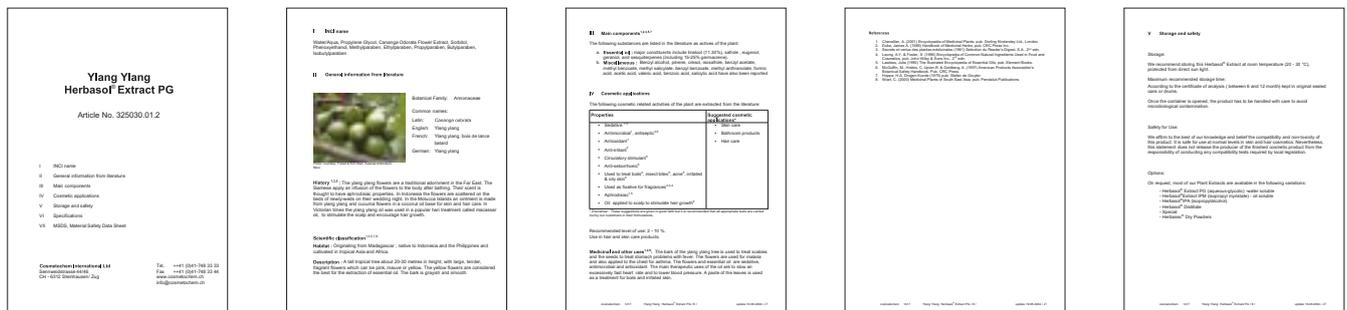


Figure 2. Example of marketing document produced for individual plants

2b. Other Trends

Organic/BIO/KBA is now a growing trend and more formulators are asking for extracts made from organically grown plants. In some cases where these are not available commercially, extract manufacturers have to organise the cultivation of organic plants themselves. In addition to alpine herbs the company has initiated the cultivation of organically grown white lilies – plants that are normally grown commercially only for floral decoration and therefore treated with pesticides. Unfortunately there is currently no globally approved organic certification. There is also a grey area where the choice of plant

can be made for a mixture of fantasy and functional purposes. For example, plants that are associated with good health, trends which have transferred from nutraceuticals, herbal or traditional remedies such as the use of plants in Chinese or Ayurvedic medicine or in aromatherapy and spa treatments, to convey the feeling of well-being. The use of phytohormones in cosmetics has been growing, particularly in anti-ageing products. This trend transferred from the use of plants in traditional medicine to treat hormonal imbalances in women and may be coming under regulatory pressure in the near future.

Natural Ingredients

3. Function /Activity

The highest level of information is required when plants are used as functional actives in a formulation. From ancient times plants have been used for their healing and medicinal properties. Actives originally from plants are used in 50-75% of our medicines today:

- Quinine (Cinchona spp) – anti-malarial
- Dioxin (Digitalis spp) – heart regulator
- Morphine (Papaver somniferum) – pain killer
- Ephedrine (Ephedra sinica) – cough relief
- Aspirin (Salix sp) – pain killer
- Taxol (Taxus brevifolia) - anti-cancer

So the use of functional actives from plants is not new.

3a. Plant Properties

Information that is often requested is for traditional properties

of plants such as astringency, circulatory stimulation, anti-inflammatory, nourishing or for suggestions of plants to use in specific product types e.g. products for anti-cellulite, sun care, anti-ageing, sensitive or blemished skins.

How does one go about selecting candidates for different applications? Let us take as examples products for blemished skin and anti-ageing. The first step would be to decide all the properties that might be required in a particular application. In the case of blemished skin the following properties could be desirable:

- Sebum regulating
- Anti-bacterial
- Anti-inflammatory / anti-irritant
- Soothing /calming
- Skin healing & regeneration



Figure 3. Field of white lilies organically grown in Switzerland

| Plant | Sebum regulating | Anti-bacterial | Anti-inflammatory | Anti-irritant | Soothing/calming | Skin healing/regeneration |
|-------|------------------|----------------|-------------------|---------------|------------------|---------------------------|
| A | | | | | | |
| B | | | | | | |
| C | | | | | | |
| D | | | | | | |
| E | | | | | | |
| F | | | | | | |
| G | | | | | | |
| H | | | | | | |
| I | | | | | | |
| J | | | | | | |

Figure 4. Plants with properties ideal for blemished skin

Key for figs 4 and 5

| | |
|--|--------------------------------|
| | Properties cited in literature |
|--|--------------------------------|

Similarly for anti-ageing products the following properties could be desirable:

- Stimulate skin regeneration
- Stimulate collagen production or inhibit breakdown
- Protect against UV & harsh conditions
- Anti-oxidant / free radical scavenger
- Presence of phytohormones
- Moisturising/nourishing/smoothing
- Circulatory stimulant
- Anti-swelling
- Astringent

| Plant | Skin Regeneration | Collagen | UV protection | Anti-oxidant | Phyto-sterols | Moisturising Nourishing | Circulatory stimulant | Anti-swell | Astringent |
|-------|-------------------|----------|---------------|--------------|---------------|-------------------------|-----------------------|------------|------------|
| K | | | | | | | | | |
| L | | | | | | | | | |
| M | | | | | | | | | |
| N | | | | | | | | | |
| O | | | | | | | | | |
| P | | | | | | | | | |
| Q | | | | | | | | | |
| R | | | | | | | | | |
| S | | | | | | | | | |

Figure 5. Plants with properties ideal for anti-ageing products

Constructing tables as shown in Figures 4 & 5, where the properties can be tabulated and compared between a number of plant candidates, gives the formulator the possibility of choosing the plant extract to meet the requirements of a particular application.

Natural Ingredients

3b. Plant Actives

Often requests are made for specific plant actives or groups of actives, rather than the properties of the plants themselves. These demands may be very general, such as the level of flavonoids, tannins etc. or they may be very specific in the case of a phytochemical that the formulator has identified as having a technical/functional advantage or one that has been receiving increased publicity in, for example, the nutraceutical or herbal supplement area. The type of information requested for plant actives falls into three

groups, each with an increased level of data requirement :

- Identification of plants high in specific actives
- Analytical data
- Claims substantiation

Let us take a specific example to illustrate this. Fig. 6 shows a list of some plants which are high in rutin. Rutin is a flavonoid or more specifically a flavonol glycoside composed of the flavonol quercetin and the disaccharide rutinose (Fig. 7).

| Common Name | Latin Name |
|----------------------|-------------------------|
| Wild pansy | Viola tricolor |
| Japanese Pagoda Tree | Sophora japonica |
| Buckwheat | Fagopyrum esculentum |
| Parsley | Petroselinum crispum |
| Tomato | Lycopersicum esculentum |
| Apricot | Prunus armeniaca |
| Elder | Sambucus nigra |
| Orange | Citrus sinensis |

Figure 6. Plants high in rutin

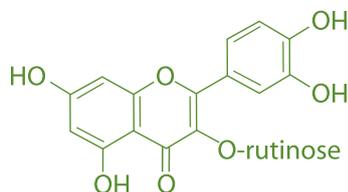


Figure 7. Chemical structure of rutin

Rutin is an anti-oxidant and free-radical scavenger but is often chosen for its vaso-protective properties in applications where anti-couperose activity is required. Rutin can be analysed

by both HPLC and HPTLC. Fig. 8 shows an example of HPTL chromatogram of lemon and orange peel where rutin is identified.

Analytical HPTLC

- Solvent system : ethyl acetate-formic acid-glacial acetic acid -water (100:11:11:26)
 - 1= Lemon peel/MeOH
 - 2 = Bitter orange peel / MeOH
 - T1 = rutin
 - Yellow = rutin
 - Orange = eriocitrin
 - Green band above orange = naringen, neohesperidin & hesperidin
- From Wagner & Blattl

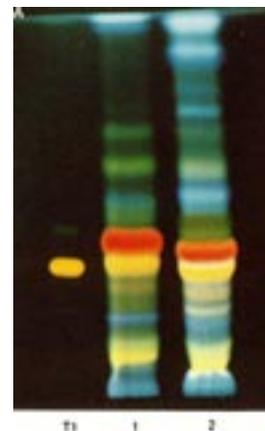


Figure 8. High performance thin layer chromatogram of lemon & orange extracts to show presence of rutin

I have discussed the different levels of information required for an active, using rutin as an example. However, choosing plants according to the presence of one specific active has resulted in what are sometimes inappropriately called “standardised” extracts, where one active is singled out for concentration or even the addition of the purified active. True standardisation should in fact encompass the whole process from plant cultivation through to manufacturing and thus the complete composition of the extract. This debate has been raging for some time in the herbal supplement market. Plants contain a multitude of phytochemicals and these often have more than one property. The activity of actives is often additive or synergistic. A good example is antioxidant activity. This

is often associated with a specific phytochemical group such as the flavonoids or even a specific member of this group. What is sometimes forgotten is that there are a wide range of phytochemicals that have antioxidant properties (Fig. 9). The efficacy of a concentrated extract with a full spectrum of plant actives can be superior to a single isolated active. This is in agreement with the tenets of traditional Chinese medicine, where whole plants are used because it is believed that the effect of the plant is due to a synergy which exists between the constituents. Perhaps the goal should be standardisation for activity rather than for a specific phytochemical. This leads us on to the last information group required for actives – claims substantiation.

| Phytochemical | Phytochemical Group |
|----------------------|---------------------|
| α -tocopherol | Vitamin |
| Ascorbic acid | Vitamin |
| β -sitosterol | Phytosterol |
| Caffeic acid | Phenolic acid |
| Carotene | Tetraterpene |
| Catechin | Tannin |
| Ellagitannin | Tannin |
| Ferulic acid | Phenolic acid |
| Gallitannin | Tannin |
| Ginkgolide A & B | Terpenoid |
| Kaempferol | Flavone |
| Lycopene | Tetraterpene |
| Naringenin | Flavone glycoside |
| Quercetin | Flavone |
| Resveratrol | Stilbene |
| Rosmarinic acid | Phenolic |
| Rutin | Flavonol glycoside |
| Shikimic acid | Organic acid |

Figure 9. A few examples of phytochemicals with antioxidant activity

3c. Claims substantiation

Substantiation of claims requires that an active or specialised extract is tested in the laboratory, either in vitro using cell culture or chemically measuring activity or in vivo on human volunteers to prove activity. This subject is too vast to be dealt with in detail here but the type of activity that may be tested for includes:

- Skin lightening
- Anti-wrinkle / skin smoothing
- Antioxidant activity / free radical scavenger
- Anti-inflammatory / anti-irritant
- Collagen stimulation
- Cell regeneration / stimulation
- Sebum regulation
- Anti-cellulite
- Antimicrobial