Cosmetic Preservation
1st Published in SPC - 2015
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The Legal Stuff

If a cosmetic contains water it must be resistant to microbial contamination. This is an essential part of EU Cosmetics Regulation (EC) No. 1223/2009, which requires that the efficacy of the preservation of a cosmetic product has to be assessed experimentally to ensure microbial stability and preservation during storage and use. The 8th revision of the Scientific Committee on Consumer Safety (SCCS) notes of guidance for the testing of cosmetic substances and their safety evaluation are published as SCCS/1501/12 and these include guidelines on microbiological quality of the finished cosmetic product.

These guidelines state that in order to ensure the quality of the product and the safety for the consumer, it is necessary to carry out routine microbiological analysis of each batch of the finished product coming on the market. The parameters examined, the criteria and methods used, and the results obtained per batch should be specified in properly filed reports and be recorded in the Technical Information File (TIF).

It is generally accepted that for cosmetics classified in Category 1, for children and application to mucous membranes, the total viable count for aerobic mesophilic microorganisms should not exceed 100 cfu/g or 100 cfu/ml of the product (cfu = colony forming unit). For cosmetics classified in Category 2, i.e. all other applications, the total viable count should not exceed 1000 cfu/g or 1000 cfu/ml of the product. In addition certain potentially pathogenic organisms should not be detected in these samples. Expert opinion is that this is a worst-case situation, since by choice of good quality raw materials and good hygienic GMP it is usually possible to have a limit of <10 cfu/gm in practice.

The guidelines also state that the efficacy of the preservation of a cosmetic product under development has to be assessed experimentally in order to ensure microbial stability and preservation during storage and use. This is done by

challenge testing, which is mandatory for all cosmetic products that, under normal conditions of storage and use, may deteriorate or form a risk to infect the consumer.

For cosmetics sold in Europe (EC) No. 1223/2009 lists a table of permitted preservatives as Annex V. This list was first compiled in 1982 and more than half are not in general use. There have only been two new ones added to the permitted list in the last decade and the prohibitive cost of gaining acceptance for any new ones will severely restrict any future additions. At Making Cosmetics 2015 Valérie Murset of the EFfCI* said that the limited number of available preservatives increases the risk of developing resistant strains of bacteria. It also increases the risk that consumers will develop allergic reactions to the preservative and a diverse palette is needed.

*EFfCI is the European Federation for Cosmetic Ingredients – a European trade association that brings together manufacturers of synthetic and natural ingredients for the cosmetics industry.

Formulators have an obligation not to exceed the maximum use concentration for any given preservative so where effective preservation of a formulation may have been achieved in the past by a combination of ingredients, now it has to be achieved by fewer preservatives used to their maximum level. This may not be sufficient for effective preservation, said Murset [Ref 1].

Also at Making Cosmetics 2015, **Svend L'Anson, MSL Solutions**, gave a presentation that focused on focus on bringing together the current procedures and guidelines for Preservative Efficacy (Challenge) Testing (BS EN ISO 11930:2012); Product Stability Testing and Microbial Limits (BS EN ISO 17516:2014). These were linked to article 12 "Sampling & Analysis" and article 8 "Good Manufacturing Practice" of EC 1223/2009.

L'Anson said that testing the efficacy of a cosmetic's preservative system was detailed in ISO 29621:2011 Guidelines for Risk Assessment but other methods were available such as those in European and USA Pharmacopoeia. Whatever method is selected it is important to test for factory isolates, also a repeat challenge test on aged product is important where a novel system is used.

Despite public fears and misconceptions based on discredited science, parabens remain the most popular preservatives in common use. In 2010 figures published by the FDA showed that parabens appeared in approximately 60% of all cosmetic products; phenoxyethanol appeared in approximately 24% followed by methylchloroisothiazolinone and methylisothiazolinone (6%), DMDM hydantoin (5.5%) and imidazolidinyl urea (5.45%).

What Next

So, with no new preservatives permitted what is available that will meet current legislative requirements? A presentation from **Inolex,** Cosmetic Preservation, Market Review**,** makes the very valid point that the internet gives voice to all, regardless of qualification and that "Real science" and "Junk science" are given the same credibility by an ill-informed public. Consumer, environmental and political groups are capitalising on this to move their cause forward. According to the Inolex presentation consumer's "fear of chemicals" is at an all-time high and consumers are reading the label. They fear certain product categories and once a category is feared, it is virtually impossible to remove this fear with data obtained from sound scientific principles. Consumers prefer ingredients that have natural sounding names and certification bodies such as Ecocert, BDIH, Cosmos and Natrue further confuse the issue and "brands" validate fears by removing offending ingredients and replacing them with greener alternatives.

In response many suppliers of traditional preservatives have widened their ranges to encompass both synergistic blends of those listed in Annex V of EC

1223/2009 and have introduced materials that have an antimicrobial effect although it may be argued that this is not their primary purpose. **IMCD** is a good example; it inherited the traditional Dekaben preservatives when it acquired **Jan Dekker** and has added many others to its preservatives portfolio. These include its Neofect range of glycols and organic acids with and without phenoxyethanol and p-anisic acid, described as a masking agent with antifungal activity.

Dekaben BL from **IMCD** is a preservative listed in Annex V that is permitted at up to 0.1% in leave-on and wash-off products. The CIR Review shows it as safe at concentrations up to 0.5% and there is no upper limit in Japan provided the product is not intended for use on mucous membranes. Chemically it is 4-isopropyl-m-cresol and has the INCI name o-cyment-5-ol. It is closely related to thymol, which occurs naturally in many plants including thyme, where it may represent 60% of its essential oil. Because of the limit on its maximum concentration in Europe Dekaben BL is suggested as a preservative booster to be used in combination with either traditional preservatives or currently used alternatives.

Ashland have produced a brochure about preservatives for personal care that offers a variety of solutions for skin, sun and hair care products. Available in five categories under the titles progressive; nature-identical, aromatic and classic plus preservative boosters, each are fully described with chemical structures, features and benefits. Its classic ones are those listed in Annex V with well-known properties and its aromatic ones combine phenylethanol, which has a mild rose-like odour, with caprylyl glycol.

The “progressive preservatives” from **Ashland** feature the Optiphen and Rokonsal preservative products. They are approved for use in all major markets and are not based on paraben, formaldehyde or halogens and are effective

against gram-positive and gram-negative bacteria, yeast and mould. They offer excellent heat stability, are easily solubilised in water and work across a wide pH range. They are mainly based on phenoxyethanol in combination with caprylyl glycol or organic acids.

Organic Acids

Under the current climate of public mistrust of traditional preservatives the use of organic acids has been increasing. Organic acids must be in the undissociated state to have any antimicrobial effect and the following table [Courtesy of **Inolex**] shows the effect of pH on dissociation and it is apparent that most organic acids have little or no antimicrobial activity above pH 6.

% Undissociated Acid					
pH →	3	4	5	6	7
Dehydroacetic Acid	99.5	94.9	65.1	15.7	1.8
Benzoic Acid	94.1	61.3	13.7	1.6	0.2
Sorbic Acid	98.3	84.9	36.0	5.3	0.6
Salicylic Acid	48.3	8.5	0.9	0.1	0.0
Levulinic Acid	97.5	79.9	28.5	3.8	0.4
Anisic Acid	96.9	76.0	24.0	3.1	0.3
CHA	100	100	100	99.9	99.0

Of the carboxylic acids listed dehydroacetic acid shows the least disassociation below pH 7 and it is marketed as Geogard 111A by **Lonza**. Geogard 111S is sodium dehydroacetate, which is the water soluble form of dehydroacetic acid. Test data comparing Geogard 111A and 111S to parabens show higher efficacy and substantially better performance in acidic pH formulations. They have Ecocert and COSMOS approval and combine high antifungal activity with moderate antibacterial activity and an excellent toxicology profile.

Other preservative mixtures from **Lonza** with COSMOS approval are Geogard 221 [INCI: Dehydroacetic acid, benzyl alcohol]; Geogard ECT [INCI: Benzyl

alcohol, salicylic acid, glycerin, sorbic acid] and Geogard Ultra [INCI: Sodium benzoate, gluconolactone]. Sodium benzoate and gluconolactone are widely used in the food industry for pH adjustment and preservation and are globally accepted for many personal care and cosmetic applications.

Referring to the table, CHA is caprylhydroxamic acid and it is available from **Inolex** as a white, free-flowing powder. CHA is a hydroxamic acid, which have much higher pKa's than carboxylic acids, so they remain active at higher pH. CHA is the only organic acid that remains fully active at neutral pH. It is also a powerful chelating agent for iron and many microorganisms have a reduced survival rate in iron-limited environments.

Salicylic acid is one of the materials listed in Annex V to be used at a maximum concentration of 0.5% as a preservative however it is permitted at 3% in rinse-off hair products and 2% in leave-on skin care with the provision that its primary purpose must not be the inhibition of micro-organisms and its purpose must be apparent from the presentation of the product! It is readily available as a chemical commodity but **Alban Muller International** has introduced Amipreserve as natural salicylic acid extracted from wintergreen. It is claimed to be the only entirely natural preservative listed in Annex V.

A source of synthetic salicylic acid is **Salicylates and Chemicals Pvt. Ltd**. of India and this company also produces mixtures of naturally occurring essential oils with a preservative action. There are currently four available as Salinatural CCL based on curry leaf and cinnamon leaf oils: Salinatural OLG based on orange, lemon grass and sesame oils; Salinatural BCLS based on basil extract with clove bud, lemon grass and sesame oils and Salinatural TCLS that is based on turmeric oil with clove bud, lemon grass and sesame oils. All have applications other than for preservative use and have Ecocert approval.

More Alternatives

DUB MUG [INCI: Glyceryl undecylenate] from **Stearinerie Dubois** is described as a glyceryl and undecylenic acid ester that is entirely vegetable-based with approval by COSMOS for use in organic cosmetics. It can be incorporated at 0.5% for its emollient properties and is coincidently effective against bacteria at this level. If it is combined with 5% DUB DIOL [INCI: Methylpropanediol] it is also affective against yeast and mould. Another effective combination is DUB MUG with DUB Zenoate [INCI: Propanediol dicaprylate], to be added for its sensory properties.

A material offered as a skin feel enhancer with excellent conditioning properties and sensorial benefits is Arlasilk PTM [INCI: Myristamidopropyl PG-dimonium chloride phosphate] from **Croda**. It is described as a coconut-derived phospholipid complex with a net cationic charge and is said to provide excellent preservative boosting and antimicrobial effects, allowing formulators to reduce the usage levels of those less desirable preservatives or enhance the efficacy of less effective preservatives.

Biovert from **Lonza** is a system that cannot be marketed in Europe as a preservative but can be included in cosmetics for other purposes. It is a two part system consisting of a substrate and enzyme. When these materials are combined together a cascade of linked reactions take place producing antimicrobial products in situ. The cascade is initiated by the action of the glucose oxidase enzyme in the presence of its substrate (glucose) and oxygen. This generates hydrogen peroxide, which is used by the lactoperoxidase to catalyse the oxidation of I- and SCN- anions, forming hypoiodite and hypothiocyanate, both of which have antimicrobial activity and the result is rapid microbial cell death. Biovert also acts as an antioxidant as it removes oxygen from a system, reducing the risk of oxidative degradation.

By Coincidence

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There is now wide spread use of materials where the principle function is defined as emollients or humectants, even though they are mainly used for their antimicrobial behaviour.

Cosphatec have produced a folder of suggestions for alternative preservation, which breaks them down by chemical classes into alcohols; diols and glycols; organic acids; glyceryl esters, oils and plant extracts with notes about their advantages, disadvantages and the pH range over which they are effective. Cosphatec produces many compounds in each of these groups and the brochure gives much useful information, including the primary purposes (i.e. non-preservative) for which they can be included in formulations. It also contains a useful guide to the selection of replacement alternative preservatives for new and existing formulations.

Dr Straetmans has long promoted its range of emollient glyceryl esters with coincidental antimicrobial effects and it has recently added Dermorganics 1388 to its portfolio. The product's active principle is a blend of compounds found in many plants in nature in combination with plant-derived glycerol to provide a moisturising effect. It is claimed that the delicate scent of Dermorganics 1388 [INCI: Glycerin, aqua, sodium levulinate, sodium anisate] will help mask undesirable odours of raw materials but will not usually interfere with a products fragrance. Dr Straetmans claims that when added at 3 – 4% the antimicrobial activity of Dermorganics 1388 can convert most cosmetic formulations into self preserving products with no further need for traditional preservatives.

Plants may have the Answer

Plants have developed their own preservative systems and these are being studied for their suitability for cosmetic use. Melaleuca alternifolia (Tea tree) leaf oil excited a lot of interest when commercial quantities were offered to the

cosmetic market. Unfortunately its strong characteristic odour and reports of allergic reactions restricted its use but **Southern Cross Botanicals,** now part of **Lucas Meyer**, has refined the natural oil to yield 96% terpinen-4-ol. This is the principal active compound in tea tree oil responsible for its antimicrobial and anti-inflammatory activities. It is claimed that Melafresh T96 is more potent than tea tree oil with significantly lower odour. Also available is Melafresh T10-WS [INCI: Melaleuca alternifolia (Tea Tree) leaf oil, aqua, polysorbate 20, PEG-40 hydrogenated castor oil] as a water soluble active version containing 10% terpinen-4-ol and Melafresh T10-SLR, which is the oil encapsulated in cyclodextrin to provide a slow release system.

p-Anisic acid is found naturally in anise and has a strong action against yeast and mould below pH 5.5. It is available from many sources including **Cosphatec** as Cosphaderm pAS and natural and nature-identical grades plus a water-soluble sodium salt are listed. The same company also produces a Magnolia officinalis bark extract that is not pH dependent and is effective against yeast and mould. This is combined with glyceryl caprylate and pentylene glycol as Cosphaderm MultiMEG to provide antibacterial properties.

Romacil V from **Lonza** is a water-soluble mixture with a delicate vanilla fragrance used to mildly enhance the attributes of personal care products whilst maintaining and protecting the integrity of the product offering secondary properties of broad spectrum anti-microbial activity. Effective between pH 4-7 this mixture of 1, 5 pentanediol, polyglyceryl-10 oleate, vanillin and caprylic acid is globally accepted, however in the EU vanillin has been identified as a potential perfume allergen by the SCCS.

Many of the materials mentioned have Ecocert and/or COSMOS approval and those interested are advised to contact the suppliers for further information, including a full INCI breakdown.

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Ref 1 Murset, V. The Preservation Challenge: How Will We Preserve Products Safely, Effectively and Legally in the Future; Making Cosmetics 2015

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www.creative-developments.co.uk