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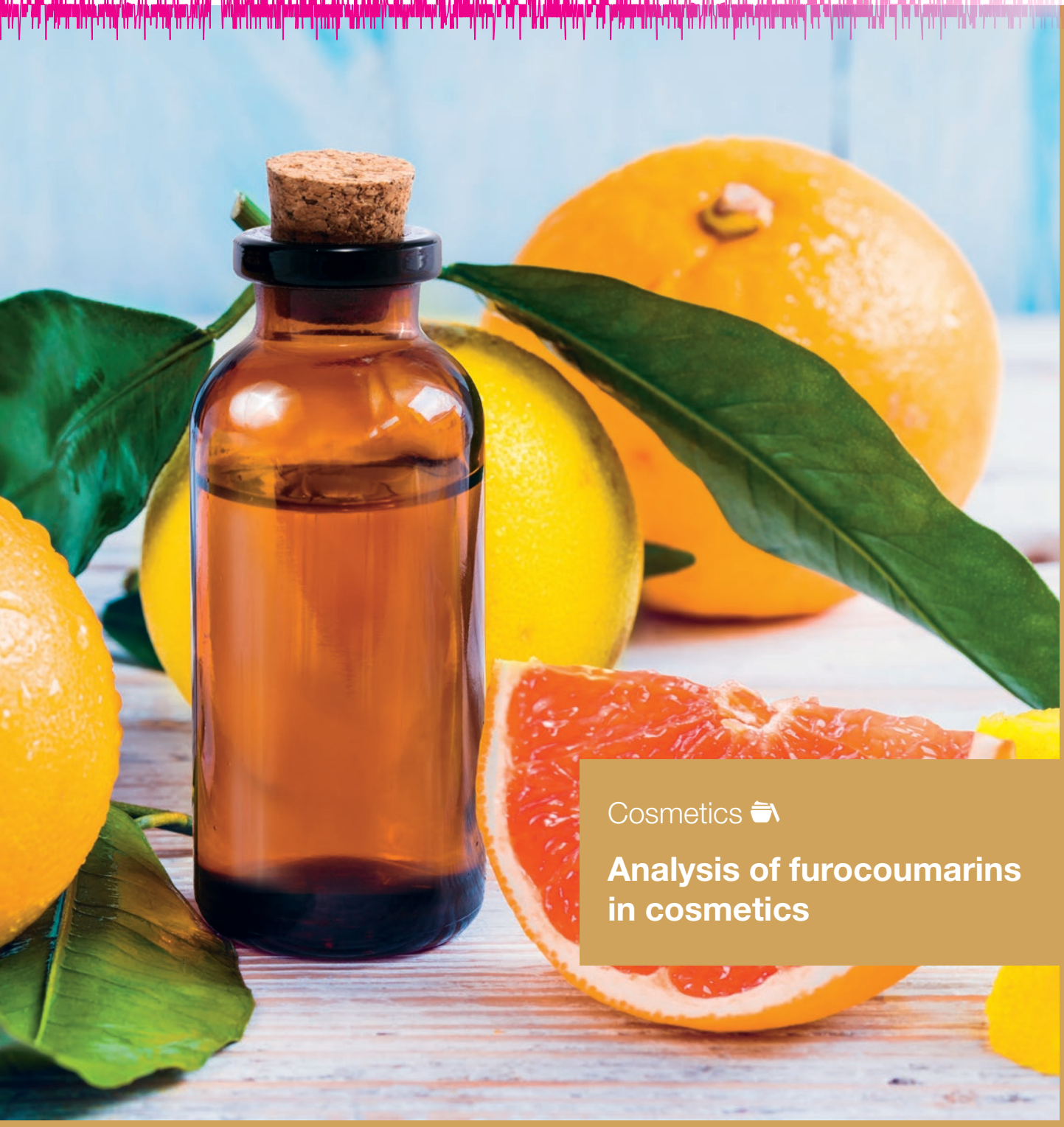

Cosmetics

Analysis of furocoumarins in cosmetics

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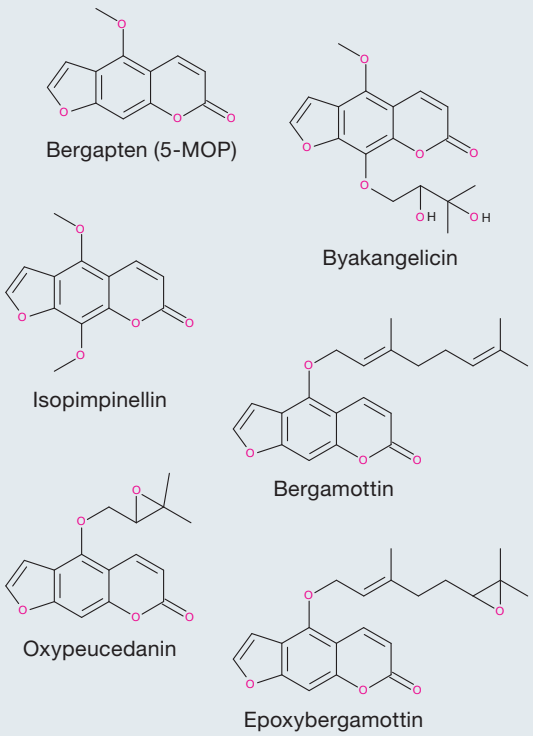
Author: Monika Gumpendobler

The trend towards more sustainability and ecologically manufactured products has now arrived in the mainstream. This is reflected in the labels and ingredients of many cosmetics. Consequently, natural raw materials are increasingly being used. It is often underestimated that, depending on the application, natural substances can also have a health-endangering effect.

A good example in this context is the substance class of furocoumarins. The phototoxic secondary plant compounds are particularly frequently found in citrus, food and spice plants of the umbellifers[1]. These also include lemons, oranges, bergamots and thyme, whose essential oils are a component of many perfumes and natural cosmetics. Furocoumarins are structurally based on coumarin and furan (see 1). Under the influence of long-wave UV radiation, the α,β-unsaturated carbonyl compounds act as photosensitisers. Therefore, phototoxic effects with sunburn-like symptoms may occur directly after exposure to sunlight[2]. In addition, some furocoumarins form adducts with cell components such as DNA bases. These interactions are the basis of their potential photomutagenicity and carcinogenicity[3].

1 Basic structures of furocoumarins



2 Essential oils with potentially high furocoumarin concentrations

Essential oil	CAS number
Angelica root oil	8015-64-3
Bergamot oil	8007-75-8
Grapefruit oil, expressed	8016-20-4
Lemon oil	8008-56-8
Lemon oil, cold pressed, California type	8008-56-8
Lemon oil, cold pressed, desert type	8008-56-8
Lime oil, cold pressed, Mexican	8008-26-2
Lime oil, expressed	8008-26-2
Lime oil, expressed rectified	8008-26-2
Orange peel oil, bitter	68916-04-1
Rue oil	8014-29-7

Legal framework and risk analysis

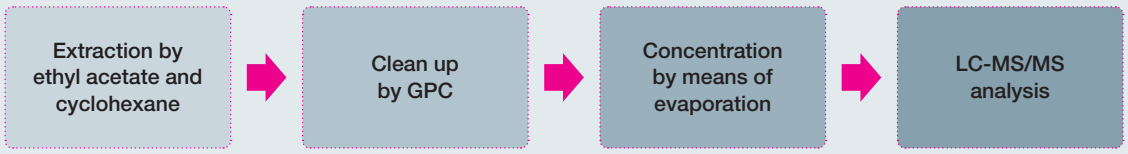
The permissible limits for furocoumarins and their scope are regulated in the new Swiss Cosmetics Ordinance, which came into force in 2017. It largely complies with the legislation of the European Union. In the case of furocoumarins, however, there is one particularity to be noted. Although the limit value of 1 mg/kg of the EU Cosmetics Regulation was adopted for the sum of the six marker substances (see 1), it was adopted for a much more extensive area of application. In contrast to the European Union, the limit value in Switzerland applies not only to sun protection and tanning agents, but also to all products exposed to sunlight. For guidance, the Scientific Committee on Cosmetic Products and Non-Food Products intended for Consumers (SCCNFP) of the European Commission has issued an opinion listing eleven essential oils[4], for which the limit of 1 mg/kg is recommended (see 2). The practical, analytical implementation of this recommendation is difficult because there is neither a fixed definition of the term “furocoumarins and furocoumarin-like substances” nor a publicly available,

standardised method for their residue determination. Interlabor Belp AG has oriented itself to the solution approach of the global industry association of the fragrance industry (IFRA; International Fragrance Association). It provides for estimating the furocoumarin load of a cosmetic product by testing it for six known marker substances (see 3). The marker substances were selected because of their frequency and their occurrence in high concentrations (> 1000 ppm) in essential oils[5].

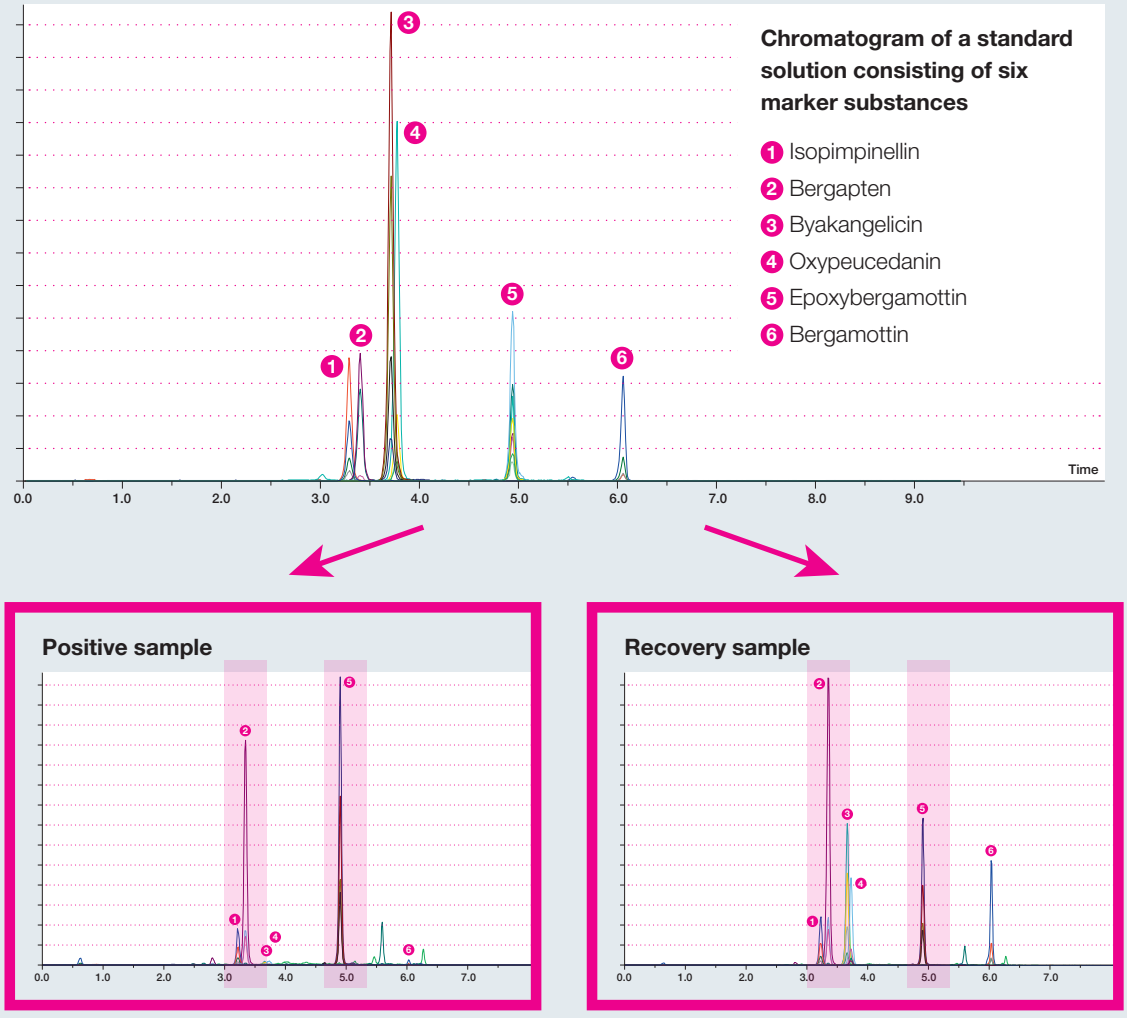
Method

Interlabor Belp AG determines the furocoumarins using liquid chromatography with tandem mass spectrometry coupling (LC-MS/MS). At the beginning, an aliquot of the sample is extracted in a solvent mixture of ethyl acetate and cyclohexane and purified by gel permeation chromatography (GPC). The extract is then concentrated and the extracted furocoumarins are determined with

Scheme of the method



3 Chromatograms



The graph shows the chromatograms of a furocoumarin analysis. The extracted sample contains high concentrations of furocoumarins. The control sample is analysed simultaneously and enables to determine the extraction yield and possible matrix effects.

ESI(+)LC-MS/MS. Quantification is performed by external calibration, i.e. the prepared sample extracts are measured together with standard solutions and the concentration of the standards is plotted against the detected signal area. Based on this calibration, the detected residues are quantified. Due to MS/MS detection, the marker substances for furocoumarins can be determined both with very high sensitivity and selectivity (see 3). This enables detection limits of 10 ppb to be achieved even in complex matrices such as skin care products with a high oil or fat content.

Outlook

Investigations by Interlabor Belp AG and the cantonal laboratories[6] show that the concentration of furocoumarins in many products exceeds the limit value of 1 mg/kg. Detailed knowledge about the raw materials used and the intended use of the product is required in order to ensure that cosmetics are harmless with regard to the exposure to furocoumarins. In addition, it is recommended to periodically test the starting materials and the final product for the presence of furocoumarin marker substances. □

References

1. *L. Santana, E. Uriarte, F. Roleira, N. Milhazes, F. Borges, Furocoumarins in Medicinal Chemistry. Synthesis, Natural Occurrence and Biological Activity, Current Medicinal Chemistry, 2004, Vol.11.*
2. *K. Iyer, M. Rengifo-Pardo, A. Ehrlich, Plant-Associated Dermatitis, Dermatology Nurses' Association, 2015, Vol.7.*
3. *M. M. Melough, E. Cho, O. K. Chun, Furocoumarins: A review of biochemical activities, dietary sources and intake, and potential health risks, Food and Chemical Toxicology, 2018, Vol.113.*
4. *Scientific Committee on Consumer Products (SCCP): SCCP/0942/05: Opinion on Furocoumarins in cosmetic products; Adopted by the SCCP during the 6th plenary of 13 December 2005; http://ec.europa.eu/health/ph_risk/committees/04_sccp/docs/sccp_o_036.pdf*
5. *Furocoumarins in finished cosmetic products, IFRA 21170_IL799 ANNEX; http://www.ifraorg.org/view_document_annex.aspx?annexId=21170.*
6. *U. Hauri, Care products with essential oils / preservatives, dyes, fragrances, UV filters, furocoumarins and nitrosamines, http://www.kantonslabor.bs.ch/dam/jcr:1ee639a9-06cf-4a1d-be63-041ecb28381b/Pflegeprodukte%202017.pdf*

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