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Inside-out Beauty: Merging Cosmetics
and Nutricosmetics for Well-being

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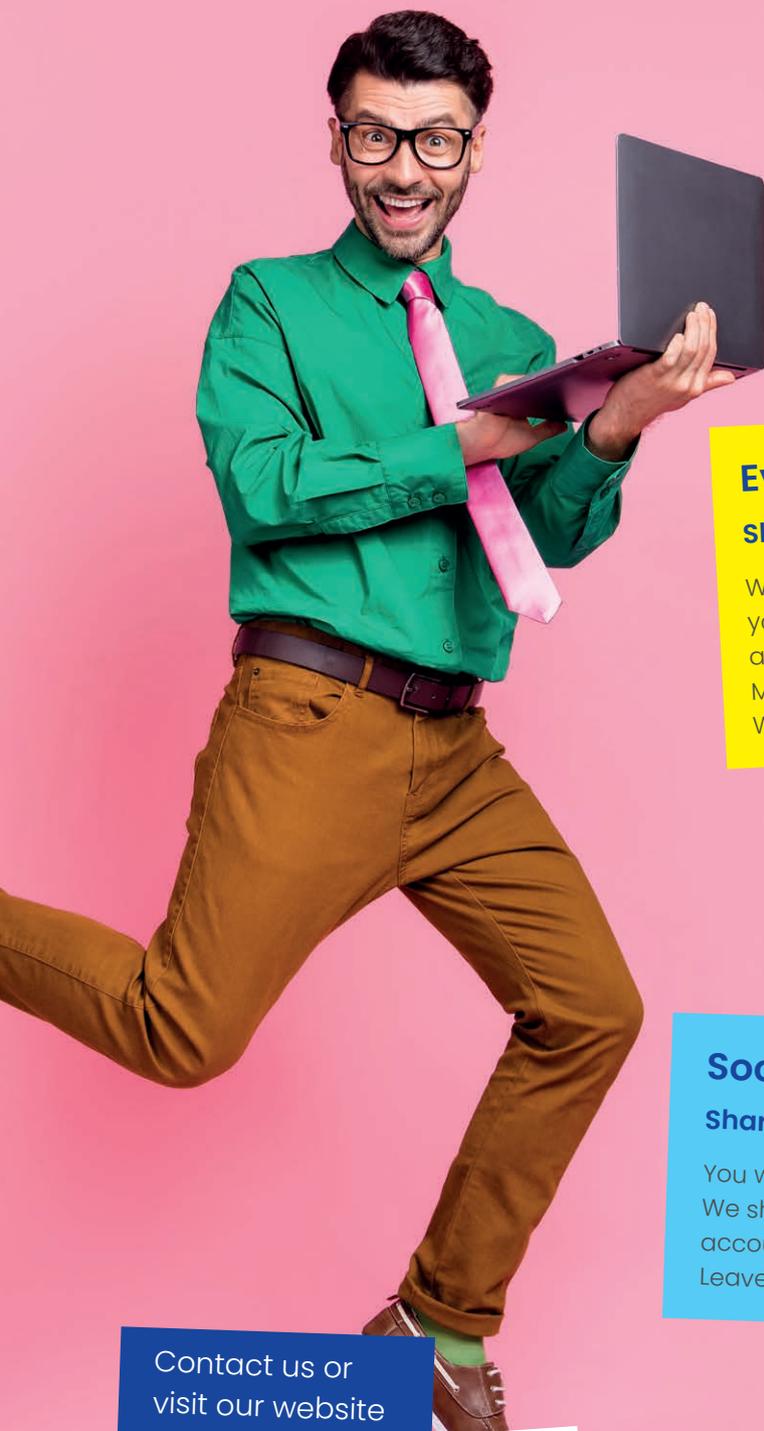
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SEPAWA® CONGRESS

Event Report 2022

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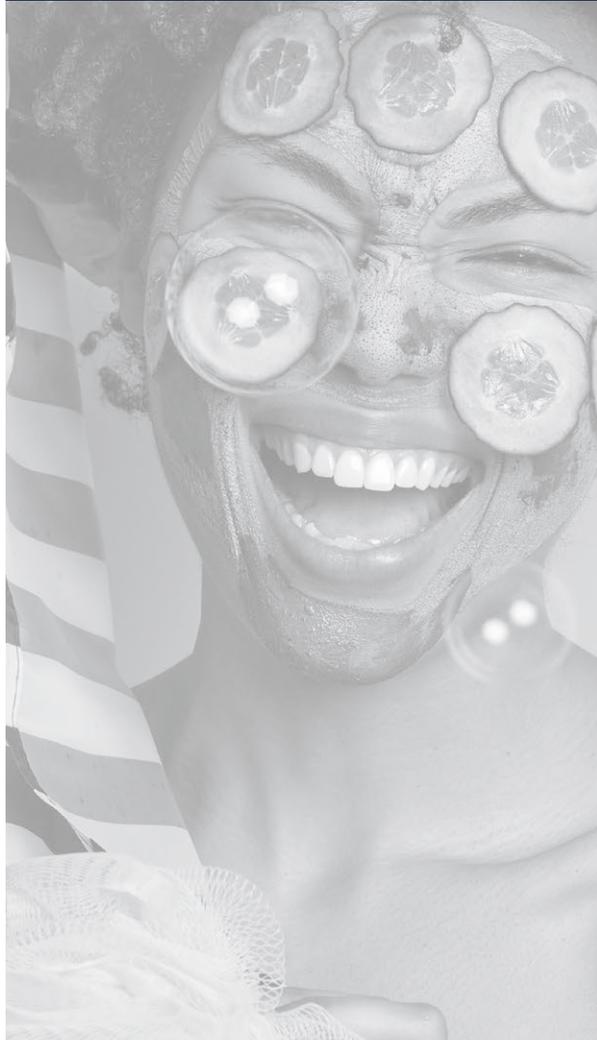
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26–28 OCTOBER 2022
**SEPAWA®
 CONGRESS**

The 69th SEPAWA® CONGRESS
 the 18th European Detergents Conference
 and the Cosmetic Science Conference
 from 26 to 28 October 2022 in Berlin

“Sunshine” on the Sonnenallee

By now, word will have got out: “The SEPAWA® CONGRESS has again taken place at the Estrel Congress Center in Berlin.” For two years, the traditional face-to-face congress had to be held virtually because of extensive pandemic restrictions. The organisers, the Executive Board of SEPAWA® e.V. and SEPAWA® eVent GmbH, were not sure in the run-up to the congress whether the well-known congress format would still be attractive?

During parallel sessions, the results of industry-related basic scientific research were presented as part of the European Detergents Conference (EDC), the results of scientific cosmetics as part of the Cosmetic Science Conference (CSC) of DGK e.V., and the results from application-orientated R&D on detergents and cleaning agents, cosmetics and perfumes. The latter also reflected the work of SEPAWA® specialist groups. The block of lectures on regulatory issues and sustainability, which was conceived by the SEPAWA® Specialist Group “Legislative-Environment-Consumers” and the Main Committee On Detergents (HAD) of the GDCh, was a feature of increasing importance. The TEGEWA association also addressed current issues of European chemical policy and the strategy for sustainability. A new feature of the lecture programme was a session on sustainable packaging. We now know how very much we missed the “live” lecture event and the personal contact of congress participants and exhibitors. Thank you! Interested professional colleagues remained loyal to the congress and the parallel trade exhibition. And the popularity of the congress and the trade exhibition had indeed grown. The statistics show participation by 3,175 attendees from 60 different countries. Some 302 companies exhibited their profile and presented their new products at the trade exhibition. A total of 153 presentations were held in parallel sessions.

Young Researchers’ Award Ceremony of the SEPAWA® e.V.

One highlight every year is the honouring of special achievements. The 1st Chairman of SEPAWA® e.V., **Dr. Hans Jürgen Scholz**, performed the appreciations.

The annual **SEPAWA® Young Researchers’ Award** fulfils one of the most important goals of SEPAWA® e.V. to promote the education of young professionals especially. The award is given to students for outstanding bachelor, master and doctoral theses. The jury selected 5 prize winners from the submit-

ted theses. Specifically, two bachelor’s thesis and three master’s theses were deemed worthy of the award.

The **1st prize** in the category “**Outstanding Bachelor’s Graduate**” was awarded to **Ms. Selina Mussler**, Technische Hochschule Ostwestfalen-Lippe, for her work with the title: “*Development of a „microplastic signal light“ for cosmetic products*”.

The **2nd prize** was awarded to **Ms. Marie Hensel**, Henkel AG & Co. KGaA, for her work. The title of the thesis is: “*Investigation of defined aged keratinous fibers by zeta potential measurement*”.



From left to right: A. Nadarzynski, A. Neutsch, Dr. H. J. Scholz, M. Hensel, S. Mussler



Picture credits: ©Katrin Heyer

The **1st prize** in the category **“Outstanding Master’s thesis”** had been awarded to **Ms. Nele Marie Dallmann**, Henkel AG & Co. KGaA, for her work entitled: *“Multiparametric Investigation of Logwood as a Natural Color Source for Hair Dye (Haematoxylum campechianum L.)”*.

The **2nd prize** was awarded to **Ms. Alexandra Neutsch**, evident ingredients GmbH & Universität Hamburg, for her work entitled: *“Development of a natural cosmetic-compliant solubilizer blend”*.

The honour for the **3rd prize** was accepted by **Ms. Alexandra Nadarzynski**, Cosphatec GmbH, for her work. The title of the thesis is: *“Use of multifunctional raw materials to reduce the water activity of cosmetic formulations”*.

SEPAWA® Innovation Award Ceremony

Innovations are crucial for growth and competitiveness in our markets and form the basis for successful and sustainable business. For the tenth time, this year’s SEPAWA® Innovation Award was presented to three winners from the cosmetics and detergents sectors. The prize is intended to provide impetus for active idea management in the member companies of SEPAWA® e.V. and to raise public awareness of a valued innovation.

A neutral, independent jury consisting of 7 members of the scientific advisory board of SEPAWA® e.V., the board and the advisory board of SEPAWA® e.V. selected 3 prize winners from 31 submitted proposals. The prize consists of a certificate and a trophy showing the SEPAWA® wave in stylised form. The aluminium body of the trophy has given way to a sustainable wooden body.

The **1st prize** was awarded to the company **Krüss GmbH Hamburg**. The title of the award-winning novelty is: *“Ayrís – The revolution for contact angle measurements”*. The award was received by **Marisa Asmuss & Malte Snoyek**.

The **2nd prize** was awarded to the company **Holiform UK**, represented by **Richard Lock**. The work is entitled: *“Gravity step separation fermentation method of producing sophorolipids”*.

The **3rd prize** went to the company **Connect Chemicals Group & P2 Science Inc.** entitled: *“Citropol®, sustainable & performing silicone alternatives”*. **Ms. Olechowski** received the award.

In keeping with tradition, the prizes were awarded at the beginning of the After Event show, this year by **Robert Fischer** (Verlag für chemische Industrie). The applause of more than 900 participants could not be ignored.



Picture: Innovation Award Winners 2022

Ceremony Young Scientists' Award of the GDCh Division of Detergent Chemistry

Mrs Prof. Dr. Birgit Glösen, University of Applied Sciences Köln, Chairperson of the GDCh Division of Detergent Chemistry, awarded the **Prize of the Division 2020** to **Dr. Astrid Rohrdanz**. The laudatory speech was held by **Marcus Gast**, Umweltbundesamt Dessau-Roßlau.

In keeping with tradition, the GDCh Division of Detergent Chemistry awarded 3 young scientists for excellent work with special relevance for the development of detergents. The award ceremony had been held by **Mrs Prof. Dr. Birgit Glösen**.

The prize for the **best PhD thesis** was awarded to **Dr. Christoph Brudl**, claro products GmbH & Technische Universität Graz. The title of the thesis is: *"Going green and clean – Is it possible?"*

The prize for the **best Master's thesis** received **Ms. Hailey Poole**, Universität Stuttgart & Queen's University Kingston Canada. The title is: *"CO₂-Switchable Foaming Agents"*.

The prize for the **best Bachelor thesis** was awarded to **Ms. Sophia Botsch**, University of Stuttgart. The title is: *"Influence of the surfactant concentration on the structure of porous polystyrene synthesized via emulsion templating"*.

The lecture event – a compilation of selected key topics

The lecture event excellently reflects the scientific foundation as well as the breadth of technical applications of our detergent/cleaning agent, cosmetics and perfume industries.

The **European Detergents Conference**, which was conceived by the "Division of Detergent Chemistry" sec-

The **SOFW award** was given to the 3 best articles in the SOFW Journal (SOFW Journal issues November 21 to October 22). The winners were honoured at an award ceremony. **Robert Fischer**, editor of the SOFW Journal, presented the prizes.

1st place was won by **BASF** with the article entitled: *"Nano or Non-Nano: the Key Aspect of the Measurement Method"*. The prize was accepted by **Dr. Myriam Sohn** and **Prof. Dr. Bernd Herzog**.

2nd place went to **FRAMES Formulation Intelligence** with the article *"Optimising Your Resources for Market Intelligence and Product Development"*. **Jean-Paul Janssens** and **Roel Hermant** accepted the prize.

3rd place went to **DSM**. **Julijana Ivosevic-Zaper** and **Olivier Garet** from DSM accepted the award for *"New Method for Connecting Sunscreens with Consumers via a Relative Eco-score"*.



Picture: SOFW award Winners 2022

tion of the **German Chemical Society**, saw 12 scientific lectures presented on the subject of *"Interface Interactions: Experiment & Modeling"*. The presentations were accompanied by topics from the award-winning doctoral thesis by the award winner.

Some 28 papers were presented during the **SEPAWA® Scientific Conference** on topics covering the latest research results from our detergents/cleaners, cosmetics and perfumes industries, including their regulatory framework.

The lecture block of the **DGK** conference, the **Cosmetic Science Conference**, hosted 19 scientific lectures. The

theme of this year's CSC was *"Cosmetics 360 Degrees"*. The aim of this conference was to present the development of cosmetic sciences "holistically" (and with a focus on sustainability).

The lecture blocks in the **Forum for Innovation** are a firmly established part of congress programme. This year, 92 speakers took the opportunity to present their latest developments. The entire lecture programme was complemented by a total of 39 poster presentations, including 14 science-orientated posters related to EDC, 14 related to the SEPAWA® e.V. conference and 11 with application-focused content. The posters were the work of young



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Keynote Address

scientists from universities and academic institutes, as well as employees from industrial research and institutional bodies in our sectors.

The **Fragrance Session** on Thursday morning focused on topics of the sustainability and naturalness of fragrances, and the physiological and emotional response to fragrances.

The **DGP sponsorship award** was also presented. This year's award winner was **Akshita Joshi (Technical University of Dresden)** who received the certificate for her work on *"Neural Associations Between Well-being and Odor Perception"*.

After event

A popular tradition. More than 900 participants eagerly awaited the **After Event** at the end of the 2nd day of the congress. Star chefs created delicacies of the most diverse kind – there was something special for every taste. The brief waiting times at the 11 food stations were gladly accepted.

Accompanied by the band of the Estrel Hotel, the sporting action continued, sometimes louder, sometimes more mellow but with a lot of verve on the packed dance floor.

As usual, the party went on until well after midnight.

This year's lecture was given by **JENS BODE | DER INNOLOGE®**. A wide audience was excited about what the innologist told us about innovation under the title: *"THE I-POINT. WITH YOUR OWN TALENT, (TREND)INSPIRATION & DESIRE TO INNOVATE"*. Here are a few key points from the presentation:

An 'i' for relevant inspiration, an 'i' for your individual talent and an 'i' for impact, and that with a large portion of intrinsic motivation towards the desire to innovate.

- Your unique talent & a creativity technique that can be used directly
- Sense of Urgency or 'what is actually going on out there?'



Picture credits: ©Katrin Heyer

- A loud commitment and 'yes' to a positive culture of innovation and free resources
- Innovating is easy, but...
- Inspirations & the treasure-hunter-mindset
- 12 top trending search fields
- Final & 5 (mental) hacks to innovation.



Picture credits: ©Katrin Heyer



Picture: After Event 2022

Summary, thanks and outlook

It has certainly become clear that the annual **SEPAWA® CONGRESS** is the most important meeting place for the detergent/cleaning agent, cosmetics and perfumery industry in Europe.

The Executive Board of SEPAWA® e.V. would like to thank everyone who contributed to the success of the 69th SEPAWA® CONGRESS. Special thanks go to the speakers on different topics during the various sessions. With their creative stands, the exhibiting compa-

nies provided the framework for the evolved trade exhibition with more than **300 exhibitors**. It was above all the **3,175 congress participants** who ensured a lively atmosphere at the Estrel Congress Center. The interest in the lectures has increased pleasingly, simply due to the number of lectures submitted. Demands placed on the quality of the content and the thematic breadth of the lectures remained and was also guaranteed by the active participation of the GDCh Division of Detergent Chemistry during the EDC and the DGK during the CSC. Thematically, the keyword "sustainability" ran through almost all lectures, regardless of whether they represented fundamental scientific or application-focused content. Particularly noticeable was the search for natural, sustainable active ingredients in personal care and cosmetic applications, but also the use of biosurfactants, specifically sophorose and rhamnolipids, as an alternative to classic surfactants. New, refined measurement techniques for surfactant-related substance data were also the subject of several presentations.

The 69th SEPAWA® CONGRESS was a success. From today's perspective, there seems to be no need to change the congress location, and it has already been announced for coming years.



Picture: SEPAWA® CONGRESS Exhibition

Special thanks go to the team behind **Robert Fischer** of the newly founded **SEPAWA® eVent GmbH**, which as a 100% subsidiary represents the interests of SEPAWA® e.V. in an outstanding way. You don't organise a congress of these dimensions "off the cuff". It takes a high degree of experience and enthusiasm. It's not copying successful past congresses that makes the difference. The main thing is also to tackle new topics such as "packaging".

Of course, preparations for the 70th SEPAWA® CONGRESS are already under way. Yours too?

You can find a detailed report on the congress website at:

www.sepawa-congress.de -> Highlights.

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Switzerland



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Cellulose Fibrils – Sustainable Rheology Additive for Home Care Products

R. Raggio

abstract

Cleaning products manufacturers are looking for new biobased solutions to replace traditional petrochemical ingredients. They aim to meet consumers' expectations and conform to new upcoming regulations by reducing the carbon footprint and improving the sustainability profile of the formulated end products. In this paper, we present an innovative rheology additive that represents a sustainable option for the HI&I industry, and a solution to bring new developments closer to meeting environmental goals without compromising the performances. Exilva® cellulose fibrils is a bio-based additive composed of pure cellulose, characterized by rheological and mechanical functionalities that impart a unique combination of properties in finished products. In this paper, we investigate a fabric softener-like system containing Exilva and a cationic surfactant, assessing the compatibility between these two ingredients. We show that small concentrations of cellulose fibrils can structure the formulations and suspend microencapsulated fragrances dispersed in the system, both in case of traditional and new generation microplastic free microcapsules.

Introduction

To comply with regulations established by governments and environmental protection agencies to fight pollution and climate change, and to meet consumers' expectations for more eco-friendly products, many cleaning products manufacturers have moved toward environmentally sustainable solutions. A significant improvement of the sustainability profile can be obtained by replacing traditional petrochemical ingredients with biobased ingredients produced by sustainably sourcing and processing natural renewable raw materials and therefore reducing the carbon footprint of cleaning products. Even though some commercially biobased solutions are available in the market today, researchers and product development groups continue to scout for highly compatible and robust biobased additives to meet future goals on sustainability and performance.

The rheology additive discussed in this paper represents an innovative solution that will help the HI&I industry to meet its environmental and performance goals. Exilva is a high quality and high-performance cellulose fibrils product with a very low carbon footprint, obtained from wood sourced from sustainably managed Scandinavian forests. Being only highly pure cellulose and water, it is a non-toxic ingredient, 100% biobased and free of microplastics. It consists of very fine fibrils with dimensions in the micrometer range and with an extremely high surface area. Cellulose fibrils are non-soluble but compatible with aqueous or common polar solvent systems and can create a robust 3D-entangled network when dispersed in a liquid formulation. Thanks to these features, cellulose fibrils can improve the stability, viscosity, consistency

and pourability, shelf-life and sprayability of cleaning products.

Cellulose fibrils will typically improve anti-settling of liquid formulations containing suspended solids, capsules, or oil droplets. The ability to prevent sedimentation of suspended particles, together with the other properties listed above, is maintained also in challenging environments such as in the presence of salts, surfactants, and extreme pH values. To present this concept, we report in this article the study of our cellulose fibrils additive used in combination with a cationic surfactant in the stabilization of encapsulated fragrances, in a fabric softener-like system.

Microencapsulation is an appreciated technology to pack liquid and solid ingredients, in different industrial applications. In fact, many active ingredients used in printing, construction, cosmetics, food and nutrition, agriculture, pharmaceuticals and home and body detergents need to be confined or coated in order to be protected from degradation processes until they are delivered and released to the application site. This is also the case of fragrances used in laundry detergents and specifically fabric softeners, used by consumers to soften the laundry and to give a pleasant and long-lasting smell to clothes and fabrics.

Microencapsulation in core-shell systems is the typical strategy used to confine active ingredients. When microcapsules are used in liquid detergents, the presence of rheology additives in the product is essential to stabilize the formulation

and to maintain the microcapsules suspended and homogeneously dispersed during preparation and storage.

In this paper, first we describe the preparation and characterization of suspensions containing cellulose fibrils dispersed in a cationic surfactant solution, the main ingredient of fabric softeners formulations. Then, by suspending two different types of microcapsules into the formulations, we demonstrate that cellulose fibrils with viscoelastic properties can structure cationic surfactant-based products and give them optimal suspending properties and storage stability over time.

Results & Discussion

The first part of the study presented in this paper investigated the compatibility of Exilva cellulose fibrils with a cationic surfactant used in fabric softeners. This was an important point that we needed to assess, since other commercial biobased rheology additives show stability issues in the presence of cationic surfactants.

The formulations contained Exilva cellulose fibrils and the cationic surfactant (cat surf in some parts of the text) in aqueous suspension at different dosages (expressed in this article as

% by weight of active ingredient based on total weight of the composition). The formulations were white, opaque, and homogeneous, and could be easily poured at all the concentrations tested (**Figure 1**). These features were maintained also during prolonged periods of storage (for a minimum of 6 months at room temperature).



Fig.1 A representative picture of the homogeneous texture and pouring behaviour of formulations containing Exilva® cellulose fibrils at 0.5% w/w and cationic surfactant at 5% w/w.

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After the preparation, the flow behavior of the samples was studied. **Figure 2** shows that the commercial fabric softener used as reference and the sample with 5% w/w of cationic surfactant, both with no Exilva added, had a low viscosity with values between 0.2 and 0.01 Pa*s. In presence of Exilva, the viscosity increased compared to the two reference samples, but formulations maintained similar homogeneous and smooth texture, consistency and good pourability. The presence of the cellulose fibrils in the cationic surfactant increased the viscosity of the suspensions at low shear rates. The viscosity at 0.01 s^{-1} (low shear) was 0.14 Pa*s for *cat surf 5%* (curve with yellow empty dots in **Figure 2**). At 0.01 s^{-1} , the viscosity increased up to 49.00 Pa*s for *Exilva 0.5%-cat surf 5%* (curve with blue triangles). This is the sample with the highest Exilva dosage considered in the study. In general, the viscosity increased with the concentration of cellulose fibrils. At the same time, the flow curves show that Exilva gives low viscosity under medium and high shear rate, even when the concentration of cellulose fibrils is increased. For example, to the act of pouring corresponds a shear rate of around 1 s^{-1} : under this shear rate, the formulations have higher viscosity with increasing Exilva dosage, but they remain pourable and sprayable.

This is an effect of the strong shear thinning behavior of Exilva: high viscosity at rest, and low viscosity under application of a shear strain that results in optimal pouring and workability. In addition, formulations containing Exilva quickly recover their viscosity, which can help to reduce product spillages when filling the detergent drawer tray compartment of the washing machine.

To determine the gel strength of Exilva network in the cationic surfactant systems, we calculated the yield stress of the formulations. The value of the yield stress expresses the maximum amount of shear stress that can be applied before the network starts to break down and indicates the ability of the formulation to keep fragrance microcapsules stably suspended.

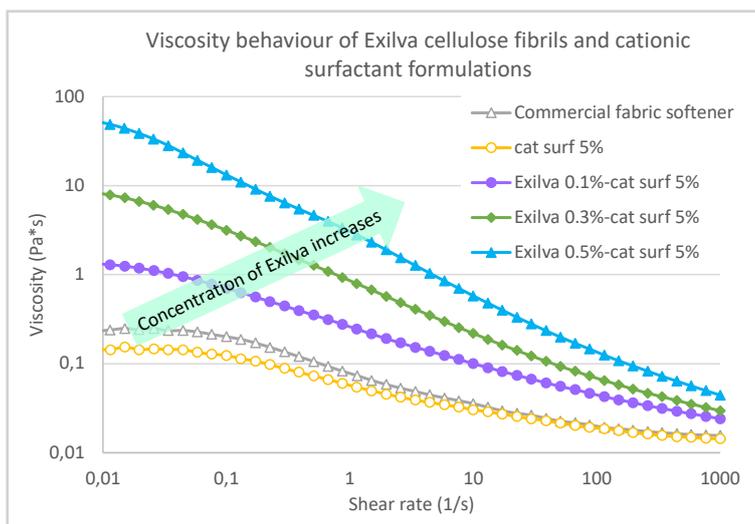
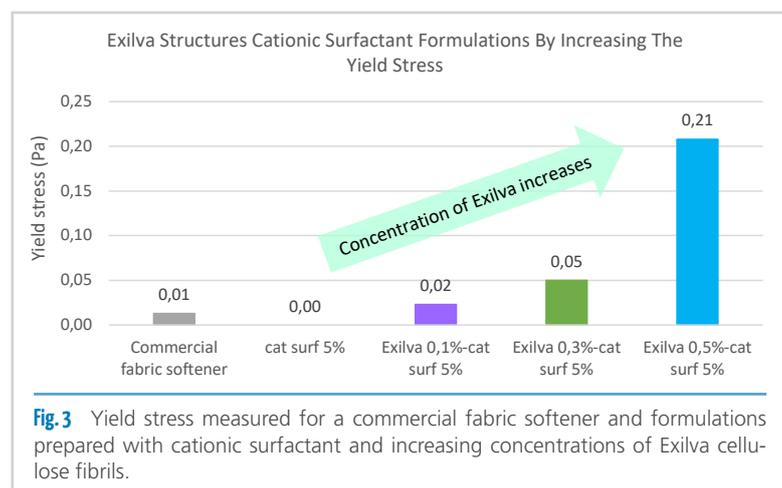


Fig. 2 Viscosity measured at increasing shear rates for a commercial fabric softener and formulations prepared with cationic surfactant and increasing concentrations of cellulose fibrils.

ed. If the stress applied by the microcapsules is weaker than the yield stress of the formulation, the solid particles do not sink during storage.

Figure 3 clearly shows the effect of the addition of Exilva on the yield stress of the formulations: increasing concentrations of cellulose fibrils gradually built a structure inside the cationic surfactant formulations and increased the yield stress. Sample *cat surf 5%* had no yield stress, and the commercial fabric softener exhibited a very low value, suggesting poorer stabilising properties for these two products.

To prove that Exilva can effectively help to prevent sedimentation of suspended microcapsules, we dispersed the microcapsules at 1.5% w/w in the formulations containing Exilva at different concentrations and cationic surfactant.

0.3% w/w of Exilva cellulose fibrils could stabilize the biodegradable microcapsules Folco Smartcaps Bio in suspension for at least 12 weeks at room temperature. The samples appeared homogeneous throughout their volume to the naked eye. This observation was confirmed by optical microscopy images on portions of the samples collected at different depths. In **Figure 4**, the microscopy picture of the sample with 0.3% w/w Exilva cellulose fibrils and 5% w/w cationic surfactant (on the left) shows the same composition and microcapsules distribution at all collection points (only one image representative for top, central and bottom layers reported here). The cellulose fibrils are visible as elongated thin units and the microcapsules as round shaped units homogeneously dispersed.

The images collected on the bottom layer of the formulation with 5% w/w cationic surfactant and no cellulose fibrils show sedimentation of the microcapsules with only few microcapsules remain-

ing suspended and visible in the images of samples collected on top and central layers.

A similar situation could be observed when microcapsules Folco Microdeur were used. Interestingly, in this case, an even lower dosage of Exilva could be used to obtain stable suspensions. 0.1% w/w of Exilva cellulose fibrils with 5% w/w of cationic surfactant successfully stabilized these fragrance microcapsules, as visible in the left picture of **Figure 5**. The cellulose fibrils and capsules are homogeneously dispersed at all collection points. 0.1% w/w of Exilva and 5% w/w surfactant could stabilize for some time also Folco Smartcaps Bio, but after 12 weeks of storage at room temperature sedimentation initiated and the top layer appeared poorly populated by the microcapsules (images not shown here). Folco Smartcaps Bio probably have a density slightly higher than Folco Microdeur, therefore a higher dosage of cellulose fibrils was needed to obtain stabilization over a prolonged period of time.

Folco Microdeur could not be maintained in suspension without the addition of Exilva to the 5% w/w cationic surfactant formulation, as shown by the right pictures of **Figure 5**.

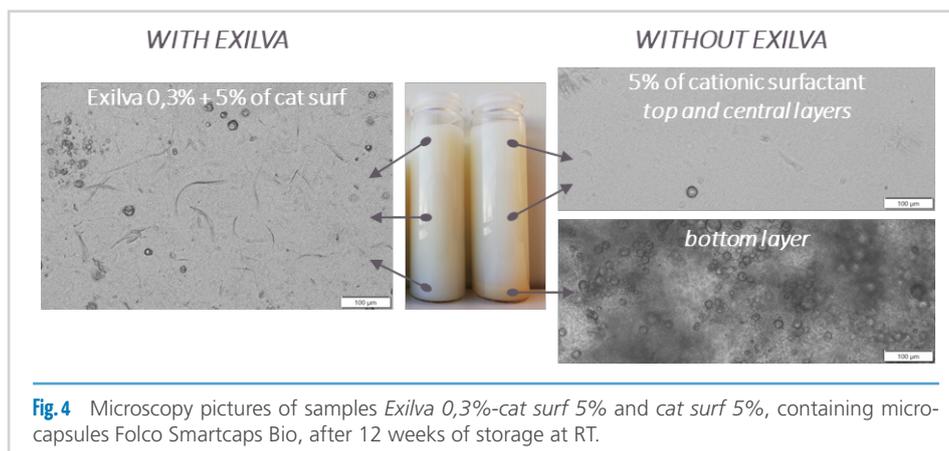


Fig. 4 Microscopy pictures of samples *Exilva 0,3%-cat surf 5%* and *cat surf 5%*, containing microcapsules Folco Smartcaps Bio, after 12 weeks of storage at RT.

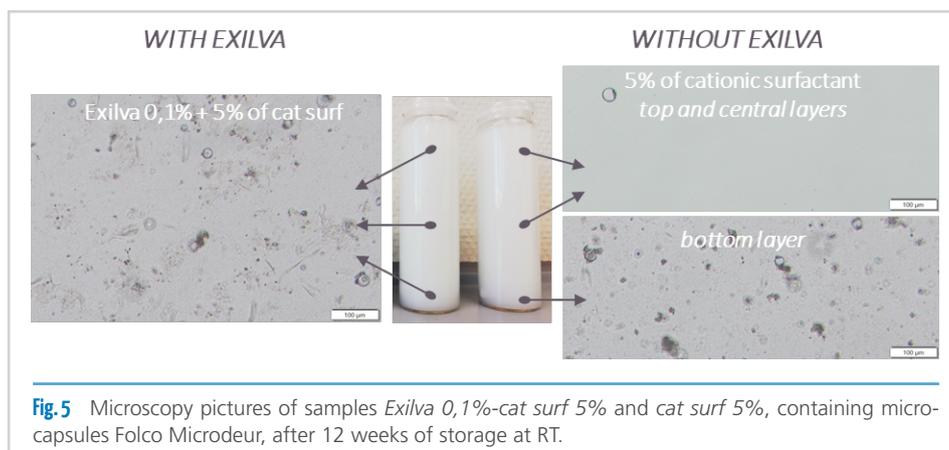


Fig. 5 Microscopy pictures of samples *Exilva 0,1%-cat surf 5%* and *cat surf 5%*, containing microcapsules Folco Microdeur, after 12 weeks of storage at RT.

Materials & methods

Materials

Exilva, consisting of sustainable cellulose fibrils produced by Borregaard AS (Sarpsborg, Norway) from Norway Spruce wood sourced from Scandinavian forests, was used without any further modification after it was received from the pro-



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duction plant. In particular, both the commercial suspension (2% w/w of cellulose fibrils) and the commercial paste (10% w/w of cellulose fibrils) were used for the experiments (Figure 6). The only difference between these two products is given by the content of cellulose fibrils, which is higher in the paste.

Since similar results were obtained with the two products, only the experiments conducted with the Exilva suspension (product with 2% w/w of cellulose fibrils) are described in this article.

A cationic surfactant for laundry application, an esterquat based on fatty acids of vegetable origin (Clariant GmbH, Frankfurt am Main, Germany), was used for the experiments. A common commercial fabric softener, probably formulated without using microencapsulation to confine fragrances, was also included in the study as reference sample.

The formulations prepared in this study included encapsulated fragrances fabricated with different technologies and therefore characterized by different density and composition. Since the chemico-physical properties of the microcapsules have an impact on their stability in a liquid suspension, we selected two different microcapsules, both containing a mixture of fragrances. The first system selected consisted of polymeric core-shell microcapsules based on melamine formaldehyde technology. These microcapsules are the current state of the art and present two advantages: they can ensure controlled release of core ingredients, and production is well established. However, these synthetic microcapsules often contain residual amounts of free unreacted formaldehyde, and, in addition, they fall under the definition of microplastics [1]. The final regulations regarding microplastics have not been approved yet by the European Community, but the ban on the use of microplastics is expected to be imposed soon. This is why formaldehyde-free biodegradable delivery systems are of growing interest in industry. The second system selected was in fact a biodegradable microcapsule system produced using a sustainable technology for the shell and the core. These biodegradable microcapsules are not yet widespread on the market but are becoming more and more interesting and will probably soon replace the traditional ones.

The microcapsules used in this study were kindly provided by Follmann GmbH & Co. KG (Minden, Germany) and consisted of Folco Microdeur (a white liquid suspension of traditional

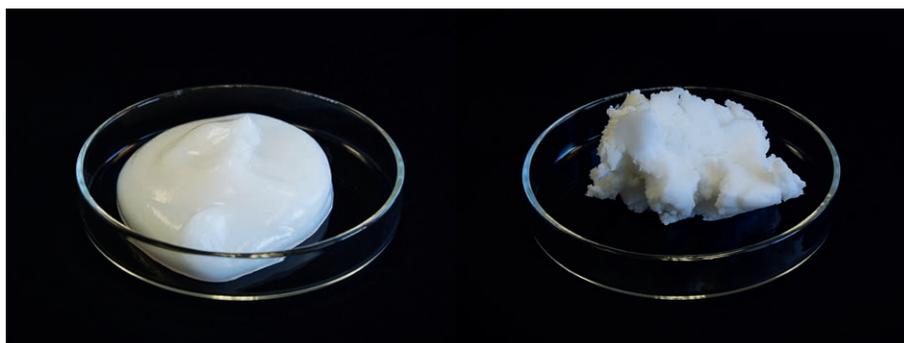


Fig. 6 Picture showing the appearance of Exilva suspension on the left, and Exilva paste on the right.

microcapsules) and Folco Smartcaps Bio (a brownish liquid suspension of biodegradable microcapsules).

Methods

A simple recipe was used to prepare the samples investigated in this study. The cationic surfactant, supplied as an opaque water-soluble paste with 90% w/w of active ingredient, was first dissolved in deionized water by an overhead stirrer. Then, Exilva cellulose fibrils suspension was added to the mixture and stirring was maintained until homogeneous. To investigate the effects of the composition on the samples' rheological properties and suspending ability, different concentrations of cellulose fibrils and cationic surfactants were used. The concentration of active cellulose fibrils in the total sample volume was varied from 0 to 0.5% w/w. The concentration of the cationic surfactant was varied from 5 to 10% w/w, in line with common fabric softeners composition [2]. Only the results obtained on samples with 5% w/w are reported in this study, since no compatibility issues were observed at any concentration tested.

Table 1 shows the typical recipe used for sample preparation in this study.

Formulation				Mixing instructions
#	Component	Reference (%w/w)	With Exilva (%w/w)	
1	Exilva	0	0.3	I. Add the cationic surfactant to water and mixed gently until dissolution. II. Add Exilva and eventually more water to complete to 250g. III. Mix gently without creating foam (around 15 min at 200 rpm with overhead stirrer).
2	Cationic surfactant	5	5	
3	Water	95	94.7	

Tab. 1 Typical recipe for preparation of cationic surfactant dispersion stabilized with Exilva cellulose fibrils.

Storage stability was monitored at room temperature. Portions of the samples were used for the suspending ability experiments in presence of the fragrance microcapsules.

The microcapsules, supplied as water suspensions, were added at 1.5% w/w, under gentle mixing, to the formulations containing Exilva and cationic surfactant. Samples were mixed until the microcapsules were homogeneously dispersed.

The samples were characterized in terms of visual appearance and microstructure under optical microscope (Olympus BX51, phase contrast imaging), both as freshly prepared and after storage. The properties of the samples under flow and deformation were measured before the addition of the microcapsules by Anton Paar Rheometer, using coaxial cylinder geometry. The viscosity at different shear rates, the elastic and storage moduli and the yield stress (calculated as the value of the shear stress at the limit of the linear viscoelastic region) were evaluated and compared for the different formulations considered in this study.

Conclusion

This article describes the study of Exilva cellulose fibrils additive, produced by Borregaard, used in the stabilization of encapsulated fragrances in a cationic surfactant-based system for laundry applications. When dispersed in a liquid system, Exilva can form a robust entangled network of insoluble cellulose fibrils that give exceptional viscoelastic (shear thinning) properties and improved performances during application. As already demonstrated and in addition to the results described in the article, the advantages that can be obtained with Exilva cellulose fibrils as stabilizer of microcapsules include:

- Improved long-term stability.
- Improved phase stability, easy dosing and pouring, reduced leakages.
- Robustness in challenging formulations; in particular, high shear stability and compatibility with salts, surfactants, high/low pH and a broad temperature range.

Moreover, since Exilva is a 100% biobased product and can be used in small dosages, it can reduce the CO₂ footprint of

the products, conferring a green and sustainable profile to manufacturing companies.

Cellulose fibrils could stabilize two different types of microencapsulated fragrances in cationic surfactant formulations. A concentration of only 0.3 wt% Exilva cellulose fibrils helped to stabilize the biodegradable microcapsules in suspension. An even lower concentration of 0.1 wt% Exilva cellulose fibrils could stabilize the traditional microcapsules and prevent sedimentation.

The results showed that Exilva® is a promising technology that imparts a unique combination of properties not only to laundry products but potentially to a variety of finished product systems. We believe that our new-to-the-market cellulose fibrils additive can act as a problem solver for formulators facing stability and compatibility issues and can help them to prepare more sustainable end products.

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Inside-out Beauty: Merging Cosmetics and Nutricosmetics for Well-being

M. Merlini

Boundaries between nutrition, health and beauty are becoming progressively blurred. At the crossroads of cosmetics and nutraceuticals, lies nutricosmetics. Although this segment is popular among millennials who look for healthier lifestyles, it is mainly driven by independent brands. However, cosmetic brands can also hold their own at the market. As a supplier of both cosmetic and nutraceutical ingredients, Seppic sheds light on the key expertises required to shape a relevant “beauty from within” offer: from ingredient to formulation, including regulations.

Introduction

Today, well-being is a popular concern among consumers that pursue solutions to improve it in many aspects of their lives. It'll be a long-term asset for the beauty industry, especially in Europe. Indeed, consumers look for beauty routines making them feel good in their body. These routines have a dual dimension, both practical and emotional since cosmetic products aim to improve body appearance with sensoriality.

Following the COVID-19 pandemic, this quest for well-being has increased and now, the boundaries between nutrition, health and beauty are considerably blurring. As a matter of fact, consumers reinvent beauty rituals with the use of nutricosmetics and the development of inside-out routines.

Inside-out: merging two universes

Although there is no official definition, the inside-out beauty consists of combining a food supplement (“inside”) and a cosmetic product (“out”), mainly focusing on improving skin appearance.

This new beauty routine plays upon the addition of the cosmetic and nutricosmetics product benefits, in order to get the most out of aesthetic performances and sensoriality. On one hand, topical applications target locally the upper layers of the skin, with most of the time quick effect; on the other hand, beauty from within acts from the inside at a systemic level over a longer period. Moreover, with regard to sensorial-

ity, the inside-out routine awakens different senses, from the touch to the taste, creating in this way multi-sensory routines.

Still niche and mainly driven by new independent brands, the inside-out beauty shows promise in the future and could be foreseen as a “blue ocean” for cosmetics brands.

In Europe, it is supported by the growth of both sectors: the cosmetic industries will reach 140 billion euros by 2026 [1] while the nutricosmetics market will soar worldwide to almost 11 billion euros by 2026, with Europe being the second most dynamic market.

However, merging the two universes of cosmetic and nutricosmetic implies to overcome various stakes and understand the expertises that shape the cosmetic and nutraceutical industries.

Proven efficacy: the cornerstone of an inside-out routine dedicated to the well-being

The inside-out carries a global philosophy, with preventive and corrective actions generally targeting skin aging (wrinkles, firmness), loss of radiance, skin sensitivity and the correction of imperfections (acne, redness).

To tackle these skin disorders, the inside-out routine lies on two approaches. On one hand, inside-out products are com-

posed of the same efficient active ingredient, both in the “inside” and the “out” products. Sometimes, even a single inside-out product can be used orally and topically. On the other hand, the inside-out products contain distinct active ingredients that work in a complementary way.

As a supplier of cosmetic and nutraceutical ingredients, Seppic offers a purified wheat extract concentrated in phytoceramides, in order to help hydrate the skin, reduce wrinkles and enhance skin texture, both orally and topically (Glycosphingolipids - glycolipids). Another example is when addressing sensitive skin disorders, Seppic relies on a duo of nutricosmetic and cosmetic ingredients: a natural and 100% virgin coriander seed oil highly concentrated in petroselinic acid acting orally on four phenomena involved in the reactivity of the skin and an oily extract of *Laminaria ochroleuca* (Caprylid/Capric Triglyceride - *Laminaria Ochroleuca* Extract) offering topical immediate to medium-term relief.

Beside the approach, a cornerstone of the inside-out beauty is the proven efficacy.

Indeed, at the beginning of nutricosmetics forty years ago, the lack of a framework for the claims on products allowed questionable marketing messages, not backed by scientific

proofs and ultimately creating a reluctance among consumers to the true effectiveness of nutricosmetics. Since 2006, the claims of a food supplement efficacy are henceforth governed by a European regulation relating to nutritional and health claims. The arrival of this text in 2006 requires a high level of proof and prior authorization for the use of such nutritional and health claims. Among nutraceutical ingredients, there are the nutricosmetics ones that don't target health. In fact, nutricosmetics target the skin through claims that refer to a structural change in the skin and bring a visible effect to the skin (wrinkles, radiance, firmness, etc). Unfortunately, the evaluation of these beauty-related claims is not harmonized at European level; but, their use remains more easily accepted since they don't fall within the scope of health-related claims and even more when they are supported by solid evidence of efficiency.

Consequently, more and more nutricosmetic active ingredients are the subject of clinical studies and *in vitro* tests, thus providing proof of their visible benefits and mode of action. As an example, Seppic set up a randomized, double-blind, placebo-controlled clinical trial on a panel of 60 women to evaluate the efficacy of its nutricosmetic blueberry-fermented extract. It demonstrated the visible effects on the skin color, uniformity, roughness and microcirculation harmonization.

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At the same time, in a highly competitive environment and faced with increasingly well-educated consumers, efficacy and proof of the claimed effects are the keys to the success of cosmetic products.

Thus, the inside-out makes it possible to benefit from the efficiency and innovation of two dynamic sectors, serving the well-being of consumers.

The challenges of formulating an inside-out routine focused on well-being

Beyond the nutricosmetic and cosmetic active ingredients, the formulation, or also called the galenic, is a vector of efficiency. On one hand, in cosmetics, excipient ingredients support the effectiveness of the active ingredients. On the other hand, through the oral route, the formulation plays an essential role in the bio-availability and protection of the active ingredients. Seppic also offers cosmetic and nutricosmetic excipient ingredients and masters the formulation of "inside" and "out" products. We are able to create effective and sensory formulas thanks in particular to our expertise in emulsion and coating.

Moreover, other attributes are factors of success: the ease of use and the sensoriality. On one hand, the ease of use is an intrinsic characteristic of the inside-out beauty: routines are often frugal with fewer products and the oral route is also easy to take everywhere. On the other hand, the inside-out beauty appeals to many senses, reinforcing the feeling of well-being: the "inside" products appeal to the sense of touch, the "out" products appeal to the sense of smell, taste, and even the in-mouth texture.

In particular, nutricosmetic products come in many galenics: tablets or capsules are the most common but gummies, powders and ready-to-drink beverages are on rise.

Each galenic has its own advantages in terms of efficiency, ease of use and sensoriality. For example, the tablet – which remains one of the most popular dosage forms among con-

sumers – contains a large quantity of active ingredients with a short-term or prolonged release effect, comes in a wide variety of shapes, colors, sizes or flavors and responds to different modes of intake.

With regard to gummies, they are soaring because they are highly appreciated by consumers for their childish side. They also offer a strong sensory experience through taste, smell and texture and facilitate the routine for optimized results.

Conclusion

Inside-out routines have a bright future ahead with consumers looking for solutions to improve their well-being thanks to the additional benefits of cosmetic and nutricosmetic products and the multitude of easy-to-use and sensorial galenics. However, in order to build a consistent offer, it is important to identify the main stakes in terms of effectiveness and formulation and to master the expertises of the two universes, those of cosmetics and nutrition. Especially since in the future, more holistic offers will appear and merge even more nutrition, health and beauty targeting claims such as "complexion radiance & energy boost", "healthy glow effect & better quality of sleep", "hydration and tonicity", etc., and at the end allowing consumers to improve both their physical and psychological well-being.

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It's Not Just Collagen – Nutricosmetics, an Evolving Landscape

U. Wollenweber, C. G. Suárez Rizzo

abstract

Since recent years the look for a holistic beauty approach becomes more important and we observed a shift to care for oneself. So, the application of topical skin care products is often combined with oral supplementation and “edible skin care” is on its way. One idea behind is that well-being including nutrition and mental health reflects a healthy skin.

In this article we like to point out the trend from a market view and explain the different kinds of ingestible products.

Introduction

All over the world, we are seeing strong growth and awareness of the relationship between dietary supplementation and skin appearance. Consumers are more informed about the health benefits of balanced nutrition and supplementation.

As people take a more holistic approach to their well-being against the backdrop of a global pandemic, it is natural that they are taking a similar approach to their beauty and skincare.

Parallely, consumers are becoming more interested in “natural” alternatives to skin health and beauty. This coincides with the eco-friendly and organic beauty brands with increasing need for natural products.

Nutricosmetic ingredients are often naturally sourced, making them appealing to this type of consumer.

Innova Market Insights included ingestible beauty in its top ten trends nowadays, both beauty from within and clean beauty are experiencing significant growth [1].

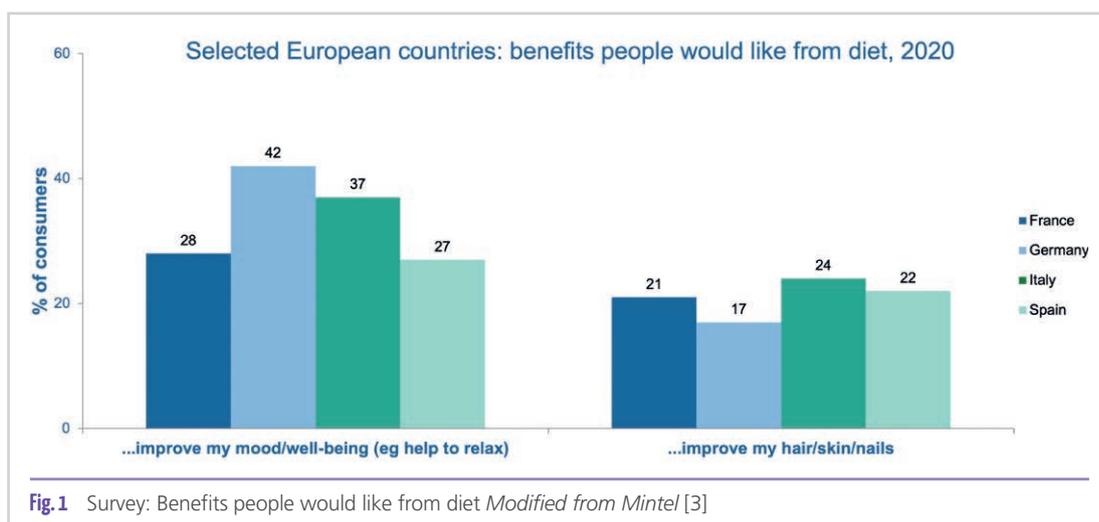
In Global Cosmetic Industry it was pointed out that since nearly two years, safety, sustainability, and efficacy are driving consumers' ingredient demands and that the most innovative beauty brands are adding nutricosmetics to their product line [2].

Trends

In the last years the focus has moved away from appearance being associated with beauty to a healthy concept where people were investing in skin health. These are driving demands for cosmetics and nutricosmetics that blur the boundaries between traditional beauty products and medicine products. People find new ways to feel comfortable at all ages as well as throughout their lives changing needs.

So, beauty and grooming routines are not connected to the necessity to maximize physical appearance but instead, the concept of beauty from within and the view that good skin health can boost other areas of physical and emotional well-being.

A Mintel study dealing with the use of nutrients and diets to support skin health points out especially opportunities to reduce stress and anxiety. As well, it is shown that sleep, worries, and diet impact consumers' skin as “common lifestyle issues”.



In addition to diet, consumers recognize that these other factors influence skin health, too [3].

In the past, the beauty from within market was covered predominantly by the elder consumers looking for anti-aging remedies. Nowadays, especially younger consumers are aware of aging's effects on their appearance and are pursuing solutions a lot earlier.

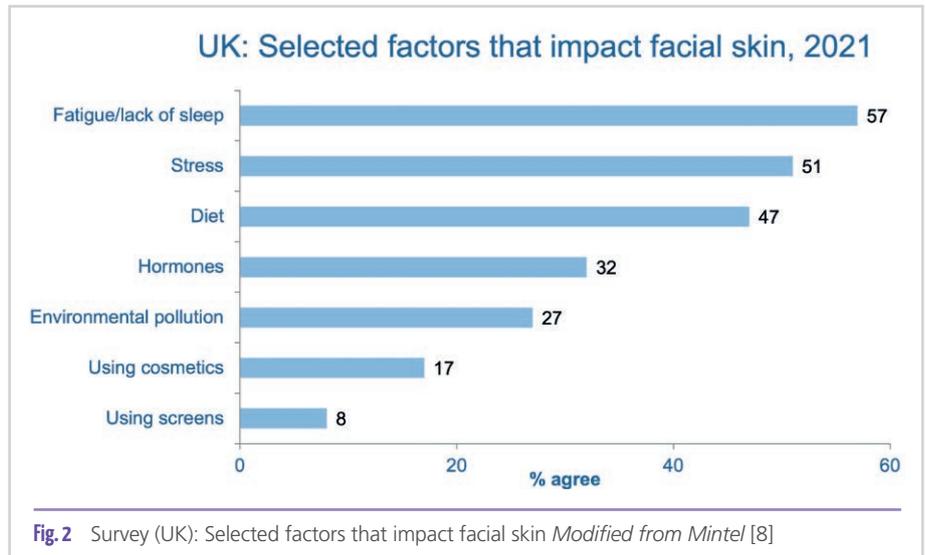
Ingredients and Formulations – "It's not just collagen"

Currently, convenience is an important factor in every day's life, and it is easier to incorporate the benefits of nutrients in form of a pill or a gummy per day than to apply cosmetics to skin and hair.

Next to younger consumers, especially men are reached by this approach.

Regarding the formulation, new ingredients are changing the market with an accent in a cellular level, where products do not target particular skin color, race, or age.

Cosmetics brands are focusing on products' end benefits and ageless and genderless solutions for healthy-looking, radiant skin.



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On-the-Glow



Progressive brands in the Beauty and Personal Care (BPC) space are shifting to all-inclusive product offerings, creating opportunities for skincare and color cosmetics to focus on a product's benefits first.

As identified in Mintel Trend "The Next Generation", consumers are moving away from traditional gender stereotypes and expressions while embracing gender neutrality. The consumers are responding to these products that they offer a platform for inclusivity [4].

A holistic and inclusive approach is offering all consumers solutions that help them look and feel their best, while coping with the lifestyle and environmental factors that affect skin and so much more.

Skin renewal takes place in the upper layers of the skin, which means that when using topical products, such as moisturizing creams, serums, and lotions, their effect is limited. This is where the positive impact of using nutricosmetics comes into play [5].

Following this trend, nutricosmetics are formulated to:

- Increase ROS scavenging activity
- Reduce chronic inflammation
- Support healthy skin cell renewal and strong structure
- Potentially renew/repair photo-damaged skin
- Promote healthy hair and nails

From a scientific point of view, it is very well known, that extrinsic factors have a mayor influence on the skin's appearance and health. These environmental factors are diet, stress, lack of sleep and lifestyle. By using supplements, we may positively affect the condition of the skin [6].

Skin health nutrients can help consumers look their best by supporting healthy skin from the inside out, while simultaneously supporting other areas of health:

- Blood flow and microcirculation
- Support weight management
- Stimulate immunity
- Energy Management

These functions can be achieved with a bundle of active ingredients as potent nutricosmetics like antioxidants and vitamins, minerals, unsaturated fatty acids, and pre-, pro- and post-biotics [3].

Applying food science principles for BPC products are transforming time-tested rituals, ingredients, and techniques into a skincare formula.

Classicals – Collagen and Hyaluronic Acid

Hydration is important for general health and consumers were drinking water long time ago to support hydration of the skin. However, hydrating the skin goes beyond simply drinking water to keeping skin looking firm and plump [8]. Nowadays, consumers are using functional drinks with a beauty-enhancing benefit.

Besides barriers to protect the skin from drying out, nutrients such as hyaluronic acid and collagen-boosting vitamin C play key roles in skin hydration.

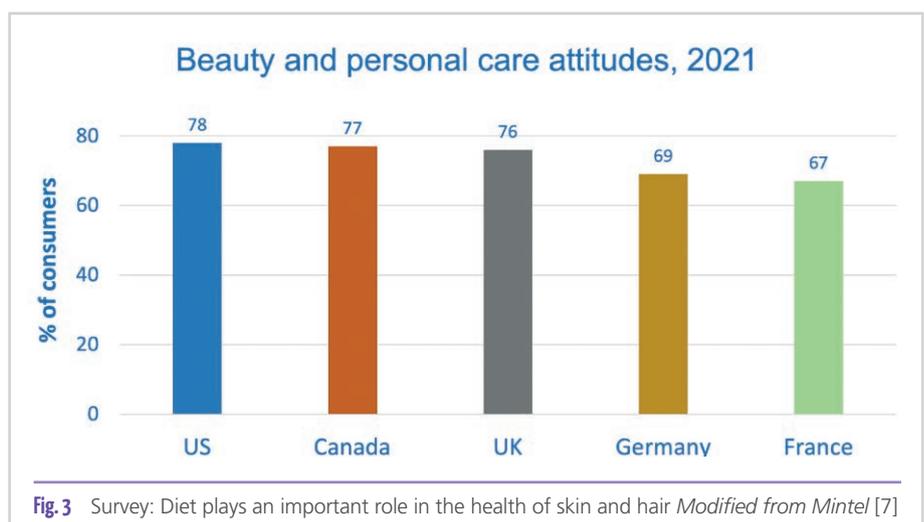
A long historical claim was anti-aging and compassing this, the most traditional and best-known ingredient was collagen. Considering that, the amount of collagen production in the body declines from about the age of 30 onwards, supplying the body with collagen in supplemental form, we can replenish the body's natural resources of this vital nutrient and address these issues. The anti-aging claims fitted well with this concept.

Today, more and more consumers are looking for other delivery formats to reduce the need to take pills and capsules. Fortified food solutions such as gummies represent an increasingly attractive way to consume supplemental collagen. Now, new-generation skin health ingredients, mainly hyaluronic acid, and collagen peptides, are outpacing vitamins and minerals giving a revival of both classical ingredients.

Repair Versus Regeneration

Antioxidants

It is well known that free radicals produce inflammation, and the daily intake of antioxidants from fruits and vegetables or supplements scavenges reactive oxygen species (ROS), thereby preventing skin damage [10].



Antioxidants reduce ROS in cells and eliminate the effects of advanced glycation end-products (AGEs) on the divergent regulation of gene expression of receptors. Some of antioxidant-based ingestible products already well-established are carotenoids from tomato, polyphenols, flavonoids and proanthocyanidins from green tea or algae, and vitamin C from fruits rich in ascorbic acid like Acai or Rose hips [7,9,5,11,12].

The power of superfruits and superfoods could achieve a skin's perfect balance with solutions to reset and reveal visibly brighter, glowing skin. The digestible beauty ingredients also halt UVA-induced pigmentation, boost skin's resistance against UVB-induced erythema or boosts collagen to regenerate skin with increased vitality and hydration.

Unsaturated Fatty Acids

Healthy fats like omega-3 and -6, are coming from natural virgin oils, such as linseed, chia, argan and evening primrose, which provide skin-caring properties for healthy and radiant skin. As we age, the natural production of unsaturated fatty acids in our body begins to slow down and can only be supplemented by our diet [13].

Trace minerals (especially zinc, copper, selen) are important co-factors for enzymes like glutathione peroxidases and Su-

peroxide dismutase (SOD), which eliminate free radicals. But next to their benefits to protect cells against oxidative stress the efficacy includes supporting collagen formation, and aiding in optimal hydration, respectively.

An integrated and balanced concept – Pre-, pro-, and postbiotics

Ingestible beauty is a category that touches on every major trend in beauty. Ingredient innovation for these products therefore continues apace.

Wellness-oriented materials brands may be incorporating into well-beauty offerings. These include immunity-boosting materials, mood enhancers and well-being ingredients.

The holistic approach connects with consumer concerns for not just beauty, but health, along with shifting priorities during and post-pandemic.

Pre-, pro-, and postbiotics:

From prebiotics and probiotics to postbiotics, a range of ingredients are emerging to support the microbiome. Greater understanding and awareness of the importance of gut health



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for overall wellbeing provides fertile ground for innovation around supplements that support multiple areas of health.

Also, cosmetics are targeting the microbiome and step into 'new' areas of health, like gut and brain health.

Regarding the gut-skin axis, it could be found that a healthy gut leads to a radiant and even skin. Pre- and probiotics strengthen the microbiota of the skin and help absorb nutrients although when they are applied orally whereas post-biotics work directly on the skin's microbiome when applied topically.

Taking dairy as source of probiotics incorporated into topical cosmetics, works as supplier of moisture and nutrition for tired skin and reduces itchiness and symptoms of eczema [14,15,16].

The real breakthrough, if a good brand marketing company can master it, would be to use a probiotic for nourishment from the inside, while a postbiotic does the skin work [17].

Next to the gut-skin axis also an effect between brain and skin can be observed and our skin reflects our lifestyle whereas a non-stressed person with good mood has radiant skin. In this direction, botanicals help with a long history of use supporting these claims and close the circle regarding plant-based active ingredients. Consumer insights confirm that globally, about 80% of consumers agree that well-being is connected to the beauty of the skin [18].

At a glance

While skin aging is a natural process, many factors can improve skin's health and appearance. Nutricosmetics are one approach.

The trend in nutricosmetics is fast accelerating and it has experienced significant growth in the past few years. This will continue as consumers look for natural ingredients that promote beauty by ingesting beneficial active ingredients.

Consumers in nearly all age groups recognize the need for preventive and holistic approaches to healthy skin. They are more educated than ever before and are seeking out brands, whose health benefits are supported by quality science.

Small changes in daily routines can have a great impact in the long term. Unlike a topical skincare product, nutricosmetics are metabolized through a different route of delivery and take more time to attain results.

Thus, using ingestible ingredients in tandem with topical solutions can provide deeper support to obtain a more beautiful and healthy skin.

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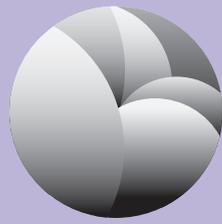
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Protective Beauty – Holistic Skin Protection through Enzymes

S. Christian, V. Krug

abstract

Every day, our skin is exposed to many factors that promote premature skin ageing. Two key factors are also closely related to each other: UV radiation and free radicals. It is known that UV radiation alone is responsible for 80% of the visible signs of facial skin ageing [1]. Therefore, our skin needs a reliable repair and protection system.

Following nature's example, enzymes are ideal components for such a system, as they offer a highly efficient and long-lasting effect. The active ingredient Glorydermal® GUARD contains a synergistically acting complex consisting mainly of two enzymes: the repair enzyme photolyase, which is derived from microalgae, and an antioxidant enzyme in the form of an iron peptide. A liposomal encapsulation of the enzymes additionally improves their penetration into the skin.

The repair enzyme photolyase repairs UV-induced DNA damage, the so-called CPDs (Cyclobutane Pyrimidine Dimers), very efficiently and faster than the body's own repair mechanisms. The antioxidant enzyme neutralises ROS (Reactive Oxygen Species) including free radicals long-lasting. Like an enzyme, it is not used up and therefore offers a long-term radical protection. Efficacy studies on human 3D full thickness skin models show the synergistic long-term repair and protection provided by these two enzymes to effectively prevent premature skin ageing.

Introduction

Skin protection is not a question of age. With a total surface area of about two square metres, our skin is our largest organ that covers and protects our body. It is as unique as it is diverse and accompanies us throughout our lives – so it is worth taking good care and protecting it (**Figure 1**).

In our daily lives, our skin is exposed to many influences that can be damaging. One of these influences is UV radiation. This is also associated with free radicals, which can also affect our skin and let it age more quickly. But UV radiation and free radicals are not influences that can just be reduced to the summer months. Both accompany our daily lives, some-

times to a greater or lesser extent, but also whenever we are not directly aware of them. As the main causes of premature skin ageing, UV radiation and free radicals can lead to signs of ageing such as photoageing and wrinkles through DNA damage and oxidation processes.

The active ingredient Glorydermal® GUARD targets these two influencing factors centrally and offers a reliable repair and protection system that protects our skin like an invisible shield against the negative effects of UV radiation and free radicals. It repairs UV-damaged DNA and neutralises free radicals synergistically and long-lasting.

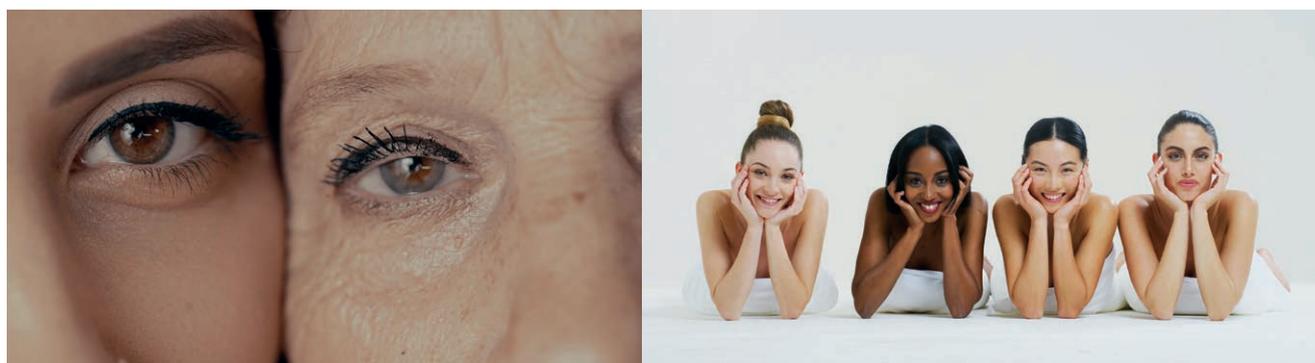


Fig. 1 Our skin is more than just the shell of our body. Its care and protection should therefore be essential elements of modern beauty concepts. This basis is comprehensively taken up by the trend Protective Beauty.

Enzymes are the conductors of life – Efficacy based on the example of nature

The research for suitable active components yields numerous active ingredients, especially in the area of free radical neutralisation, which are used as antioxidants in cosmetic products. However, in DNA repair and the neutralisation of free radicals, effectiveness alone is not the decisive factor; speed and a long-term effect are also important to ensure that our skin can be effectively protected throughout the day.

UV radiation and free radicals are both very well-known, natural influences of ancient origin. Since the beginning of life, organisms depend on counteracting these influences with effective repair and protective mechanisms in order to survive. Enzymes play an essential role in these processes. They enable and accelerate many biochemical reactions and have important functions in the metabolism of organisms. A crucial feature is also that enzymes are not used up even over many reaction cycles and thus uniquely combine a particularly fast and long-lasting effect.

Therefore, enzymes provide the optimal basis for fulfilling the above-mentioned important requirements for effective skin protection against the negative effects of UV radiation and free radicals. The synergistic active ingredient complex of

Glorydermal® GUARD is thus composed mainly of two enzymes. It combines the DNA repair enzyme photolyase, which is extracted from microalgae, with an antioxidant enzyme in the form of an iron peptide for neutralising free radicals. Both enzymes are also liposomally encapsulated to improve skin penetration.

Enzymes can support the repair mechanisms of our skin very effectively. The repair enzyme photolyase from microalgae, for example, offers a 10 to 100 times faster repair of UV-damaged DNA than the body's own human repair mechanisms. The origin of this highly efficient repair lies in the evolution of microalgae: billions of years ago, they already developed an effective protection and repair system against intense UV radiation, which was significantly stronger in this epoch than it is today, as it was not diminished by an atmospheric layer. This layer developed only later during the course of the earth's history - but the repair and protective mechanisms of the microalgae have been preserved, so that they can be made available to cosmetics today.

The most common UV-induced lesion of DNA is Cyclobutane Pyrimidine Dimers (CPDs), in which UV radiation separates opposite base pairings in the DNA double helix and two adjacent bases of the same strand subsequently combine incor-

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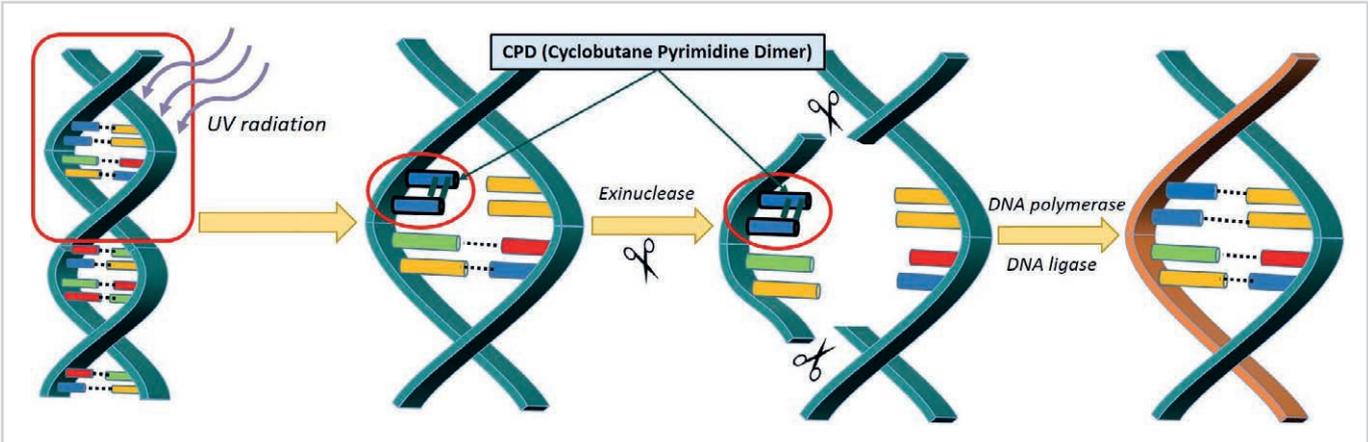


Fig. 2 Human endogenous repair mechanism of UV-damaged DNA (nucleotide excision repair) to remove CPDs, delineated according to the research of Lindahl et al. which was awarded the Nobel Prize in Chemistry in 2015 [2]. Repair via an intermediate step in which the CPDs are generously separated and the DNA strand is subsequently re-synthesised.

rectly. The human endogenous repair mechanism to eliminate these DNA damages involves an intermediate step in which the CPDs with the affected strand segment are generously separated (**Figure 2**). The complementary DNA strand is finally re-synthesised.

The body's own repair process can be accelerated considerably with the help of the repair enzyme photolyase, since photolyase can repair the DNA damage directly without an intermediate step by cleaving the CPD bonds in just one step (**Figure 3**). Photolyase is activated by light and is particularly active in the range of blue radiation. Thus, it can be used directly during sun exposure, for example, to repair UV-induced damage of the DNA, whereas this never replaces the use of a UV filter as the primary sun protection. In combination, however, photolyase offers an extended protection concept.

With the combination of the repair enzyme photolyase and the antioxidant enzyme in the form of an iron peptide, which is designed like an enzyme that does not use itself up over many reaction cycles, the active ingredient Glorydermal® GUARD

is based on a pairing of continuously working active accelerators. Like this, long-term radical protection and highly efficient DNA repair are not only ideally combined, they also show a synergistic effect.

Methods and results

The efficacy proof of DNA repair and long-term radical protection were gained in studies on human 3D full thickness skin models (Phenion® models [3]). Since for both effects the skin would first have to be damaged in order to be able to demonstrate both the subsequent repair of the DNA and the reduction of free radicals, no *in vivo* studies were deliberately carried out here for ethical reasons. The 3D full thickness skin models also have the advantage that they are very robust in terms of feasible study designs and also provide high reproducibility [4]. Thus, the degree of damage could be widely exploited to investigate the potential of Glorydermal® GUARD. This is particularly evident in the studies on the reduction of free radicals, in which repeated applications

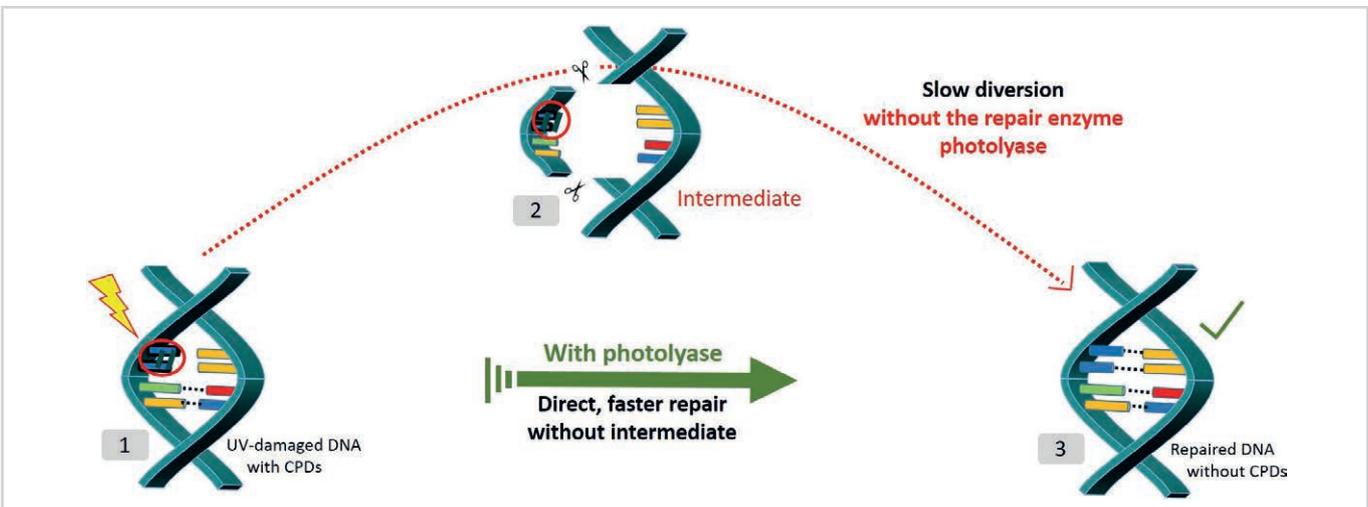


Fig. 3 Repair mechanism for the removal of CPDs with the repair enzyme photolyase. Compared to the body's own repair mechanism (dashed path above), this takes place without an intermediate directly by cleaving the CPD bonds in just one step.

of a hydrogen peroxide solution (H₂O₂) with a respective exposure time of 1 h could be used (Figure 5 and Figure 6) – a design that would not be possible in an *in vivo* study.

Efficacy study CPD reduction

To study the DNA repair, the reduction of UV-induced CPDs was analysed. For this purpose, the human 3D full thickness skin models were treated with an aqueous active ingredient solution and were then UV-irradiated. The evaluation was performed after 24h incubation against positive control by CPD ELISA assay on epidermal keratinocytes (Figure 4). The measurement results show a significant reduction of UV-induced CPDs as well as the synergistic effect of the two enzymes. The antioxidant enzyme protects the repair enzyme photolyase from oxidative degradation, so that the latter can repair more CPDs in the same period of time than without the antioxidant enzyme. Through this synergism, the already very efficient effect of photolyase can be further increased.

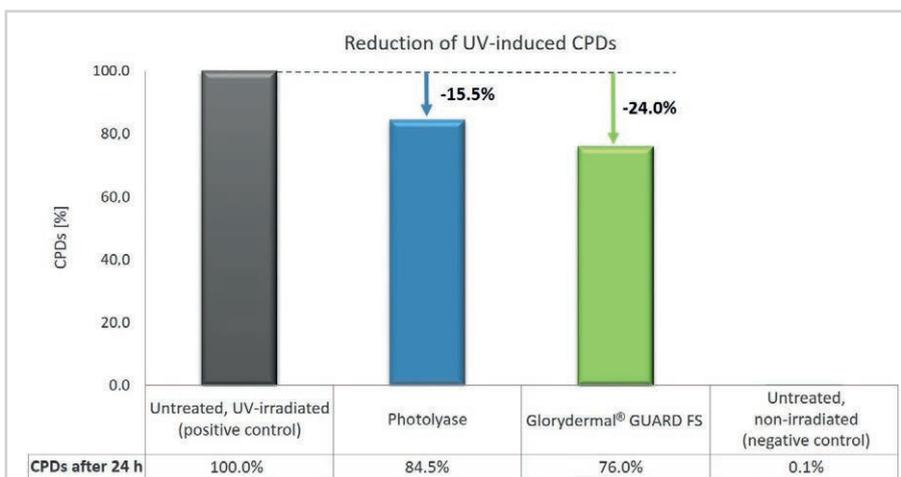


Fig. 4 Study design: human 3D full thickness skin models, used formulation: aqueous solution with 1% Glorydermal® GUARD FS or only with the corresponding photolyase concentration. Subsequent irradiation: UVB radiation (220 mJ/cm²), incubation for 24h. Untreated, UV-irradiated = positive control (normalisation to 100%, maximum stress); untreated, not irradiated = negative control. Analysis: CPD ELISA assay (epidermal keratinocytes), % values in relation to positive control (p<0.01).

Efficacy study long-term radical protection

In this study, hydrogen peroxide solution was used as an initiator for the generation of free radicals respectively ROS (Reactive Oxygen Species) to investigate the long-term radical protection. The full thickness skin models were treated once

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with the active ingredient solution followed by a treatment with a hydrogen peroxide solution (exposure time of 1 h). The treatment with hydrogen peroxide was repeated every 24 h with fresh solution over an examination period of 96 h. Within 24 h after application of the active ingredient solution and initial treatment with hydrogen peroxide solution, ROS could be reduced by over 76% and after 48 h and second treatment with fresh hydrogen peroxide solution even by more than 80% (Figure 5).

The reduction of ROS can be detected significantly even after 72 and 96 h accordingly, whereby the degree of reduction decreases with time, as the antioxidant enzyme in the skin is degraded over this long period of time (Figure 6). As in the CPD reduction study, a synergistic effect of the repair enzyme photolyase with the antioxidant enzyme was demonstrated, shown in the same figure. This bi-directional synergism represents a significant performance advantage compared to the single enzymes. The respective enzyme concentrations in Glorydermal® GUARD are also optimally harmonised with each other regarding these synergistic effects.

Discussion

As the studies described herein show, the repair enzyme photolyase and the antioxidant enzyme (iron peptide) represent continuously acting partners and thus provide the direct response to UV radiation and free radicals, which are also closely related as key causes of premature skin ageing. The proven synergistic long-term repair of UV-damaged DNA and the also synergistic long-term radical protection are based on the enzymatic action that enzymes do not use up themselves. They are regenerated after their action is completed and are therefore available for a further reaction cycle. On this basis, the antioxidant enzyme was developed, which is a synthetic component in contrast to the repair enzyme photolyase. The reduction of ROS proven over a very long period of time demonstrates the enzymatic action of the iron peptide. In contrast to common antioxidants, which become inactive after their action, i.e. after neutralisation of free radicals, the antioxidant enzyme can undergo several reaction cycles through self-regeneration until it is naturally

degraded by skin-physiological metabolic processes. The same applies to the repair enzyme photolyase.

This advantage of the enzymatic action can be explained particularly well with the antioxidant enzyme in comparison to common antioxidants (Figure 7).

The effect of free radicals is, simplified, the drive for paired electrons. In contrast to molecules with paired electrons, free radicals have unpaired electrons. They compensate for this electron gap by taking electrons from other molecules, which can be components of skin cells, for example. This again creates an electron gap in these molecules, which corresponds to a damage (Figure 7A).

Antioxidants have flexible electrons that they can donate to free radicals in order to neutralise them. Antioxidants can balance the resulting electron gap well, e.g. through their struc-

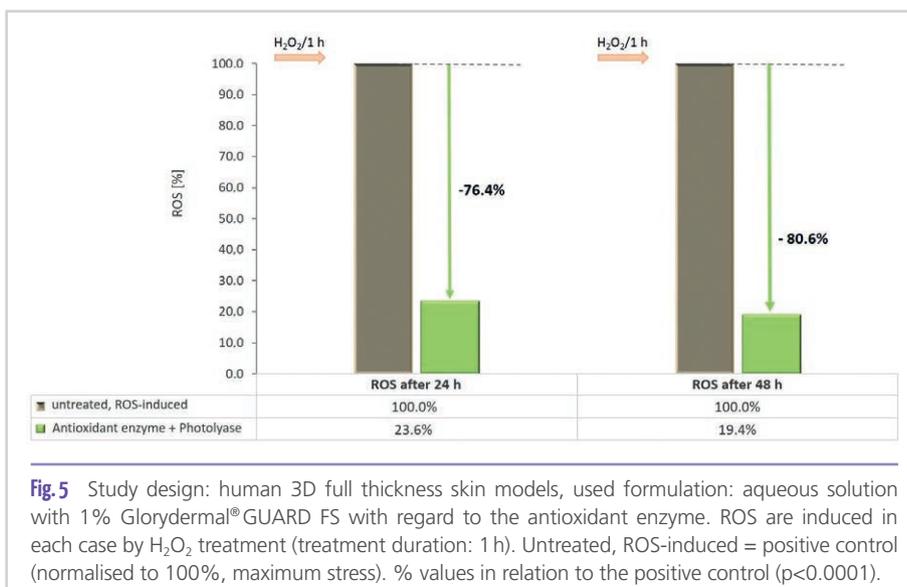


Fig. 5 Study design: human 3D full thickness skin models, used formulation: aqueous solution with 1% Glorydermal® GUARD FS with regard to the antioxidant enzyme. ROS are induced in each case by H₂O₂ treatment (treatment duration: 1 h). Untreated, ROS-induced = positive control (normalised to 100%, maximum stress). % values in relation to the positive control (p<0.0001).

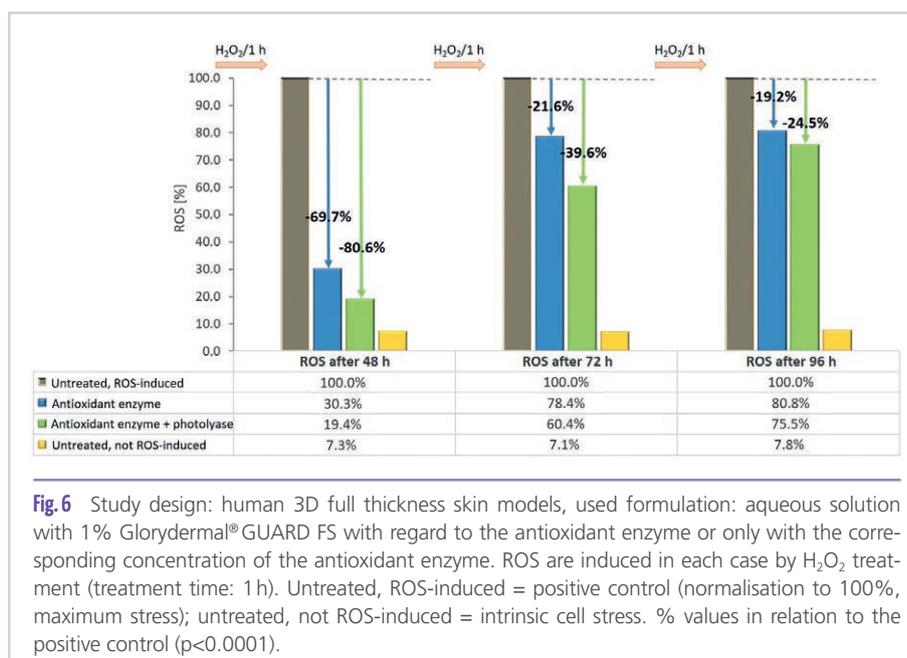
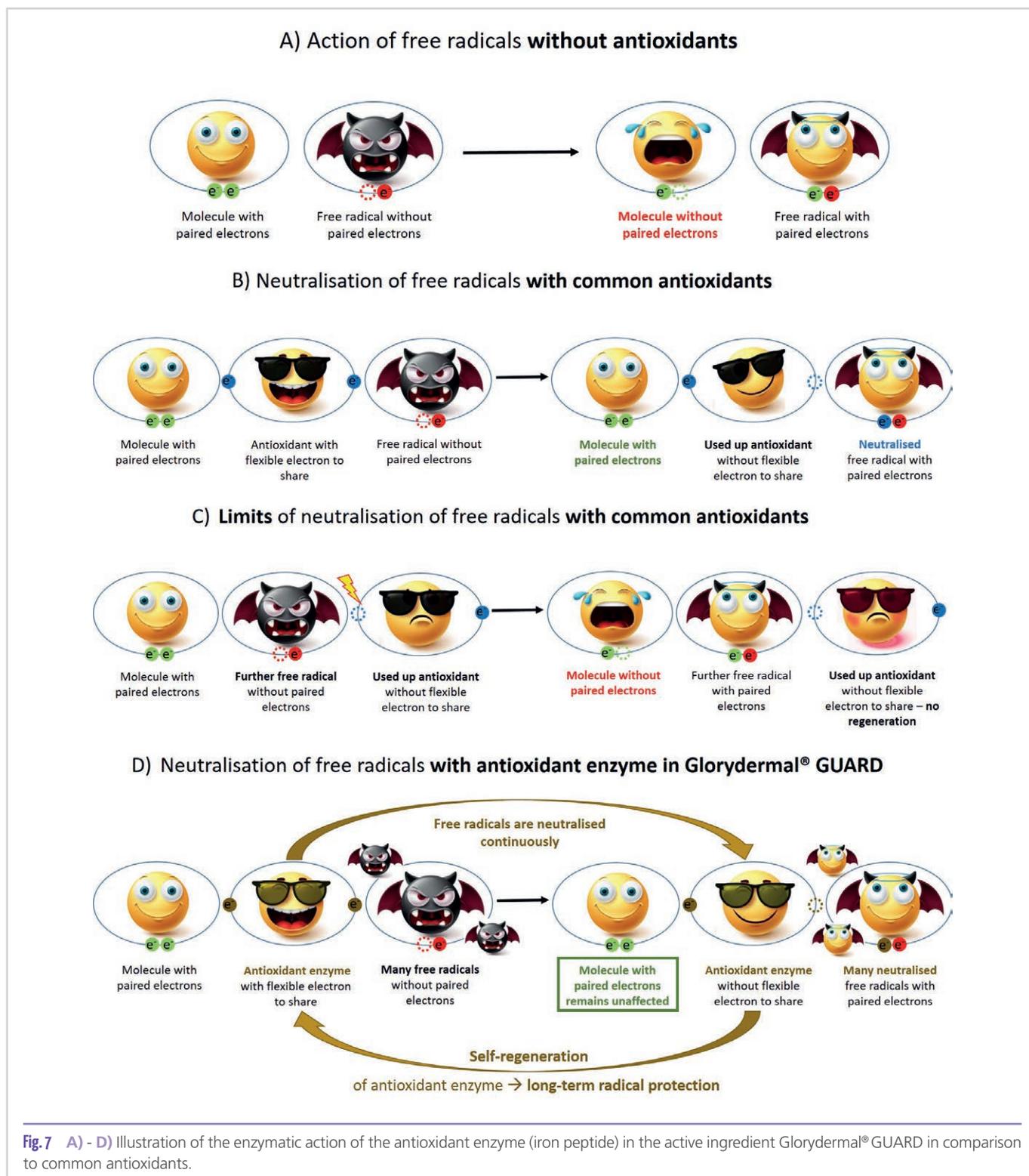


Fig. 6 Study design: human 3D full thickness skin models, used formulation: aqueous solution with 1% Glorydermal® GUARD FS with regard to the antioxidant enzyme or only with the corresponding concentration of the antioxidant enzyme. ROS are induced in each case by H₂O₂ treatment (treatment time: 1 h). Untreated, ROS-induced = positive control (normalisation to 100%, maximum stress); untreated, not ROS-induced = intrinsic cell stress. % values in relation to the positive control (p<0.0001).

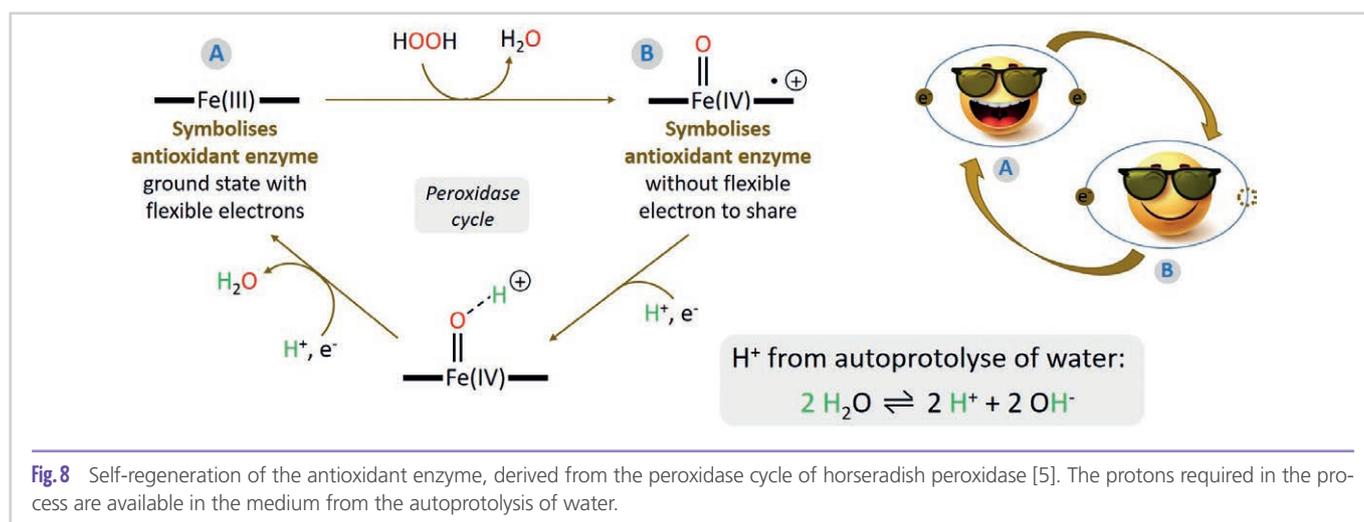


ture. However, they are used up in this state and can no longer donate any more electrons to free radicals for neutralisation. In return, the other molecule remains unaffected and no damage occurs, for example, to components of skin cells (Figure 7B).

Since used-up antioxidants cannot neutralise further free radicals due to electrons already given off, their protective effect is temporarily limited. As a consequence, like in the case without antioxidants, damage can occur to cell components that the used-up antioxidant cannot block (Figure 7C).

The antioxidant enzyme in Glorydermal® GUARD targets precisely this point: it neutralises free radicals like ordinary antioxidants, but is subsequently able to regenerate itself. Like an enzyme, it does not consume itself and can therefore continuously neutralise many more free radicals. Through this long-term radical protection, skin cell components remain protected from oxidative damage in the long term (Figure 7D).

The iron in the centre of the antioxidant enzyme does not chemically pass through the usual +II/+III oxidation stages for



iron, but +III/+IV. The mechanism of action corresponds to that of a natural peroxidase (**Figure 8**).

This holistic approach shows that the active ingredient Glorydermal® GUARD can be used in a wide range of cosmetic formulations, from daily face and body care to sun protection and after sun products.

Outlook

For the reasons described above, the proof of efficacy, which directly demonstrates both the repair of UV-damaged DNA and the reduction of free radicals/ROS, was provided via human 3D full thickness skin models and deliberately not via *in vivo* studies. However, the latter are currently being carried out to prove the resulting effects, such as wrinkle depth reduction and moisture retention, in order to complement the proof of concept already presented.

Conclusion

Premature skin ageing is primarily due to two key factors that are closely related to each other, namely UV radiation and free radicals. In the research for suitable active components slowing down premature ageing, speed and a long-term effect were essential requirements to ensure efficient repair of UV-damaged DNA and neutralisation of free radicals. Following nature's example, enzymes were therefore chosen for the active ingredient Glorydermal® GUARD to fulfil these two important demands. The repair enzyme photolyase from microalgae for repairing UV-damaged DNA (reduction of UV-induced CPDs) in combination with an antioxidant enzyme (iron peptide) in liposomal encapsulation mainly forms the synergistic active complex of Glorydermal® GUARD. This has been proven to provide comprehensive skin protection, acting like an invisible shield to protect the skin from the negative effects of UV radiation and free radicals. Due to the enzymatic mode of action, a long-term effect is also possible through continu-

ous repair of DNA damage and long-lasting neutralisation of ROS/free radicals, which significantly exceeds the duration of action of common antioxidants. Simple incorporation in the active ingredient phase at the end of production also enables uncomplicated handling of the active ingredient in the production of cosmetic formulations, such as day care, body care, sun protection and after sun products.

The currently popular trend Protective Beauty could even become more than a trend with active ingredients like Glorydermal® GUARD. It could be the beginning of a new, holistic care concept for our skin – however, trends are fleeting, but the care and protection of our skin will remain.

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Natural Cosmetics and the Attitude-Behaviour Gap

– Environmental knowledge, (producer) transparency and social norms make the difference for young adults

K. Wons, M. Bendig

abstract

The desire of consumers for sustainable cosmetic products has grown significantly in Germany in recent years, but nevertheless only a minority buy corresponding products in their everyday life. This gap between attitude and behaviour – referred to as the attitude-behaviour gap – is the focus of this empirical study. The data and the analysis are based on a quantitative online survey and regression analysis. In brief, the influence of customer attitude on the actual reported purchasing behaviour of natural cosmetics among young adults in Germany is explored by the identification of possible determining factors, which are included in the analysis measuring their statistical significance. From the results, possible solutions are derived as to how affected manufacturing companies can deal with the gap between attitude and behaviour.

The results show that the attitude significantly influences the purchasing behaviour of natural cosmetics. However, this is not the only influencing factor. The purchasing behaviour also depends on the availability of relevant information about natural cosmetics and the influence of social norms. A lack of transparency of manufacturer information weakens a previously positive attitude or – if present – strengthens a negative attitude towards natural cosmetics. Consequently, manufacturers have the opportunity to address and significantly reduce the attitude-behaviour gap for natural cosmetic products through addressing or reducing these factors.

Introduction

In recent years the environmental awareness is steadily growing among people, which led to environmental, but also ethical aspects playing an increasingly important role in every purchasing process [1]. To cause as little damage as possible to society and the environment with their personal consumption, today's customers include ecological, social and health factors in their purchasing decisions [1,2].

Despite this trend towards more sustainable purchasing behaviour, previous research shows that a positive attitude towards sustainable products does not necessarily lead to increased purchasing behaviour [3]. Since this phenomenon, also known as the attitude-behaviour gap, is of great research interest, because it leads – until today – to unsolved challenges for manufacturing companies of sustainable products [4]. Especially for the production and marketing of natural goods, it is important to understand the purchase decision process and to derive measures that can mitigate the discrepancy between attitude and behaviour [5]. In terms of effective marketing of sustainable products, further analysis of the attitude-behaviour gap can help to improve customer segmentation as well as the detection of new trends [5]. Moreover, by taking the phenomenon into account, buying behaviour can be positively influenced [5].

Building on an empirical analysis of the reported purchasing behaviour of natural cosmetics, the attitude-behaviour-gap

within the German cosmetics sector is examined here. In doing so, the challenges for the natural cosmetics sector associated with this phenomenon will be highlighted and their emergence will be further analyzed. Finally, possible solutions are outlined that affected companies can use to sustainably reduce the discrepancy between attitude and behaviour.

Current Research Status

The previous research on the attitude-behaviour gap mainly refers to other consumer goods sectors; thus, knowledge about the cosmetics industry is extremely limited in respect to this. Behavioural and attitude research first shows that there is generally a positive relationship between attitude and behaviour [6]. For the natural cosmetics sector, the following hypothesis can be derived from this:

Hypothesis 1: Attitudes towards natural cosmetics influence the purchasing behaviour of natural cosmetics (positively).

However, numerous studies show that a positive attitude towards sustainable products does not necessarily lead to purchase [1,3,4]. Only a minority of consumers buy ethical products in everyday life [7]. To explain this discrepancy between attitude and behaviour, previous research has highlighted other external factors influencing attitude and the resulting consumer behaviour towards ethical products. In their studies from 2006 and 2008, *Vermeir and Verbeke* look at the

influence that the factors “social influence”, “perceived behavioural control” and “accessibility” have on the purchasing behaviour of ethical products in the food sector [8,9]. The researchers also address the factor “availability” in these studies and show that the lack of availability of sustainable products leads to a lower probability of purchase [8].

The results of the study by *Wiederhold and Martinez* (2018) in relation to consumer behaviour within the German fashion industry show that especially the factors “price”, “search for variety” and “pre-existing knowledge” can have a positive influence on purchasing behaviour [10]. In addition, the authors state that the individual’s perceived ability to influence has a positive effect on buying behaviour [10]. The assumption that people who consider their own influence to be large are more likely to reach out for sustainable product alternatives is supported by the study by *Hines, Hungerford and Tomera* from 1987 [11]. The factors “lack of transparency” and “perceived image”, on the other hand, have a negative influence on attitudes [10]. In addition, the study by *Tarkiainen and Sundqvist* (2005) reveals that social norms can also have a positive effect on the purchase of sustainable products [12].

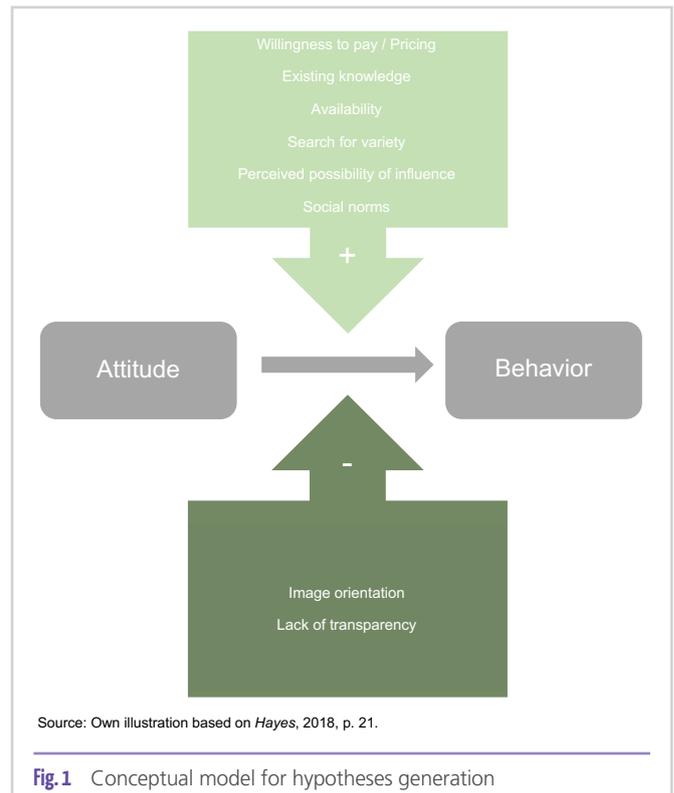
Thus, the following eight external influencing factors can be extracted from previous research and related to the cosmetics industry:

1. Willingness to pay/pricing
2. Image orientation
3. Existing knowledge
4. Lack of transparency
5. Availability
6. Search for variety
7. Perceived opportunity to influence (PCE)
8. Social norms.

Based on this, further hypotheses are developed:

Hypothesis 2: The factors a) willingness to pay/pricing, b) existing knowledge, c) availability, d) search for variety e) perceived opportunity to influence (PCE) and f) social norms strengthen the positive relationship between attitude and behaviour.

Hypothesis 3: The factors image orientation and lack of transparency weaken the positive relationship between attitude and behaviour.



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Data and Methodology

Within this study the reported purchase behaviour is used as a dependent variable and functions as an indicator for the actual behaviour, as this is permissible because, according to *Armitage and Conner* (2001), i.e., the relationship between actual and reported behaviour can be estimated as significant [13]. The reported purchasing behaviour is operationalised via a constructed index (mean index of the ordered scale variable), which includes four items of the questionnaire using five-point Likert scales. This includes the perceived frequency of buying natural cosmetics (“How often do you buy natural cosmetics and/or natural body care products?”), the probability of buying natural cosmetics in the future (“How likely is it that you will buy natural cosmetics and/or natural body care products in the near future?”), as well as asking for agreement with the following statements on buying behaviour: “I mainly use natural cosmetics and/or natural body care products.”, “When buying cosmetics, I specifically choose natural and organic products”.

The index of the dependent variable does not show a normal, but an equal distribution. Only the expressions with the scale values 2 and 5 show increased frequencies. This may indicate that only a small number of test persons prefer a mix of natural and conventional cosmetics but implicates rather an either/or buying behaviour.

The attitude is used as the main independent variable. So far, there is no standard measurement for attitude in the literature. Thus, an index of four items from the questionnaire is built. All items are based on a five-point Likert scale. The items of the scale variables are based on the study by *Taylor and Todd* (1995) and are defined as follows [14]: “I think buying natural cosmetics is reasonable”, “I like the idea of buying natural cosmetics and/or natural body care products”, “I think buying natural cosmetics and/or natural body care is a good idea” and “Using natural cosmetics and/or natural body care is reasonable”.

For this index representing the attitude of the sample, the individual scale variables were summarised using a mean value index. When checking the constructed index for normal distribution, it is noticeable that it is left-skewed distributed, since according to *Mostafa* (2006) the response behaviour for sustainable products can be influenced by social desirability [15].

The eight external influencing factors mentioned above are used as moderators in the analysis: Willingness to pay/pricing, Image orientation, Existing knowledge, Lack of transparency, Availability, Search for variety, Perceived opportunity to influence (PCE) and Social norms. The operationalisation of these factors is constructed via index variables, which are formed from three to five items of the questionnaire as a mean index. The data to check the previously formulated hypotheses is collected in the form of an quantitative online survey within

the target group of young adults aged between 18 and 35. This group of people is chosen and relevant, as they will be a decisive target audience for the future natural cosmetics market [1]. Especially the awareness for the necessity of a sustainable change in consumer behaviour, of the climate crisis and the relevance of sustainability is comparatively high among young adults [16, 17]. To take this into account, a sample consisting of young adults in Germany was deliberately used for the study, even if this limits the generalisation of the results to the total population.

Within the study, there is an increased willingness to participate and consequently a predominance of female test persons [6]. This can be attributed to the rather higher interest in cosmetic products of females. The selected sample is therefore a so-called convenience sample [18]. This is considered admissible if the selected sample corresponds to the statistical mass of interest and the focus of the study is primarily on internal validity [18]. Since this study is intended to investigate the causal relationship between attitudes and behaviour of young adults with regard to cosmetics consumption, these requirements are met.

After an initial descriptive analysis of the sample structure, this paper uses (1) a moderator analysis and (2) a stepwise linear regression (OLS) as evaluation methods to analyse the attitude-behaviour gap and its external influencing factors.

Both estimation methods assume a linear relationship between the examined variables. Compared to a simple linear regression, which only measures the correlation between two variables, the addition of further independent variables increases the predictive power of the estimation model.

A moderator analysis, as a special case of multiple regression, serves to test whether the relationship between an exogenous and an endogenous variable (here: attitude - behaviour) is influenced by another variable (moderator) [19]. In this study, the so-called moderator represents an additional variable that affects the relationship between attitude and behaviour [20]. The analysis of moderation effects is carried out using the moderator model according to *Hayes* (2018) by forming interaction terms [21].

By using the estimation of a step-by-step regression, different models are calculated by forward and backward selection (of independent variables) until the coefficient of determination R^2 can no longer be improved by the inclusion of further variables. In the first step, the independent variable with the highest variance explanation is included. If the resulting model can be significantly improved by the addition of further variables, the strongest variable is included in the next steps.

In general, relevant quality criteria for quantitative surveys are met by the methodological procedure. The validity of the constructed index variables can be confirmed with the help

of a confirmatory factor analysis. A calculation of the Cronbach's alpha values of the items shows the internal reliability of the estimation model. To exclude the occurrence of multicollinearity in the estimations, a collinearity analysis is carried out with the calculation of the variance inflation factors (VIF). The low VIF (around the value of one) of the models indicates that there is no multicollinearity in any of the estimations. To address the possible problem of heteroskedasticity, the robust standard errors are calculated and shown in the regressions using the HC3 method.

Results

The data sample includes 193 persons. The descriptive analysis of the sample represents the following structuring (Figure 2).

Furthermore, the analysis reveals that the persons in the sample spend an average of 25.73 euros per month on cosmetic products in general. About 42 percent of a purchase is for natural cosmetics or body care products. A mean comparison between the index variables behaviour (value of 3.26) and attitude (value of 4.24) illustrates that the test persons on average have a positive attitude towards the topic of natural cosmetics, but do not consume natural products in everyday life. This first descriptive result shows a gap between the attitude towards natural cosmetic products and the actual consumption behaviour.

In the following analysis, this phenomenon will be investigated. Using the Spearman correlation as well as a single factor variance analysis, it is first examined for the surveyed status control variables of gender, age, level of education, occupation, and income whether there is a connection between the individual control variables and behaviour. Both analyses lead to the result that none of the variables surveyed has a significant influence on behaviour. Thus, these are excluded from the further estimations.

Linear Regression (Attitude and behaviour)

First, a regression model is estimated for attitude as the independent variable and behaviour as the dependent variable. The regression coefficient of the variable attitude is $\beta=0.897$ and statistically significant. This means that attitude is a significant predictor variable for the reported buying behaviour

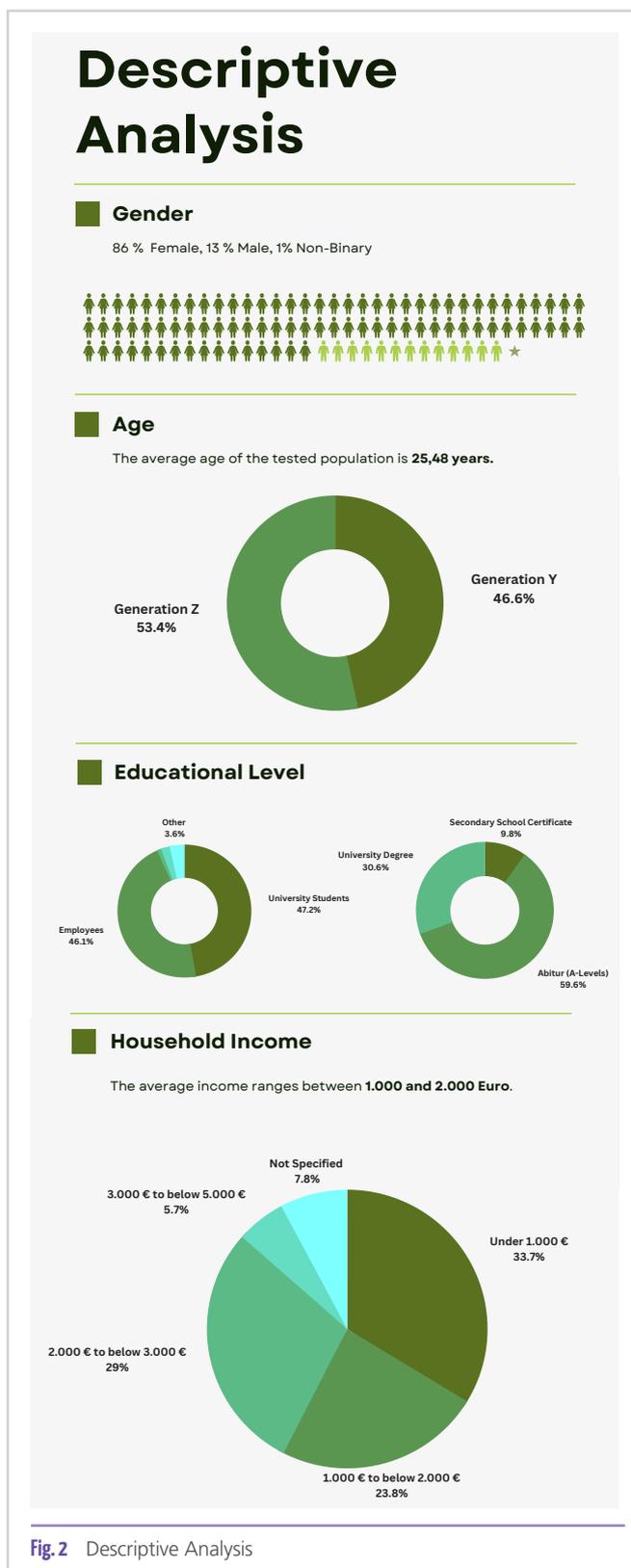


Fig. 2 Descriptive Analysis

	Regression Coefficient B*	Standard. Coefficient Beta	T*	Sig.*	R ²	R ² Change	F Change	Sig. F Change
Constant	-0.539		-1.388	0.167	0.417	0.417	136.761	<0.001
Attitude	0.897	0.646	9.982	<0.001				

* Heteroscedasticity consistent standard errors are being used

Table 1: Linear Regression (Attitude and Behavior). Source: Own Calculations

of natural cosmetics. For each additional unit that the variable attitude increases, the purchasing behaviour increases by 0.897 units. If the positive customer's attitude towards natural cosmetics increases, so the more likely he or she is to buy natural cosmetics. With this result, the formulated hypothesis 1 can be verified. However, with a value of 41.7 percent, the variance explanation of the present regression also points to a lack of further external factors influencing the reported purchasing behaviour.

**Moderator analysis
(Attitude and the lack of transparency)**

For this reason, the interaction effects of the external influencing factors listed above are examined using a moderator analysis. Hypothesis 2 cannot be confirmed on the basis of this study, as an indirect influence of the potential moderators willingness to pay/pricing, existing knowledge, availability, search for variety, perceived opportunity to influence (PCE) and social norms on the relationship between attitude and behaviour is not verified. Only the index variable for lack of transparency shows a significant interaction effect with attitude here. In this case, a statistically significant but negative coefficient of the interaction term ($\beta=-0.347$) can be calculated, which might reduce the positive effect of the independent variable (attitude) on the dependent variable (behaviour). The lack of transparency regarding the manufacturer's claims for natural cosmetics and the associated scepticism towards these products could reduce an originally positive attitude or increase an already negative attitude. This means that despite a positive attitude towards natural cosmetics, fewer or no natural cosmetics are purchased. This result is in line with hypothesis 3 above and therefore confirms it.

**Step-by-step linear regression
(Attitude, existing knowledge and social norms)**

Although only an interaction effect is valid for the variable lack of transparency, it can be suspected from the results of the simple linear regression that other factors may have a direct influence on behaviour. Therefore, the external influencing factors listed above are added step by step to the first regression model. Out of these estimations, only the significant influencing factors are considered further. The model with the highest explanatory power (70.4 %) for reported purchase behaviour contains the independent variables attitude, existing knowledge and social norms with highly significant estimation coefficients.

For each additional unit of information provided, buying behaviour increases by 0.587 units. For each additional unit of the variable attitude, the variable behaviour also increases by 0.591 units as well as increase in the variable social norms by one unit increases the dependent variable by 0.215 units. This implicates that the more information is provided to consumers about natural cosmetics, the more positive their attitude towards these products is and the higher the social pressure on consumers is, the more likely they buy natural cosmetics. If the standardised coefficients in this model are also considered, the variable existing knowledge has the highest influence on the dependent variable with a beta value of 0.500. The lowest influence on behaviour is exerted by the variable existing knowledge. The variable social norms has the lowest influence on behaviour in this model ($\beta=0.162$).

This means that the existing knowledge regarding natural cosmetics has the strongest influence on the actual con-

	Regression Coefficient B*	Standard. Coefficient Beta	T*	Sig.*	R ²	R ² Change	F Change	Sig. F Change
Constant	3.208	0.063	51.263	<0.001	0.48	0.48	58.123	<0.001
Attitude (mean centered)	0.946	0.062	15.352	<0.001				
Transparency (mean centered)	-0.190	0.084	-2.258	0.025				
Interaction Term (Attitude x Transparency)	-0.347	0.092	-3.765	<0.001				

* Heteroscedasticity consistent standard errors are being used

Table 2: Moderator analysis (attitude and the lack of transparency). Source: Own Calculations

	Regression Coefficient B*	Standard. Coefficient Beta	T*	Sig.*	R ²	R ² Change	F Change	Sig. F Change
Constant	-1.627		-7.172	<0.001	0.704	0.018	11.954	<0.001
Knowledge	0.587	0.500	10,451	<0.001				
Attitude	0.591	0.426	10.184	<0.001				
Social Norms	0.215	0.162	3.258	0.001				

* Heteroscedasticity consistent standard errors are being used

Table 3: Step-by-step linear regression (Attitude, existing knowledge and social norms). Source: Own Calculations

sumption of natural cosmetic products. The perceived social pressure regarding the purchase of natural cosmetics plays a rather subordinate role.

The results of the step-by-step regression models show that not only the attitude, but also the variables existing knowledge and social norms have a direct effect on the behavioural variable. As previously assumed, this implicates that a person's attitude towards natural cosmetics influences his/her buying behaviour, but this also depends considerably on what information is available to the consuming person in advance on this topic and how much knowledge this person already has about natural cosmetics. It can be stated that more available knowledge or information on the topic of natural cosmetics leads to increased purchasing behaviour. Conversely, this means that the more informed a person is about natural cosmetics, the more likely they are to buy natural cosmetic products now and in the future. In addition, the higher the social pressure to buy natural cosmetics, the more likely these products will be consumed. In this context, it plays a role how close or important people rate natural cosmetics. If natural cosmetics are considered reasonable by others, this leads to stronger buying behaviour.

In general, it is important to understand that the individual influencing factors cannot be considered independently of each other, but always have a simultaneous effect on consumers. Cosmetics manufacturer must therefore keep an eye on the interplay of the individual factors.

Discussion and Recommendations

Despite comprehensive market analysis and research, sustainable product alternatives repeatedly fail at an early stage [4]. This is caused by the discrepancy between attitude and behaviour. Thus it is difficult to predict the actual purchase intention for sustainable products and almost impossible to adapt the items concerned to the specific customer needs [3]. This affects both customer segmentation and new product development, as positive attitudes are often overestimated by market research. To mitigate this, manufacturers can consider, analyze and, if necessary, address the external factors of this problem at the very beginning of a new product development to reduce the attitude-behaviour gap from the start on.

In addition, existing knowledge in particular can change purchasing behaviour. Thus, manufacturers can pay special attention to the availability of environmental knowledge when marketing natural cosmetics and use "informative" strategies to increase the already existing knowledge about natural cosmetics as well as conceivable product alternatives [22,23].

To achieve this, a suitable communication strategy should first be developed that enables direct customer contact [10,22]. In general, this strategy should emphasise the ecological, social, and emotional benefits of sustainable products [10,24].

Analogue media, but also digital communication tools can be used to implement the communication strategy [4, 10]. It is important that all measures used are visually and thematically coordinated [24]. Social media and influencer marketing should be used to specifically address the young customer segment [10]. With the help of this type of marketing, the regular use of social media by young adults can be used and credibility and familiarity can be conveyed through the resulting customer proximity [10].

In addition to pre-existing knowledge, social norms and interpersonal relationships can also influence buying behaviour [25]. Here, prominent opinion leaders can be used as social role models and trusted sources of information to support the pre-existing structure of social norms [23,25].

The results of the analysis also indicate that transparency and the associated trust between consumers and companies have an influence on purchasing behaviour [24]. To create a transparent customer relationship, the uniform use of trustworthy seals is of great importance in the natural cosmetics sector [8,24]. Recognised seals provide consumers with a sense of security and suggest high product quality [26]. They also help to distinguish natural cosmetics from conventional cosmetics.

Finally, it makes sense to link and combine the measures presented here and to adapt the instruments used to the specific product and its specific target group to counteract the attitude-behaviour gap as best as possible [23].

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Conclusion

The attitude-behaviour gap prevents a precise analysis of the affected target market and consequently hinders the development of suitable products in the natural cosmetics sector. Without a fundamental understanding of the causal factors, this phenomenon contributes significantly to the failure of sustainable cosmetic products. Despite the problems posed by the attitude-behaviour gap, the results of this study can nevertheless be encouraging.

The study shows that it is possible to address these challenges with targeted (counter)measures and to mitigate them accordingly. At the core of this is the fact that it is not only customer attitudes that can influence actual purchasing behaviour. The existence of environmental information, social norms and a lack of transparency regarding manufacturer information can also change the relationship between attitude and behaviour. This means that if companies concerned include the external factors addressed in their market analysis and processing, purchasing behaviour about natural cosmetics can be specifically influenced. By building up a sustainable cosmetics concept, affected companies can thus set themselves apart from conventional cosmetics manufacturers and target the ever-growing environmentally oriented, future costumers.

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CELLUGY™



Formulators and personal care brands are constantly in the search for natural and sustainable raw materials and ingredients to fulfil the increasing demand from consumers looking for bio-based, fossil-free personal care products.

Cellugy has developed **EcoFLEXY**, a multifunctional biofabricated cellulose ingredient derived from sugar fermentation. **EcoFLEXY** builds up viscosity at low dosages and, due to its high gel strength, can suspend solids and particulates. It is ideal for skin care and sun care consumer products in need of effective and sustainable ingredients. It can also be used for foam stabilization for rinse-off applications like shower gels and shampoos. Due to its entangled fiber characteristics and unique water interactions, **EcoFLEXY**'s potential viscosity per dry weight is much higher than typical molecular scale polymers, therefore thickening at low dosages, and due to its natural origin, is ideal for bio-based and natural formulations. Moreover, **EcoFLEXY** has extremely high cellulose purity in the fibers due to the absence of residual anionic contaminants such as hemicelluloses, which occur in plant-derived cellulose, making the network extremely stable in the presence of salts or other charged compounds that affect molecular scale polymers and plant celluloses. On top of that, **Cellugy** produces biofabricated cellulose with exceptionally high crystallinity, which makes the fiber surface even less anionic, and allows it to withstand challenging formulations.

Cellugy is a Danish biotechnology company expert in fermentation that has developed a proprietary energy-efficient, harsh chemicals-free process for the development of biofabricated cellulose using standard fermentation and downstream processing equipment, which allows the production of biofabricated cellulose locally. Fermentation has been around for

thousands of years in our food chain: beer, wine and bread are food examples developed by fermentation. In recent years, fermentation has slowly been adopted in the personal care space for the development of novel raw materials, allowing to create innovative and effective products that are environmentally friendly. At **Cellugy**, we believe that nature is the greatest engineer of times and we have been inspired by its own processes to redefine and redesign the materials that we use in our everyday products. **EcoFLEXY** is:

- 100% pure biofabricated cellulose
- Non-GMO
- Bio-based
- Thickening at low dosages
- Shear thinning
- Foam stabilizer
- Particle stabilizer
- Co-emulsifier
- Suitable for halal, kosher, vegan, and COSMOS certification
- Biocompatible
- Biodegradable by design
- Non-sticky, fresh sensorial feeling

EcoFLEXY is the perfect solution for formulators looking to support their developments with a natural, multifunctional ingredient that capitalizes the power of fermentation, bringing bio-based and sustainable products from idea to reality.



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The Antipollution Matrix: An Awarded Software Tool Dedicated to Pollution and Skin



Working Group Anti-Pollution, DGK e.V., Germany

Concerns about adverse effects of air pollution on our health are on the rise worldwide. Main pollutants are particulate matter (e.g. from exhaust, smoke, pollen or ash), gaseous compounds (e.g. nitrogen and sulfur oxides or ozone), sunlight (e.g. UV- and blue light) and heavy metals. Not only the lungs but also the skin is exposed and this exposure can lead to e.g. signs of premature skin aging, damage to the skin barrier and cause pigmentation disorders. Pollution can exacerbate dry and irritated skin as well as increase skin impurities.

Although, the topic has been in the public focus now for several years, systematic and easily accessible knowledge bases for pollution, its effects on skin, test methods and claims thereof were lacking. The German Society for Scientific and Applied Cosmetics (DGK), working group "Anti-pollution", therefore decided to close this gap. When scientists try to summarize the actual status of a complex research topic, they usually write a review article. The DGK working group found another solution – the Anti-Pollution Matrix.

This matrix was created in the style of an interactive webpage to make the topic of antipollution accessible to all kinds of interested groups as laypersons, developers of cosmetic products, toxicologists, dermatologists or distributors of actives

or cosmetic final products. Presented on the IFSCC Congress 2022 a jury ranked the work among the best 10 of more than 400 conference posters.

In English or German language, the reader can easily explore intuitively the electronic content by clicking the topics of interest. A series of links help to access basic information of a topic or to understand technical terms. Main headings of the matrix are *Categories of Active ingredients and Product classes*, *Pollutants*, *Damage* due to pollutants and *Methods* to assess pollution effects or antipollution efficacy (see **Figure 1**).

The matrix is not intended to be all-encompassing but to be comprehensive enough to serve as an information source and to stimulate the user to gain a better understanding of factors involved and to explore further how to address their claim support challenges when developing cosmetic products.

The Matrix is accessible directly via the **URL**:

- in **English**: <https://dgk-ev.de/antipollution-matrix-en/>
- or **German**: <https://dgk-ev.de/antipollution-matrix/>

or via the **QR-Code**:



contact

For the
DGK Working Group Anti-Pollution

Dr. Remo Campiche
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Natural Plant Peptides to Boost Growth of Hair, Eyelashes and Eyebrows

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Alopecia and hair loss is a global concern that involves both men and women. It can appear due to genetic factors and hormonal, immunological, pharmacological or disease-induced changes. The hair growth cycle consists of three phases: the growth phase or so-called 'anagen phase', the catagen phase that is the transition until the hair falls in the third phase or telogen phase.

Unlike people with health hair, those suffering from alopecia have a shorter hair growth phase and a longer hair loss phase. What if we enhanced the growth phase (anagen) and reduce the loss phase (telogen) naturally in areas such as scalp, eyebrows, eyelashes, or beard? **Vytrus Biotech** proposes a new approach to balance it, reactivating the hair cycle, stimulating microcirculation and enhancing nutrition.

Natural plant peptides to activate hair follicle regeneration and hair growth factors for healthy-looking hair. **Capilia Longa™** is a 100% natural active that reactivates the hair cycle, lengthening the growth phase and shortening the loss phase, increasing hair density, strength and anchorage. **Vytrus** was inspired by *Curcuma longa* – the Turmeric -, a tropical and subtropical plant whose rhizomes grow indefinitely and possess excellent regenerative properties. **Vytrus** transfers the plant benefits to haircare through the Phyto-Peptidic Fractions technology. The growth factors from turmeric's rhizomes are obtained and applied to the hair system, resulting in a reactivated dermal papilla (the hair root).

Capilia Longa™ is rich in innovative signalling peptides specially designed to reactivate the hair cycle. The active reactivates the dermal papilla by epigenetically modulating the growth factors generation re-

sponsible for growing new hair and regulating hair growth. The active ingredient stimulates growth factor generation of the anagen phase and delays the phases of hair cycle responsible for hair growth – catagen and telogen phase – with a unique and patented epigenetic modulation.

Vytrus carried out a complete panel of tests to demonstrate the ingredient's activity. At biological level and compared to Minoxidil effect:

- Induction of Dermal Papilla Cells proliferation
- Induction of Insulin Growth factors-1 (IGF-1)
- Modulation of microRNAs (miRNA 31 and miRNA 32)

Tested in clinical assays with volunteers with alopecia, **Capilia Longa™** increased the hair density by rebalancing the hair growth cycle (57% of hair loss reduction, 17% of hair density increase and 27% of hair bulb activation). The active regenerated the dermal papilla (hair root) and prevented hair loss in volunteers. **Capilia Longa™** also improved the eyebrows density by 35% (up to 100%) and the eyelashes density 56% on average (up to 200%) as shown on **Fig. 1**.



Fig. 1: Increase of eyelashes after applying Capilia Longa™

A wide range of haircare applications can be covered: hair loss prevention and reduction formulations, hair growth stimulation treatments, products for eyelash and eyebrow growth, beard growth treatments, and hair nourishing and strengthening formulations, amongst others.

This COSMOS-approved and IECIC-listed active is full of natural plant peptides and wraps up a global haircare strategy based on science, nature, and a sustainable biotechnology to improve the hair health and strength.

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How to Successfully Prove Psychophysiological Effects in Cosmetic Products

Interview with Jessica Freiherr, Doris Schicker and Arielle Springer,
Fraunhofer Institute for Process Engineering and Packaging IVV

The other day I read your study [1]. There, you describe the calming effect of a Face cream with an active ingredient. So just put some cream on and you will not be stressed anymore?

Jessica Freiherr: In principle, yes. It is much more complicated, of course, but basically we were able to show that people were less stressed after applying a cream with a particular active ingredient than after applying a placebo. We were able to measure this with physiological in combination with psychological methods. The current situation has encouraged us to extend this expertise to other applications and claims. Right now, many people feel helpless and demotivated due to the political and pandemic situation. Using a refreshing shower gel, for example, can then give us a motivational boost in the morning.

In fact – I have read that on a product before, too. Meanwhile, numerous marketers advertise the refreshing, invigorating, calming or relaxing effect. Does that really work?

Arielle Springer: It is legally regulated that product claims must not pretend to have an effect that the product does not have, and that the claimed effects must be provable. So if the claims have been validated with evidence of efficacy, of course it still depends on how the study was conducted. With the help of a valid study design, the improved well-being of consumers can be clearly attributed to the product or particular ingredient.

Jessica Freiherr: It is also important to define what improved well-being means. If we look at the variety of emotions, they can be characterized in two main dimensions. One is the dimension valence (pleasant/positive - unpleasant/negative) and further the dimension arousal (excited – calm). Within these two dimensions numerous nuances can be positioned. Both positive excitement (joy) and negative excitement (stress) are commonly known. Likewise, humans experience positive calm (relaxation) and negative calm (boredom). Manufacturers of various cosmetic products now pursue the goal of moving us from one emotional state to another.

That is exciting – how exactly can you influence emotions with a cosmetic product?

Jessica Freiherr: Emotions can be triggered using various methods. Within our research, we take a multisensory approach. Our main expertise is in the field of olfaction, so we often use different scents to trigger emotions in our test subjects. Another claim within our research projects is to map our daily environment as holistically as possible. Accordingly, we like to combine odor stimuli with other sensory stimuli. In the context of research on cosmetic products, a combination with tactile, visual and acoustic stimuli would be possible here, i.e. the feeling of the skin or hair, the product appearance and the sounds of the skin and hair during or after application of the product.

How can you accurately measure these emotions on the human body?

Jessica Freiherr: We can measure the calming effects of cosmetic products by putting the test person in a stress state using emotional pictures and then applying the respective product. Before and after application, the subject's stress state is measured using psychophysiological tools. These tools include emotion questionnaires, stress hormones in saliva, EEG, but also biometric measurements of heart rate, respiration or skin conductance.

Doris Schicker: In addition to cosmetic products with stress-reducing, calming effects, products that have an energizing effect are also interesting. Such products can reduce boredom or contribute to the motivational boost in the morning. To test such effects, we induce feelings of boredom in our test subjects, for example, with the help of a so-called peg-turning test before applying the product. Depending on the desired effect of the products, we use special methods to induce specific emotions. We then measure these with the help of selected and specifically combined psychophysiological tools. This enables a test design that is tailored to the individual needs of the customer.

Assuming I had a new cosmetic ingredient and wanted to find out if it was motivating and moisturizing. What might a joint project look like then?

Jessica Freiherr: We like to tailor our study designs to the customer's needs. We listen carefully to the client's goals and define the research question. In the second step, we find suitable scientific methods to achieve the desired goals. For example, a motivating effect of a cosmetic raw material could be investigated with the help of our boredom test design. We would cover the moisturizing effect of a raw material with physical measurements, e.g. conductance response.

Doris Schicker: To conduct a valid and reliable study, it is important to pay attention to several parameters. For example, it is necessary to test a product against a placebo product to be able to prove efficacy. Furthermore, we pay attention to a randomized and blind experimental design, i.e. the participants do not know whether they will receive the placebo or the (potentially active) product. In addition, we offer extensive data analysis, which provides insights into the effects of the products. Due to the scientific nature of our studies, we publish the results in peer-reviewed, publicly available and recognized scientific journals under consultation with our customers, as well as industry magazines and social media. Thus, we enable a comprehensive exploitation strategy: from technical articles to marketing and networking.

That sounds like a lot of work. What kind of funding could be available?

Arielle Springer: There are several possibilities. In a bilateral project, we work with our partners to create an offer, which is then ordered. A non-disclosure agreement is also possible. The partner receives a report at the end, which they can dispose of freely. If several companies are interested in joint research, we can also work together in a consortium project. In both variants, the industrial partners can finance the research either from their own funds or as part of their own funding.

Doris Schicker: In addition, we also work on publicly funded projects where partners can participate in the committee that accompanies the project. This gives the company insight into the unpublished results and allows it to steer the research according to the needs of industry.

Once we have done the project, can we transfer the result for all products containing the ingredient?

Arielle Springer: In principle, the results from the report and publications only apply to the samples tested. However, if the products are similar, we can check for transferability or offer



Jessica Freiherr

Prof. Dr. Jessica Freiherr studied nutrition science at FSU Jena and received her PhD in human biology from LMU Munich. Since 2019, she holds the professorship of Neuroscience of Sensory Perception at FAU Erlangen-Nuremberg. At the Fraunhofer IVV, she is an expert in multisensory perception in the context of product effects.

Doris Schicker

M.Ed. Doris Schicker studied scientific education at the TU Munich. Now she is doing her PhD in neuroscience at the Fraunhofer IVV on influences on human odor perception. At the same time, she works as a Senior Scientist at the Fraunhofer IVV to further explore multisensory aspects of product perception using data science methods.

Arielle Springer

Dipl.-Leb.Chem. Arielle Springer studied food chemistry at the TU Dresden and gained professional experience as a product developer in the cosmetics industry. Together with experienced experts, she is currently working as a business development manager and scientist across departments on the continuous development of the Personal & Home Care research area at the Fraunhofer IVV.



a follow-up project. Of course, we have to take into account that shower gel and body lotion, for example, differ greatly in their application and formulation. This could result in matrix effects that influence the release of active ingredients. These are all exciting points that we would like to do more research on in the future.

What other research is planned in this area?

Jessica Freiherr: On the one hand, we would like to continuously improve our methods for physiological measurement and work on existing problems. For example, we would like to reduce the number of cables during the measurement of physiological parameters in order to have less impact on the subjects' well-being. We are also expanding our existing field of research to include the applications of detergents and cleaning agents, room fragrances, automotive, and food. We are currently planning a funded project to predict the psychophysiological effect of scent and skin feel of cosmetic formulations, for which we are still looking for partners.

Thank all three of you for the exciting interview! How can our readers get in touch with you if they have questions?

Arielle Springer: The best way is to contact me. We welcome all kinds of questions, challenges and exciting projects with partners from research and industry. You can find my contact information here:

arielle.springer@ivv.fraunhofer.de

Phone: +49 8161 491 470 or mobile: +49 1716 411 383

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Literature:

- [1] Springer, A.; Höckmeier, L.; Schicker, D.; Hettwer, S.; Freiherr, J. Measurement of Stress Relief during Scented Cosmetic Product Application Using a Mood Questionnaire, Stress Hormone Levels and Brain Activation. *Cosmetics* 2022, 9, 97. <https://doi.org/10.3390/cosmetics9050097>



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The Challenges of Delivering Long-lasting Fragrance with Liquid Fabric Softeners

Interview with Alain Phyfferoen, Senior Technical Support & Development Manager at CP Kelco

Can you talk about some of the trends in liquid fabric softeners?

Scent is a major part of the fabric care experience, both for the elimination of odors and as an indicator of freshness. According to an Innova Market Insights category analysis, fabric freshener product launches grew by 7.8% from July 2016 to July 2021, and we see that "long lasting freshness" is often among top product claims. Many fabric softeners use oil or

liquid fragrances to give an instant, short-term scent boost to the laundry; but together with the other components in the softener, a significant proportion could be lost in the drained rinse water. An alternative approach of using encapsulated perfumes can help as some encaps become entrapped in the fabric to provide a controlled release of fragrance past the

wash-dry cycle. A consumer might use a towel or wear clothes weeks later and still pick up the scent.

If fragrance encaps can prolong fresh scents for weeks, why don't more manufacturers use them?

There are two main reasons that are somewhat related. While encaps are a great vehicle for delivering long-lasting fragrance, there have been some challenges. First, there was a need for more sustainable encapsulation material. I'm sure we have all heard of the sustainability problems with microbeads. The plastic shells historically used can be harmful to the ecosystem. Microbeads can make their way past water treatment plants and into waterways. Thankfully, new biodegradable encapsulation chemistries have started to emerge.

This leads to my second point: It can be difficult to keep biodegradable encaps stable and homogeneously distributed, especially in many types of fabric softeners with low concentrations of esterquats. Most liquid fabric softeners on the market today use a cationic quarternary ammonium compound, known as esterquats, to neutralize the charge of the anionic fabric fibers and reduce friction in the wash. When used at high concentration (e.g., 10%), esterquats can create a thickened system and encap phase separation issues are not usually observed. However, it could significantly increase the amount of fabric softener being lost in the drained rinse water. Most softeners today contain esterquat levels below 5%. At these levels, encap phase separation becomes almost unavoidable. This, in part, helps to explain why many current fabric softeners do not use encapsulated fragrance and cannot make claims on longer lasting fragrance.

Is there another technology to help manufacturers solve stability and suspension?

CP Kelco tested a new, cationic-compatible, nature-based stabilizer that can work in the presence of esterquats and is readily biodegradable. Our CELLULON® RC-76 Cellulose Liquid is developed from fermentation-derived cellulose (FDC). Because it is produced through fermentation, it offers properties not possible with other sources of cellulose. For example, its fibers possess a very fine diameter and form a 3D net-like structure that provide a very high surface area-to-weight ratio. This can suspend most fragrance encaps. We conducted an independent panel test of our new FDC product in a fabric softener formulation containing 3% esterquats and a combination of 0.8% fragrance oil and 0.4% biodegradable, encapsulated fragrance with great results. The test showed an initial fragrance boost in the freshly laundered terry cloth fabric, plus the fragrance intensity persisted on the dry fabric



Alain Phyfferoen

over two weeks after washing.

How would you compare using cationic-compatible FDC to suspend fragrance encaps instead of using a higher concentration of esterquats?

CELLULON® RC-76 Cellulose Liquid is easy to use and can be added at any point in the manufacturing process. The product typically requires high speed mixing to fully disperse, so it is often convenient to add it as one of the first ingredients to the freshwater. However, this is not required and, once added, it will quickly begin providing suspension capabilities to the formulation. It is also highly efficient and can provide stability at low concentrations, possibly even in low- or no-water formulations. Furthermore, the enhanced stability in a product can often mean that the formulation can be simplified and manufactured more consistently. Plus, using a readily biodegradable, nature-based solution can positively impact sustainability efforts.

www.cpkelco.com

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Tackling Regulatory Challenges

Interview with **Bettina Jackwerth**, Director Quality and Product Stewardship Personal Care Europe and **Engin Temeltas**, Head of Product Stewardship & EHS Master Data Personal Care Europe at **BASF**

Dear Bettina, dear Engin, you have been part of BASF's Personal Care team for a long time and have already seen a lot. What do you remember most from your journey so far?

Bettina: Compared to any past, the current times are the most challenging ones I have experienced in my almost 35 years in the industry. We never had such a dynamic regulatory situation and such a push towards increasing sustainability in many different areas, while also experiencing the need for our approach to match the cycles of the market.

My career started at Henkel in the research area, and my next post was in global marketing in Personal Care with the longest time for Cognis. Just before the acquisition of Cognis by BASF, I took over a new assignment in the European marketing and had the great chance to shape together with others the integration of Cognis into BASF. About five years ago, I started in my current position, heading the European Product Stewardship and Quality group for Personal Care.

Engin: Already in university, I observed that chemicals legislation would become an integral part of our "life in chemistry". This was again confirmed when I started my career in the coatings industry at a different company. After the introduction of the European REACH (Registration, Evaluation and Authorization of Chemicals) regulation, I joined that company's REACH implementation team, followed by taking over the responsibility for the European regulatory affairs team. In 2020, I arrived at BASF, where I took over responsibility for the Product Stewardship Europe team within the Personal Care business. Here, REACH is still a core item which keeps us busy, while at the same time, new regulations for protection of the environment, workers, and consumers are appearing all over the world. Sometimes it seems that this increase in regulatory action over recent years is growing exponentially.

And there is a lot to do for the next months or even years. How will legislation develop at European level? What will be on the list for the personal care world?

Engin: Over the last 15 years, REACH & CLP (Classification, Labelling and Packaging of Chemicals – the European version of the UN global classification rules) were regarded as "big"

milestones in the European regulatory landscape that are a challenge for companies to comply with. After the last REACH registration deadline in May 2018, many industrial actors had the impression that REACH would be "over". But industry has learned that the transition times for registration have only been the beginning of a changing regulatory world. An example is one part of REACH, the ECHA (European Chemicals Agency), which keeps regulatory experts busy while running dossier evaluation and requesting many additional toxicity data on registered substances.

In parallel, more quietly the previous EU Cosmetics Directive has been replaced in 2013 by the CPR (EU Cosmetic Products Regulation), where one mandatory element is the ban of animal tests for cosmetic ingredients and products. This animal testing ban conflicts with elements in the REACH regulation, as REACH requires certain toxicity tests for workers' protection – depending on production volume. There are still many important toxicological endpoints which can only be evaluated by animal-based test results. Although many companies – among those, BASF is one big player – and research organizations are active in developing alternative methods, it still will take decades until test data from those tests are commonly validated and accepted.

In the meantime, the dilemma remains: while our customers formulate cosmetic products, consumers increasingly desire products, especially in the personal care segment, that provide claims such as "free from animal tests". To protect workers who produce the chemical (cosmetic) ingredients, animal-based toxicity data is mandatory and required for hazard evaluation – so we are all in the same game of "the chicken and the egg".

Meanwhile, non-government organizations (NGOs) are broadening the focus of discussion to areas that include human health and environmental protection. Environmental pollution based on plastics in oceans and other impact areas are part of these. The tonality used in this process fuels consumers' uncertainty. The chemistry that surrounds us all then becomes something threatening and therefore voices for protection through regulation and policy are getting louder.

The European Commission expressed its target for protection of the population and the environment against harmful substances by means of the Chemical Strategy for Sustainability (CSS). CSS can be somehow regarded as a “summary” of all regulatory initiatives discussed over recent decades. Certain discussions on microplastic, “unintended” mixture effects and group approaches are now bound together.

The Chemicals Strategy for Sustainability gave the European Commission the opportunity to put the discussion on sustainability on everyone’s desk. How can sustainability and regulation currently be reconciled?

Bettina: We at BASF – please remember our purpose, “we create chemistry for sustainable future” – have had sustainability long on our agenda. It is implemented in all business processes and relevant company decisions. I am very proud that we in Personal Care – and here I can say globally – have been pursuing the sustainability journey together with our customers for decades. Nevertheless, the Green Deal gave another push to industrial sustainability and here specifically with the CSS to a toxic-free Europe. It is important now that the transfer into regulations is done with a good balance of all relevant aspects, e.g., protection of the environment on one side up to human health on the other. Scientific knowledge and well-acknowledged experiences need to be considered.

Cosmetic Product Regulation (CPR) is under revision. The public consultation ended in July; a new EU Commission proposal is to be expected. What has been discussed in the last few months?

Bettina: The CPR revision focuses on different topics for human health in relation to the CSS. The EU Commission proposal expected for the end of 2022 is now delayed to either Q1 2023 or even later, as the REACH revision is also delayed to potentially Q4 2023. Many of the topics to be addressed in this revision such as the consideration of new endpoints are strongly connected to REACH and the Classification, Labeling and Packaging (CLP) regulations. Thus, all regulatory initiatives should be established with scientific knowledge and

a good balance of perspectives, which requires targeted advocacy by the chemical industry.

One center of competence on risk and safety evaluation of cosmetics is the Scientific Committee on Consumer Safety (SCCS). One current proposal of the intended revision of the CPR is around a closer connection of the SCCS to the ECHA

or even the Risk Assessment Committee (RAC). The chemical industry fears that the scientific knowledge and independence of the SCCS might be lost. If this organizational connection happens, it will become increasingly difficult for the industry to place new cosmetic ingredients into the market, as RAC’s decisions may sometimes be seen as hazard-driven instead of science/fact-based driven, and a well-working risk assessment related to the application might be abandoned. Additionally, a grouping approach for hazards, the evaluation of (undesired) mixture effects and new hazard classes are being discussed. In case of any new hazard class, our concern is that validated methods are partly not available, thus a product hazard evaluation cannot be based on proper proof. A product ban for ingredients must not be based on suspicion only. We do see it as a company’s responsibility to thoroughly know their ingredients and refrain from marketing those with a known and proven risk to the consumer, anyway.

There is also a lot going on in the field of microplastics. What can we expect here?

Engin: “Microplastic pollution” is currently seen as one of the most important challenges as polymers (“plastic”) – due to their properties of degradation stability – accumulate in the environment and appear finally via maritime organisms in the food chain. Additionally, several starting (and degradation) materials like the chemical Bisphenol A have been identified as toxic to reproduction and showing endocrine disrupting effects. Although the cosmetic industry has always been a very minor contributor to microplastics, certain polymers have been used as “exfoliating” material. In fact, the use of “micro beads” is already banned in several regions in the world while some industry players have voluntarily committed to refrain from



Bettina Jackwerth



Engin Temeltaş

using such particles. The EU Commission, with the current proposal on the ban of “synthetic polymer microparticles”, i.e., “microplastics”, follows a strong approach to ban the use of “microplastic” for several industries using a rather broad definition for “synthetic polymer microparticles”; and, where the use is accepted for certain transition periods, an additional burden is created in extended labeling and reporting obligations throughout the supply chain.

To overcome the “microplastic discussion”, the industry speeded up to develop more sustainable polymers – i.e., polymers which are biodegradable under potentially adapted and suitable methods, or which have improved water solubility. Up to now, replacing “microplastic” relevant polymers is quite a challenge for the whole industry.

The current draft release of the intended regulation at least gives some room for this change, as it foresees transition times of four years for rinse-off and six years for leave-on cosmetic products, and another twelve years for lip products. Nevertheless, also for those products under transition times, reporting and labeling obligations on safe disposal remain. Based on current planning of the EU Commission, we can now expect that the regulation will be entered into force earliest end of second quarter 2023.

How relevant do you consider the possible impact a company or the entire industry can have on regulation changes?

Bettina: The intended changes can and will transform the chemical industry and thus downstream industries as well. Therefore, we believe advocating in the process of regulatory revisions is a key responsibility of the industry to support the implementation of the right measures. Although BASF supports many of the intended regulations, it is important to find the right balance between protecting the environment and society and securing the competitiveness and innovation power of the European chemical industry. There is a great deal of scientific background that goes back decades on how even hazardous chemicals can be utilized under well-known application conditions or in industrial or professional use. Depending on the specific topic, education is important for informed decisions. We see the industry as a reliable partner

for politicians in this process and trust in the mutual dialog for the best result.

Looking beyond the EU's borders, it is above all the Chinese regulations that have their challenges. What has changed here and how is this being countered in Europe?

China has released a new cosmetics regulation (CSAR – Cosmetics Supervision and Administration Regulation), which entered into force in 2021. After some delay in publication of subsidiary legislation, most of the relevant detailed regulations are now in place. The first hurdle in this new regulation is the notification of existing raw materials into a special raw material database. For “high-risk” ingredients like UV filters, the deadline was in December 2021, while the database system did not work properly. Currently, submission for “low-risk” ingredients is ongoing. While the database is still being modified, submitting companies must run certain updates on their current submissions, which results in a new submission code. Cosmetic product manufacturers must then use it to update their own product submissions. Even non-safety relevant updates result in new submission codes, which leads to an additional administrative burden for cosmetic companies. For new cosmetic ingredients, there is a notification/registration requirement, depending on the ingredient group (high-risk/low risk). Although this difference exists, the amount of data to be provided is almost the same, supported by many administrative tasks like translation and, official “notarization” (i.e., official proof of the translation of the original study report). A big hurdle is the current acceptance of non-animal derived test data, which must be proven extensively. In many cases, where existing data from other studies is not accepted, new animal-based toxicity data must be created. This need for additional data creation again interferes with the animal testing ban and marketing-related discussions in Europe.

Currently, there are many discussions with Chinese authorities and local cosmetic manufacturers and associations, but also with EFFCI (European Federation for Cosmetic Ingredients), to pragmatically navigate these obstacles.

www.basf.com

FORMULATIONS

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Phase	Ingredients	INCI	Supplier	Quantity
A	Water demin.	Aqua		Qs to 100%
	Glycerine	Glycerine		3.00%
	Sodium Gluconate	Sodium Gluconate	Jungbunzlauer	0.20%
	Xanthan Gum FNCSP-PC	Xanthan Gum	Jungbunzlauer	0.40%
B	Emulium® Delta MB	Cetyl Alcohol (and) Glyceryl Stearate (and) PEG-75 Stearate (and) Ceteth-20 (and) Steareth-20	Gattefossé	4.00%
	CITROFOL® BI	Tributyl Citrate	Jungbunzlauer	9.50%
	CITROFOL® AI Extra	Tributyl Citrate	Jungbunzlauer	6.00%
	Uvinul® T150	Ethylhexyl Triazone	BASF	4.50%
	Uvinul® A Plus	Diethylamino Hydroxybenzoyl Hexyl Benzoate	BASF	5.40%
	Tinosorb® S	Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine	BASF	1.30%
	Eusolex® OS	Ethylhexyl Salicylate	Merck	4.00%
C	Preservative			Qs

DIRECTIONS:

1. Dissolve ingredients from phase **A** and preheat to 80°C (176°F)
2. Dissolve ingredients from phase **B** and preheat to 80°C (176°F)
3. Add phase **B** into phase **A** under stirring and homogenise for 2 min
4. Cool down to room temperature whilst stirring
5. Add phase **C** and adjust pH to 6.5 with citric acid (LIQUINAT®)

TECHNICAL DATA:

Appearance: off-white cream
pH value: 6.4 - 6.6
Viscosity Brookfield: (Sp. 64 / 30 RPM): 3200 mPas

STABILITY:

Stable for at least 3 months at RT, 1°C (34°F) and 40°C (104°F)

DISCLAIMER:

The information contained herein is meant to demonstrate how our products can be used. This formulation has been subjected to limited stability tests and has been shown to perform well. The given data are suggestions without any guarantee aimed to support customers' development.

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FORMULATIONS

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with Trisodium Citrate Anhydrous

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Phase	Ingredients	INCI	Supplier	Quantity
A	Trisodium Citrate Anhydrous	Trisodium Citrate	Jungbunzlauer	32.14%
B	Plantacare® 818 UP	Coco-Glucoside	BASF	2.86%
C	BICAR® Food 0/13	Sodium Bicarbonate	Solvay	33.50%
	CITROCOAT® N10	Citric Acid, Monosodium Citrate	Jungbunzlauer	20.00%
	ERYLITE® Personal Care Grade	Erythritol	Jungbunzlauer	10.00%
	Trimagnesium Citrate Anhydrous	Trimagnesium Citrate	Jungbunzlauer	1.00%
	Xanthan Gum FF-PC	Xanthan Gum	Jungbunzlauer	0.50%
D	Perfume (optional)			

DIRECTIONS:

1. Pre-heat phase **B** to approx. 70°C (158°F) to lower viscosity of the surfactant
2. Loading of trisodium citrate anhydrous powder (phase **A**) with liquid surfactant (phase **B**) byspraying phase **B** into phase **A** under fast mixing to obtain a homogeneous, lump-free powder
3. Dry blend all ingredients (loaded powder obtained from step 1 with all powders of phase **C**)
4. Optionally: add very small quantity of preferred fragrance (phase **D**)
5. Press powder to tablets
 Device: tablet press FlexiTab® (Roeltgen)
 Punch size: 25 mm
 Fill depth: 7.7 mm
 Compression force: 24 kN

TECHNICAL DATA:

Appearance: tablets, biplanar
Weight: 4.50 g / tablet
pH value: 6.40 (2 tablets in 90 ml tap water)

STABILITY:

Stable for at least 7 weeks and 30°C (86°F) and 50% relative humidity without packaging, enhanced stability in capped tubes.

Application:

Crush tablet into wet palms; rub the product between your palms with a little water so that it foams up. More water will soften the scrub effect. Massage gently over entire face. Rinse thoroughly with water.
 Caution: For external use only. Do not ingest. Avoid eye contact. If contact occurs, rinse thoroughly with water. Do not apply to broken skin.

DISCLAIMER:

The information contained herein is meant to demonstrate how our products can be used. This formulation has been subjected to limited stability tests and has been shown to perform well. The given data are suggestions without any guarantee aimed to support customers' development.

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