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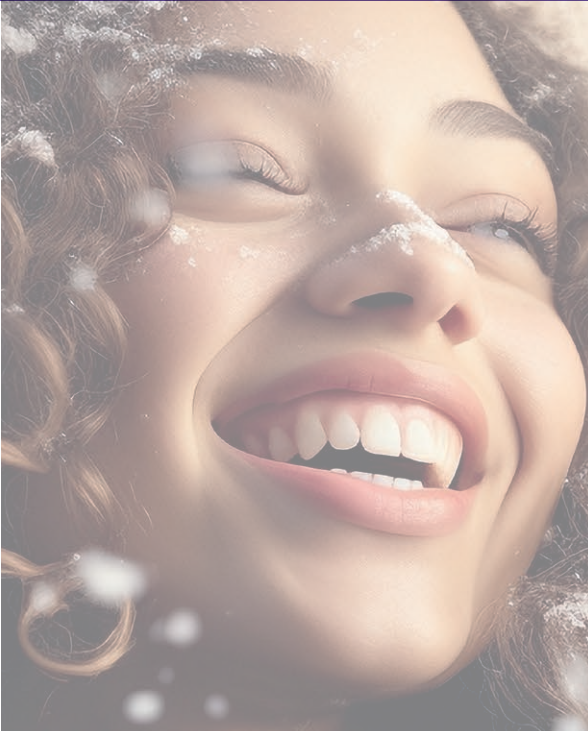
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# Is Your Brand Future-ready? Ten Customer Motivations & More, as Inspiration for Your Innovation Pipeline

J. Bode

**How are you today? Are you someone firmly rooted in the present, or do you tend to dwell in the past? Or perhaps, are you one of the few who actively engage with potential futures?**

I'll throw in a few terms from my recent columns: Poly and Perma-Crisis, Change and Transformation, Trends and New Customer Needs – and your heart rate goes up. Out of the roughly 60-80,000 impulses that hit our brains daily, about 80% are rather negative, and that's the result of our communication habits, i.e., how we absorb and mentally process information.

Especially now, this poses a certain challenge, but I think 'radically optimistically,' in terms of opportunities, and I use a little trick for that, but more on that later.

## Change-mania:

Change on the outside always causes change on the inside. We react to external influences, things we cannot control ourselves, and external aggressors, whether it's a almost practically invisible virus or a very visible politician. We are changed or we change ourselves, some more slowly and others more quickly. Change generates change within us, and that, in turn, affects 'my values and needs.' Allow me to introduce: Ten customer motivations for the future:

**01 | Prestige & Recognition:** We all want to 'matter' and be important, even if we wouldn't necessarily say it openly. To satisfy the need for recognition, we spend a lot of money on all kinds of 'secondary sexual characteristics' (status symbols) that underscore our importance and hope for social approval from third parties >> how can you make this motive emotionally, visually, and tangibly perceivable?

Keyword: Luxury, Beauty, Differentiation.

**02 | Relationships & Connection:** The negative trend: loneliness affects all age and target groups. Connecting with other people is a fundamental human need. This can be a sim-

ple, sincere, and friendly smile during a sale or finding true love >> how can you invite your customers to become 'part of the family' and provide emotional bonding, both online and of-line? Keyword: Friendship, Club, Community.

**03 | Growth & Progress:** 'Stay the way you are' is the worst birthday wish anyone can give me, and just like me, many have a dominant need to continue developing. It's about development, not perfection >> how can your solution help people move to the next level?

Keyword: Coaching, Training, Recommendation.

**04 | Finite Life & Resources:** Time spent is irreversible; it's simply gone, as is money. Both goods are very valuable life resources, and in purchase decisions, they are the new currency >> how can your solutions become caregivers and concierges, saving your customers valuable life time and budgets?

Keyword: Efficiency, 3x faster, more time.

**05 | Comfort & Security:** The facets of security are diverse: physical and financial security, data security, or future planning security >> how can you provide a tangible sense of security with your solutions?

Keyword: Guarantee, Certificates, Personal Care.

**06 | Power & Control:** Power in the sense of having power over others, as well as power over situations and processes in one's own hands. Making things easy, understanding, and being able to control them independently >> how can you make your solutions more transparent and understandable, and increase people's self-efficacy?

Keyword: Understanding, Self-Control, Security.

**07 | Pleasure & Experiences:** People are fundamentally curious, and it's important to rekindle that curiosity by providing unique product experiences through all five senses and the sixth sense, intuition >> how can your solutions offer variety?

Keyword: Individuality, Novelty, Limited.

**08 | Complexity & Radical Simplicity:** The world is becoming increasingly opaque and complex, and we all experi-

# Customer Lifetime Value



ence this in all areas of life, from complicated timetables to shopping instructions to senseless bureaucracy >> how can your solutions make people's lives simpler and more beautiful? **Keyword: Worry-free, customer-centered design, less is more.**

**09 | Holistic Health & Fitness:** Wellbeing is a \$1.5 trillion market, with annual growth of 5-10% (McKinsey study), and we all have a strong desire for holistic well-being and health. It's not about prohibitions but options, to motivate life in all dimensions to be healthier >> how can your solutions contribute to a holistic, healthy lifestyle? **Keyword: Organic, Energy Level, Vegan.**

**10 | Altruism & Your Contribution:** Despite healthy selfishness and the desire for personally experienced pleasure, it's a deeply human basic need to help others, do something good, and contribute to the common good >> how can your solutions make a simple offer to help others? **Keyword: Sharing, Meaning, Mission.**



## Yesterday > today >> tomorrow:

### Thought starters for 2024+

Deja-vu vs. Vuja-dé: I already know this vs. seeing the world with new eyes. The prerequisite for active future shaping is to constructively question your own thinking, then think in options together and interdisciplinarily, and work on the future proactively and constructively. Here are a few more impulses for you and your team:

**1. Information Overflow & Dissonance:** Society is increasingly saturated with information >> how can you ensure that your customers connect with your brand's products and services? **Benefit: Simplification & Orientation.**

**2. Simplification & Safety:** Simple, self-explanatory application and gaining more 'life' time >> what is your innovation strategy for "healthy growth," in terms of considerate, ethical, and sustainable growth for people and our planet? **Benefit: Impact & Sustainability.**

**3. Superficial & Snippet Culture:** It changes how we read and experience the world but narrows our collective attention span. Example: If your website is 250 milliseconds slower than your competitors', your website is less interesting and will be visited less frequently >> how can you humanize your product experience and make it unique? **Benefit: Relevant Information & Uniqueness.**

**4. Shopping & Experience:** In the coming years, new forms of trade will emerge, such as local, ethical, convenience, experience, service, next-generation trade >> how do you translate new customer needs, and where will you strategically invest? **Benefit: Meeting Needs & Experience.**

**5. Mindfulness & Time:** Available life span will be the ultimate reward and new currency in 2024+. What products, solutions, and services do you offer to help your customers save time, valuable 'life time'? Time is the new currency, and the companies that provide time-efficient solutions are the winners. **Benefit: Guidance & Services.**



bolic 'gap' as an NLP anchor (Neurolinguistic Programming). This gap is my visual thought stop, to avoid reacting abruptly to external influences and instead take a moment to breathe, go within, and consider different options. We have a duty to actively shape our own future, self-determined and self-effective.

**And you? What does your personal future anchor look like?**

Best of luck and above all, have fun with the implementation.

Jens

**My appeal: become a future optimist.**

So, the future doesn't become a lonely place; the world needs less complainers and alarmists. Especially in these times, people are searching for new ideas, they have a great longing for authenticity & transparency, 'radical' simplification, sustainability & ethics, life time, relationships, and security. Ultimately, it's about the joy of life >> and the new lust for life.

Insights, trends, and provocative hypotheses are my daily 'brain food.' As a little trick to remind myself to think in terms of opportunities, I wear a narrow ring with a sym-

**Jens Bode**

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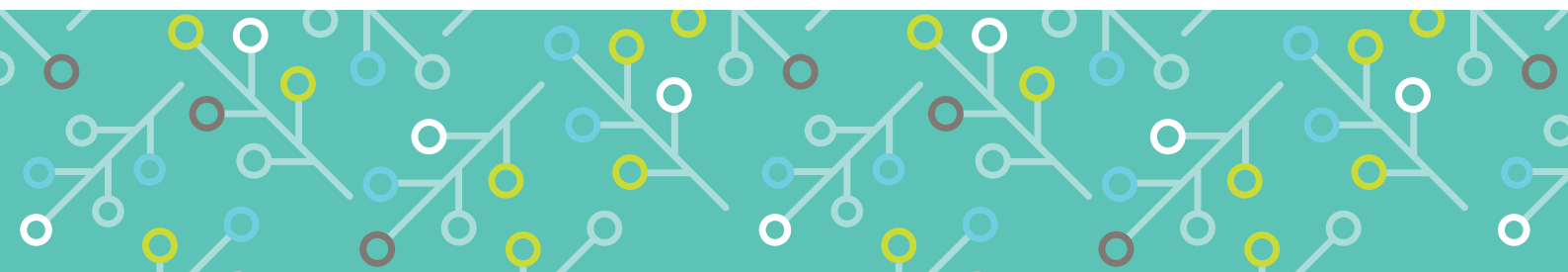
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# Moving Towards Green Technologies in Odour Control for Air Care applications

F. Tham

## abstract

There is a market need for more sustainable odour control technologies for air care applications. Consumers are looking for cleaning products that are effective, bio-based and biodegradable. In this article, the overview of global odour control business in industrial and home care applications and the future opportunities of odour control technologies are discussed. The article also highlights how Croda strives to meet the needs of today's consumers demand for sustainable products, and how it's aligned with Croda's sustainability goal of being Climate, Land and People Positive by 2030.

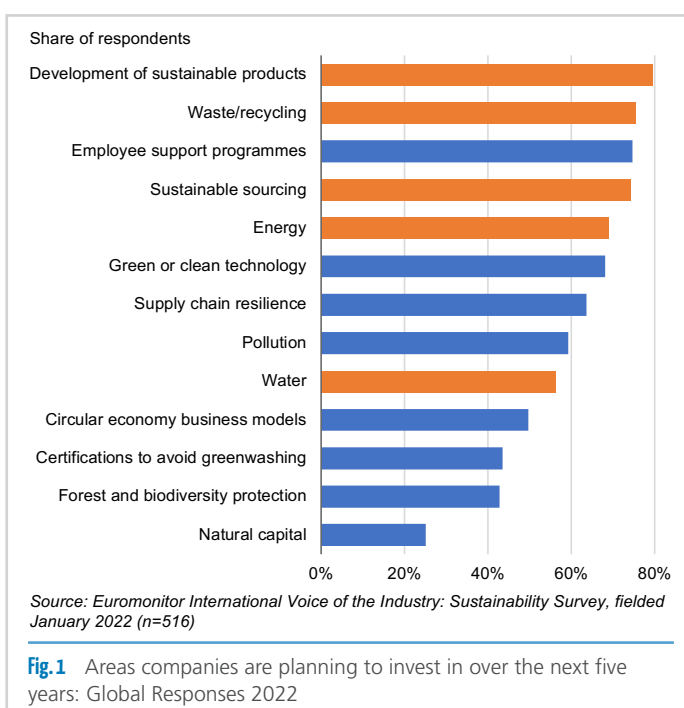
## Introduction

Consumers are seeking cleaning, laundry and air care products that are effective, and deliver high levels of sustainability through their manufacture and use. In response, companies prioritise investments to meet that demand by developing and launching sustainable products and services.

This is reflected on a Euromonitor survey done in 2022 on areas companies are planning to invest in over the next five years (Figure 1). It aligns with the sustainability commitments and policies that the big leaders in the market like Procter & Gamble (P&G), Unilever, Henkel are working towards. For example, the long-term goal for P&G on carbon emissions to achieve net-zero emissions beyond 2040, and the long-term goal for Unilever on responsible sourcing supply to reduce environmental footprint by 50%.

In line with customers' demands and needs, Croda is committed to becoming the most sustainable supplier of innovative ingredients for its customers. The company aligns with the United Nations' Sustainable Development Goals (SDGs) to develop high performance raw materials that are safe and environmentally friendly. The adoption of the SDGs provides a framework to structure and communicate corporate sustainability efforts in a globally recognised language.

At Croda, the SDGs underpin its Commitment. 23 out of the 169 targets in the SDGs are the drivers of its strategy, those where negative impacts must be reduced and where the biggest positive contributions can be made. These targets are grouped around the themes of climate, nature, and society, and hence the commitment to be Climate, Land and People Positive. Beyond these 23 drivers, the remaining SDGs and their targets are similarly important. While they do not drive



Croda's strategy, the company contributes to them through fundamental objectives and the Croda Foundation to enable wider progress across society.

This article gives an overview of the odour control business globally in the air care applications and how Croda is working towards creating a more sustainable odour neutraliser technology to meet the needs of the future home cleaning industry.

## Overview of global odour control business in industrial & home care

The global air care market industry is projected to grow from USD 13.25 billion in 2022 to USD 19.74 billion by 2030, exhibiting a compound annual growth rate (CAGR) of 5.20%



during the forecast period from 2022 – 2030 [1]. According to Mintel, about 11% of air care new product development (NPD) launched globally between 2020 to 2023 had the odour neutralising claim. Consumers are demanding more effective products than just coverage with fragrance and are looking to control odour through science-backed mechanisms and nature-derived ingredients.

Odour control empowers consumers as they allow clothing to stay fresh throughout the day with less cleaning. Controlling odour increases the perception of cleanliness which contributes to comfort and an overall feeling of well-being. To control odour industrially, some companies use air filters and absorbents, whereas at home, products designed to eliminate malodours include air freshener, pump and spray aerosols and diffusers [2].

### Chemistry of bad smells and technologies to control malodour

The everyday world is filled with unpleasant odours. From the environment, there are pollutants like smoke, cigarettes, moulds, garbage, waste, and exhaust from public transportation. From the body, there are sweat, body odour, wind or gas from the body, bad breath, vomit, and odours from baby

diapers. Environmental residues, smoke, cooking, sweat from exercising can also cling onto clothing. At home, there are food smell like fried or burnt food, smoke, grease and oil from cooking, dog smells or cat litters for those who have pets.

The chemistries of these bad smells can be broadly classified into nitrogen-containing compounds, sulphur-containing compounds and acids. Nitrogen-containing compounds can be found in fish and seafood, kitchen and garbage odours, pet urine, urine and faeces from the bathroom, and cigarette smoke. Sulphur-containing compounds can be found in for example, underarm sweat, kitchen and dirty dish smells, onions, garlic, bathroom smells, garbage, and pet odours. Acids can be found in underarm and foot sweat, hair or scalp odour, kitchen or garbage, and mould or mildew in the house or clothes.

Technologies developed to neutralise odours are designed to capture or react with these malodours to eliminate their bad smells (Table 1).

Spray products may utilise one or more of such technologies to remove the malodour and/or perception of bad smells. One such approach is using masking agents such as perfume and aromatic oils, which mask the smell of the unpleasant odour using its own fragrance.

Malodour	Chemistry	Mechanism
Smoke (cigarettes, pollution)	Cyclic compounds (e.g. methyl pyrrole, pyridine)	Complexation with cyclodextrin [3-5]
Grease	Aldehydes (octanal, nonanal)	Reaction with polyamine polymer [6]
Body odour (foot, underarm)	Acidic compounds (isovaleric acid, hexenoic acid derivatives), thiols (methanethiol) Bacterial VOCs	Acid-base neutralisation [7-8], complexation with Zinc [9-10] Microbial methods [11]
Kitchen odour	Bacteria VOCs	Microbial methods [11]
Fish, seafood	Amines (butylamine, trimethylamine)	Acid-base neutralisation, reaction with carbonyl compounds [12], complexation with Zinc [9-10]
Garlic/onion	Sulphur compounds (dipropyl sulphide)	Reaction with carbonyl compounds [13]
Meat	Amines, fatty acids	Acid-base neutralisation, reaction with carbonyl compounds [14]
Smoke (baking)	2-Penethylfuran, thiazoles, and thiols (2-ethyl-1-hexanethiol)	Complexation with cyclodextrin [15]
Garbage	Sulphites, amines (triethylamine), acid compounds (acetic acid)	Acid-base neutralisation, reaction with carbonyl compounds [14]
Sinks	Fatty acids, amines, thiols	Acid-base neutralisation, reaction with carbonyl compounds [16]
Bathroom odour		
Urine/faeces	Skatole, morpholines, acids (thioglycolic acid) Ammonia	Odour receptor blocking, reaction with carbonyl compounds [17] Complexation with Zinc [9-10]
Shower area	Bacterial VOCs	Reaction with carbonyl compounds, microbial methods [18]
Pet odour (dog smells, cat litters)	Acidic compounds, sulphur compounds, amines Bacterial VOCs	Acid-base neutralisation, reaction with carbonyl compounds, odour receptor blocking [12,17] Microbial methods [11]
Mould or mildew	Fungal VOCs	Reaction with carbonyl compounds, microbial methods [18]

Tab.1 Malodour Chemistry and Examples of Mechanisms of Neutralisation

The other technique is using substances that can directly remove common malodours from the air or the source via chemical or physical mechanisms. These mechanisms include physical adsorption such as using Zeolites, activated charcoal and clays to absorb odorous molecules, or using photocatalytic oxidants such as metal oxides [19].

Chemical oxidation of malodours involves using oxidising agents to react with some of the odorous ingredients. Complexing with metal ions, such as zinc ricinoleate type compounds, will result in the zinc atom binding to the odour molecules due to its high affinity to nitrogen and sulphur found in some odour chemistries [8].

Another widely used technology is the use of cyclodextrin or its derivatives to trap the malodours by complexation. Cyclodextrin is a bacteria-derived macromolecule made up of sugar units [3]. Less polar malodour interacts readily with the hydrophobic core of the cyclodextrin to displace water. As a result, it gets encapsulated. Once encapsulated, the volatility

of the malodour is greatly lowered and remains trapped in the cyclodextrin core [3].

Acid-base neutralisation involves ingredients that react with acids to produce salts or with alcohols to form esters. These reactions reduce the malodour [20].

Lastly, some microbes that secrete enzymes to interact and degrade malodours can also be used.

## Opportunities in future odour control technologies

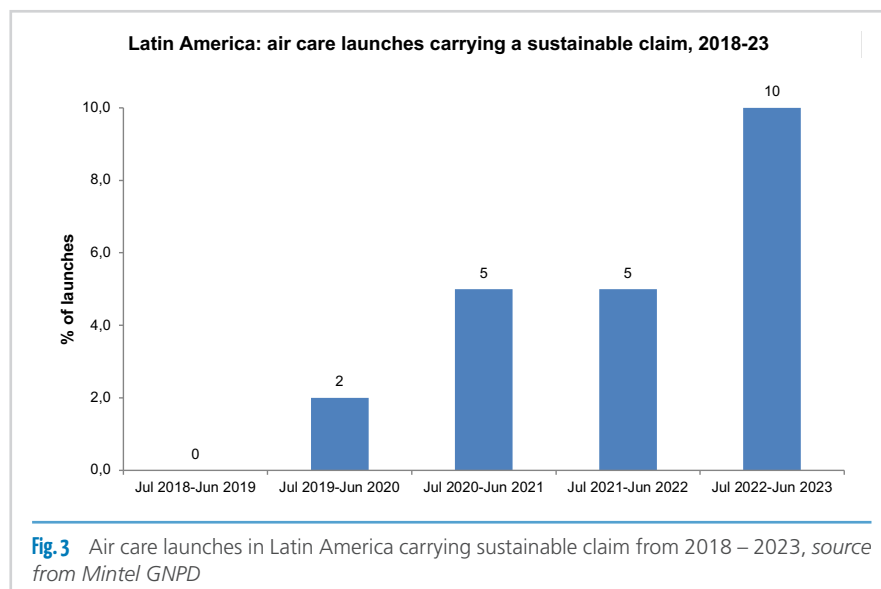
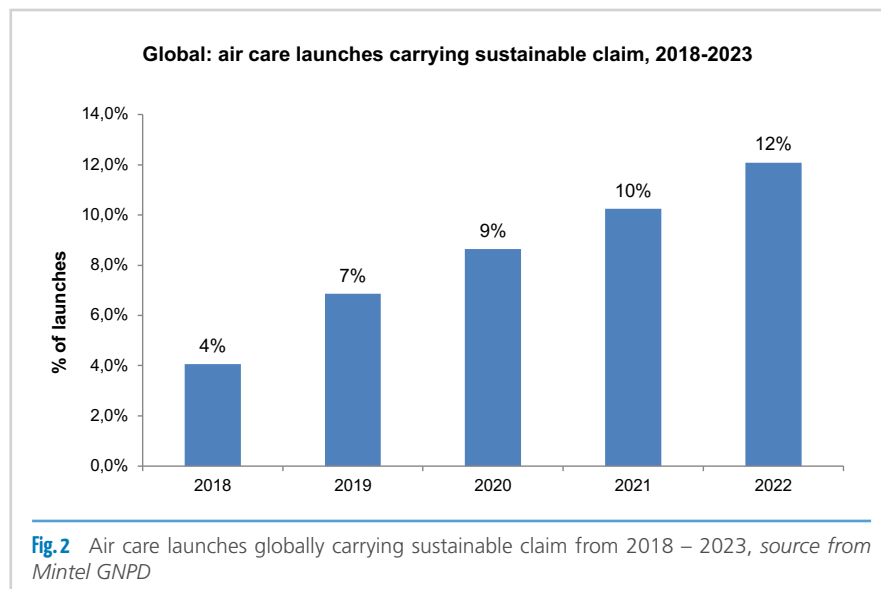
The downsides of some of these current odour control technologies are that masking agents do not eliminate the malodour source directly; masking only works to cover the smell of the odour. Physical mechanisms of odour removal are not ideal in formulations that require an aqueous application format, for example, in air fresheners and liquid laundry detergent. Lastly, chemical oxidation using zinc-based compounds may

not be perceived to be environmentally friendly; some of these ingredients carry hazardous GHS labels and are known to be very toxic to aquatic organisms if accidentally released. Zinc salts are also not favourable for ECOCERT and might not meet the biodegradability criteria.

These gaps in the air care industry on the odour neutralisation front provide opportunities to create more sustainable products that are safe for the environment and people.

Indeed, the trend of the air care industry had been moving towards sustainable claims for the past 5 years. The definition of sustainable claims by Mintel are those providing environmental, social, and economic benefits while protecting public health, welfare, and the environment over their full commercial cycle, from the extraction of raw materials to final disposition. 12% of the NPD launches in 2023 claimed to contain sustainable ingredients in their product compared to only 4% in 2018. (Figure 2).

In particular, there was a boom in sustainable product launched in Latin America. In the last five years, it went from minimal launches in 2018/19 to 10% in June 2023. This ranked second among all regions, just behind Europe (Figure 3).



According to the Mintel report on “A year of innovation in air care, 2023”, consumers wanted to minimise their ecological footprint. 84% of Peruvian adults tried to act in a way that was not harmful to the environment, indicating further opportunities for the growth of products with sustainable claims in this region.

Regardless, everyone has a responsibility to contribute to a greener environment. Croda strives to facilitate its customers’ transition to more sustainable ingredients. Through innovations in applications science, the company will create ingredients that have a positive benefit in use.

### Croda technology and future innovations

Croda currently offers several consumer-preferred portfolios on odour control for industrial and home care applications. These sustainable products effectively remove unwanted odours instead of masking them.

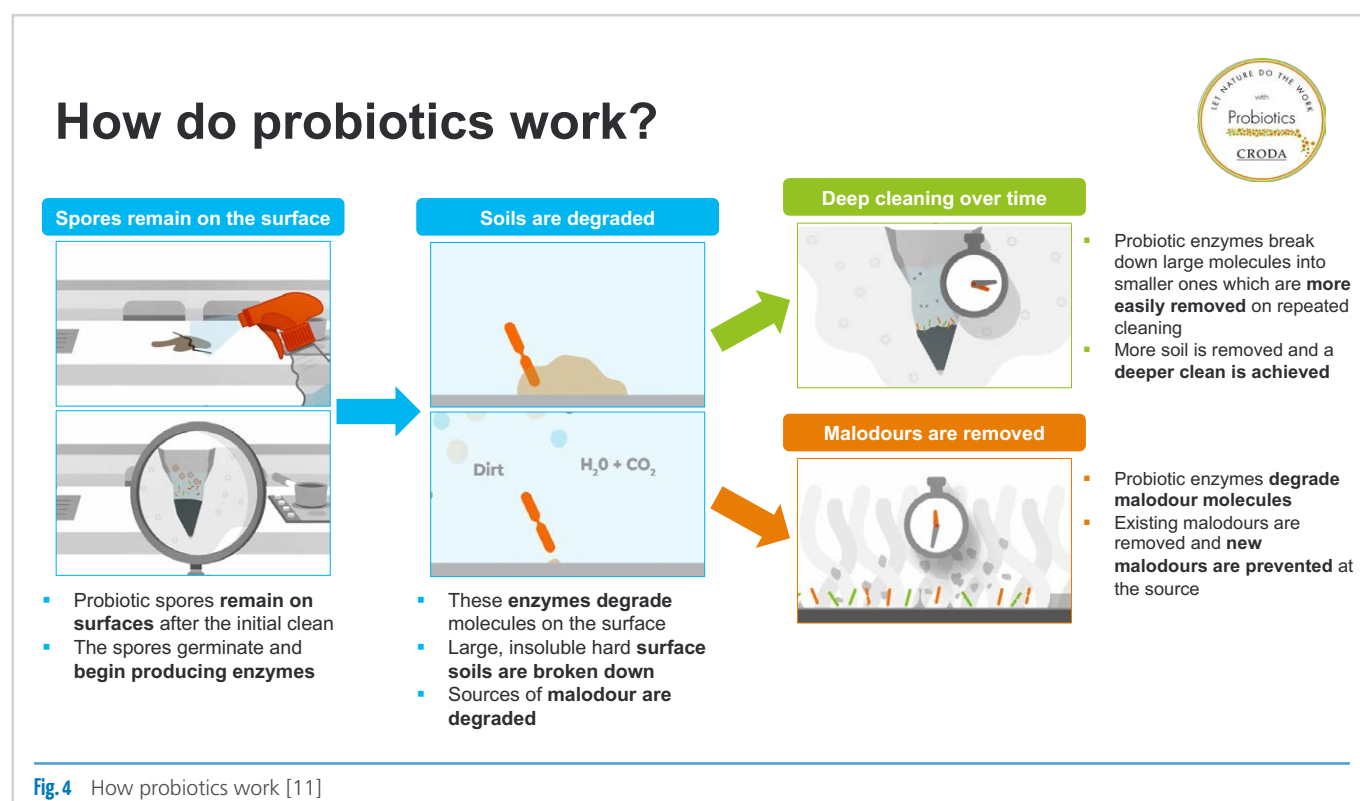
For example, Zinador™ 22L, a 100% bio-based odour neutraliser proved to be effective against a broad range of industrial and household odours. An upgraded version, Zinador™ 35L, has an increase in zinc level and proved to be effective against a broad range of odours; this product is 85% bio-based. Zinador™ products contain a molecule with a zinc ion in the centre. As mentioned earlier, zinc can bind to small odour molecules due to its affinity to nitrogen and sulphur.

This makes it effective on malodours like ammonia, mercaptans, hydrogen sulphide and body odour.

Another example is probiotics. Probiotics are becoming more appealing and important to consumers in household cleaning. According to a 2022 Euromonitor report, consumers’ awareness of the importance of beneficial natural bacteria to their personal health was growing. Potential health issues linked to the use of chemical-based antibacterial cleaners in a domestic setting would also be scrutinised more closely. In this biotechnology space, Croda offers its latest ingredient, CroBiotic™. These products are biotech-derived optimised blend of bacterial strains in a spore form that offer proven, innovative, and effective long-term approach to odour control and hard surface cleaning. It is available in both powder and liquid format. CroBiotic™ 100, the powder format, was launched in 2022 while CroBiotic™ 100L, the liquid format, was recently launched in October 2023. The application-specific bacteria in CroBiotic™ produce enzymes that degrade organic matter in the application area, allowing them to both break down and neutralise existing malodours, and prevent malodour formation over time (Figure 4).

This next generation ingredient offers a more sustainable solution to cleaning. Surveys indicated that malodour of garments was one of the biggest reasons that consumers chose to wash them. Reducing or eliminating the malodour meant that consumers could wash clothes less frequently, therefore reducing energy usage/carbon emissions and water consumption.

CroBiotic™ 100 had been shown to reduce odour from sources including pets, sweat and food. Studies demonstrated savings of 86 kg of CO<sub>2</sub> and 18,600L of water per kg of product used. The products are 100% bio-based and is



certified by ECOCERT. They contain selected bacterial strains to degrade a wide range of organic matter commonly found to be the sources of odour and soil on hard surfaces. It also provides convenience in cleaning by delivering benefits across a range of application areas with a single product, instead of requiring different products for specific applications.

Odour neutralisers offered by Croda are also compatible with the 100% bio-based ECO range of products. Formulating in this combination offer unparalleled sustainability benefits for the consumers.

There are numerous innovations in the pipeline as Croda strives to progressively fill the gaps in the air care industry on odour neutralisation. Besides performance effectiveness, Croda will create sustainable odour neutralising ingredients that are biodegradable, have low aqua toxicity and meet at least 4 SDGs; all development projects are reviewed for sustainability prior to initiation. Development of these consumer-preferred ingredients align well with Croda's sustainability goal of being Climate, Land and People Positive by 2030.

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# Product Carbon Footprint: A Key to Effective Sustainability Strategies

B. Seelig, J. Schoeneboom

## abstract

The personal care industry as well as the wider chemical industry is faced with the urgent need to adopt sustainable practices and reduce its carbon footprint. The calculation of Product Carbon Footprints (PCF) plays a key role in addressing these challenges. BASF has developed a methodology for calculating the PCF and implemented an algorithm-based solution to provide the carbon footprint of most of its product portfolio.

## Introduction

The urgent need for environmental action has prompted governments around the world to introduce stricter regulations to mitigate climate change [1]. Today, many players in the personal care industry have committed to ambitious targets aimed at addressing environmental challenges and lowering their emissions. These efforts are being driven by the fact that consumers are increasingly prioritizing climate-friendliness when choosing personal care products [2]. Developing methodologies and setting standards for measuring environmental impact is also a challenge for the personal care industry: it offers a wide range of products used by millions of people every day, and companies rely on complex global supply chains for raw materials and ingredients. Each product has its own unique formulation that includes multiple ingredients with distinct manufacturing processes, making it difficult to obtain the comprehensive and comparable data needed for precise calculations. Tracking and calculating data from various supply chain partners can be time-consuming, leading to potential data gaps and inaccuracies.

The chemical industry has a key role to play in supporting the sustainability goals of personal care product manufacturers by providing PCF data to create transparency and enabling companies to calculate their overall emissions. However, the room for interpretation within the existing standards is a major barrier to ensuring comparability and consistency of PCF data across a company's ingredient portfolio.

## The Product Carbon Footprint (PCF)

A carbon footprint is the total greenhouse gas (GHG) emissions caused by a defined unit expressed as a carbon dioxide equivalent. Greenhouse gases absorb and emit radiant energy within the thermal infrared range, thereby trapping heat in the

atmosphere and contributing to global warming. There are six greenhouse gases covered by the Kyoto protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>). These gases have different impacts on climate change. The total impact is described in CO<sub>2</sub> equivalents using the 100-year Global Warming potential coefficients. Carbon footprints can be calculated, for example, for individuals, for companies, countries and products [3].

The PCF is made up of direct GHG emissions (or according to carbon accounting language *scope 1 emissions*), which are emissions from sources that are owned or controlled by the reporting entity, and indirect GHG emissions (or *scope 2 and 3 emissions*), which are emissions that are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity.

This means for the PCF of a personal care ingredient from an ingredient supplier perspective, the direct emissions are emissions due to the direct activities of the ingredient manufacturing assets and plants. Energy-related emissions are either counted as direct (scope 1) emissions, when the energy is directly produced in the assets of the ingredient manufacturer, or as indirect (scope 2) emissions, when the energy is purchased from the grid.

All emissions related to purchased raw materials up to the very first point in the value chain where natural resources are extracted from the environment are considered as indirect emissions or scope 3 – upstream emissions. In the cradle-to-gate view of a PCF, all the emissions are considered, from the extraction of the resources to the point where the products leave the ingredient manufacturer's gate.

There is also the option to add GHG emissions, which are caused by activities downstream the value chain (scope 3

downstream emissions). These are emissions related, for example, to activities at the sites of the FMCG producers, the retailers, the end consumers during the use phase of the product and at the end of life by disposal or by recycling. This cradle-to-grave approach is normally not used for a carbon footprint of a specific product, but rather usual for a specific service or activity like having a shower with certain products at a certain temperature (Figure 1).

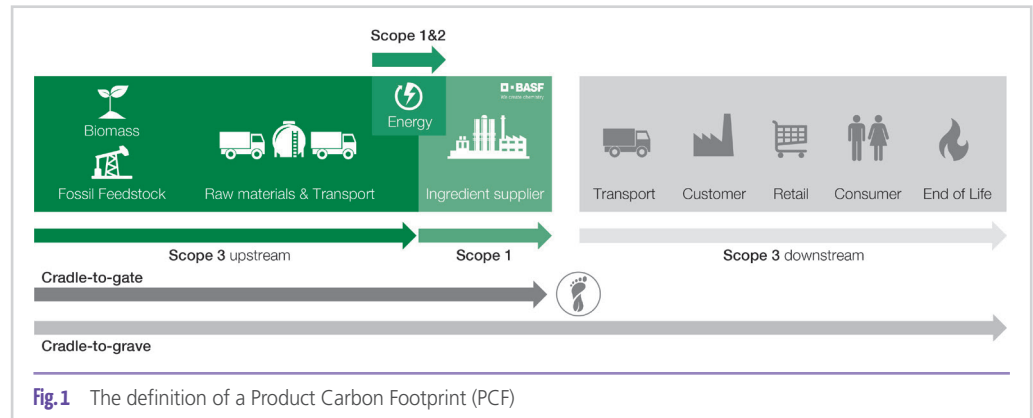


Fig.1 The definition of a Product Carbon Footprint (PCF)

The same logic applies for all other raw materials needed to produce the FAE.

According to ISO 14067:2018 *Carbon footprint of products – Requirements and guidelines for the quantification*, a product's carbon footprint is the sum of greenhouse gas (GHG) emissions and removals in a product system expressed as CO<sub>2</sub> equivalents, as the measure of the impact on climate change [4]. While the term *emissions* – in this case something that release a GHG into the atmosphere – is rather self-explanatory, the meaning of the term *removals* might not be as obvious at first glance. Removals can be defined as negative emissions. Negative emissions happen whenever a GHG is captured out of the atmosphere. A prominent example is the photosynthesis of plants: whenever a plant is growing, it absorbs CO<sub>2</sub> from the atmosphere. The corresponding amount of atmospheric CO<sub>2</sub> converted to biomass and used in certain products is considered a negative emission or removal that is counted in the product system.

There are additional (scope 2) emissions, due to the purchased energy, and direct (scope 1) emissions related to the processes which are necessary to convert the raw materials into the final FAE. Adding up all these emissions results in the net *cradle-to-gate* result, which is the partial PCF, including biogenic savings.

As an illustration, the PCF calculation of a palm kernel oil (PKO) based nonionic surfactant such as a fatty alcohol ethoxylate (FAE) from an ingredient supplier point of view looks like this: at the very first step of the value chain – at palm plantations level – the palm trees are binding CO<sub>2</sub> from the atmosphere (removals). There are also emissions already at that step due to a (direct) land use change (dLUC), caused by, for example, the drainage of peatland or deforestation and due to land use (LU) like the cultivation of the plantations. From the processing of the palm fresh fruit bunches to the final PKO raw material, in other words until the tier 1 supplier of the ingredient manufacturer, indirect scope 3 upstream emissions are added.

Going further down the value chain and adding emissions related to activities at the sites of the FMCG manufacturers, the retailers, the end consumers during the use phase of the product and at the end of life by disposal or incineration results in the net result PCF cradle-to-grave, including incineration.

In the example of the FAE, the biogenetic CO<sub>2</sub> removals from the atmosphere lead to temporarily bound carbon in the product. When the product at the end of its life is incinerated or decomposed in a wastewater treatment plant, this feedstock carbon is again released as CO<sub>2</sub> into the atmosphere. These feedstock emissions at the end of life are compensated by the biogenic removal at the very first step and therefore can be considered as CO<sub>2</sub> neutral. In contrast, for the fossil-based portion of the FAE, there is no corresponding compensation for end-of-life emissions at the beginning of the life cycle (Figure 2).

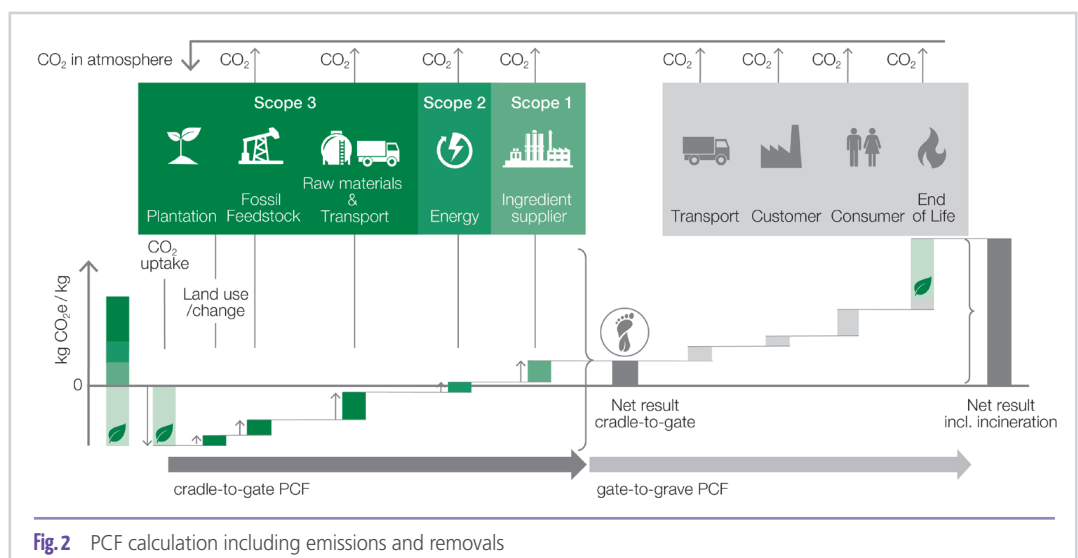


Fig.2 PCF calculation including emissions and removals

For the calculation of the PCFs of most of the (personal care) sales products, BASF has developed an algorithm-based solution, the *Strategic CO<sub>2</sub> Transparency Tool* (SCOTT), designed to automatically generate the cradle-to-gate carbon footprints. In this calculation system, BASF uses primary data for its own processes and high-quality average data from databases or from third parties for purchased energy and raw materials. The methodology used follows a bottom-up approach, commonly known as the *Life Cycle Assessment* (LCA) approach, where data is consolidated along the specific cradle-to-gate process network associated with each product. The approach complies with established international standards: ISO 14067:2018 for carbon footprint of products, which is based on ISO 14040:2006 and 14044:2006 for life cycle assessment. Additionally, the calculation at BASF is aligned with the *Together for Sustainability* (TfS) PCF guideline and the *GHG Protocol Product Standard* published by the *World Business Council for Sustainable Development* (WBCSD) and the *World Resource Institute* (WRI) in 2011. Furthermore, the company's calculations and the compliance to the TfS PCF Guideline was certified by the TÜV Rheinland in Sept 2023 (Figure 3).

While developing a process for PCF data calculation, many decisions must be taken until the final PCF value is obtained: there are cut-off rules as to where a process is included in or excluded from the calculation, allocation rules whenever there is a multi-output process, decision on how the GHG burdens of the different raw materials are partitioned to the resulting product, among others. There is a large scope for decision making within the boundary of the existing standards, which might lead to quite different values for the same product, all aligning perfectly with the existing standards. To address this issue, initiatives have been taken to provide organizations with clearer guidelines and consistent methodologies for calculating and reporting their PCFs.

## Unifying standards for PCF calculation

A notable initiative in this direction is the *Together for Sustainability* initiative (TfS) [5], which provides a first-of-its-kind approach to calculating PCFs for chemicals. To create an industry-wide level playing field, chemical companies BASF, Bayer, Evonik Industries, Henkel, Lanxess and Solvay launched the initiative to assess, audit and improve sustainability practices in their global supply chains. The program is based on *UN*

*Global Compact and Responsible Care* principles, and, since 2011, has grown into a global organization with regional representation in Asia, North and South America [6-7]. It adheres to internationally recognized standards, including ISO and GHG Protocol accounting standards, ensuring that the data it produces is not only accurate but also comparable across the industry. It also provides a drop-in solution that can be easily adopted by other industries that use chemicals. This open approach encourages collaboration and the sharing of best practices, facilitating the widespread adoption of standardized PCF calculations.

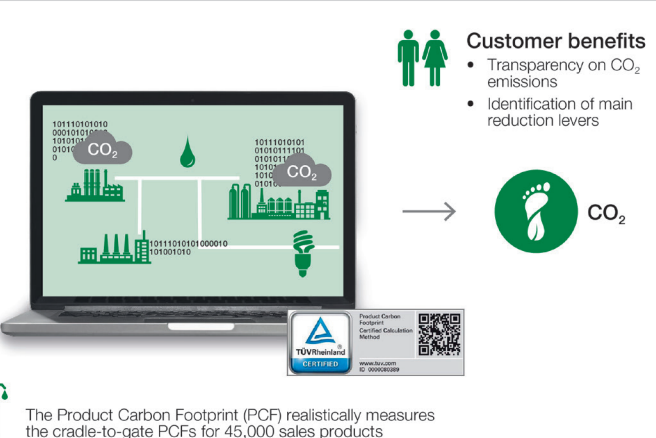


Fig. 3 BASF's calculation of Product Carbon Footprint

Meanwhile, in 2022, TfS developed comprehensive PCF guidelines that provide a sector-specific framework for measuring and managing carbon footprints in the chemical sector. Thirty-seven chemical companies have agreed to these global PCF calculation guidelines, which provide specific calculation instructions for cradle-to-gate emissions. As part of its commitment to methodological standardization, BASF's pioneering digital solution for automated PCF calculation, which has been introduced into the market via an ecosystem of partnerships, will accommodate the TfS calculation rules. With the aim of fostering standardization, the company has been openly sharing its PCF calculation methodology with suppliers, customers and peers [8-9].

Another initiative is the *Partnership for Carbon Transparency* (PACT) [10]. The approach of PACT is to bring together stakeholders from different industries in order to tackle the scope 3 challenge. The aim is to establish a global methodology and technical infrastructure for primary and verified GHG emission data exchange and measurement. This approach is built on three pillars: the PACT pathfinder framework, the PACT pathfinder network and the PACT pathfinder ecosystem.

The PACT pathfinder framework is about harmonizing existing rules for PCF calculation. They have created industry-independent guidance for emissions accounting and data exchange across value chains. A new version of this guideline, the PACT pathfinder framework 2.0, was published at the beginning of



this year. This publication provides guidance on emissions accounting, data integrity, assurance and verification as well as data exchange. The PACT pathfinder network is a standardized approach for data sharing and interoperability. This network facilitates a confidential peer-to-peer exchange of data across technology solutions and networks. The PACT pathfinder ecosystem connects already more than 100 core stakeholders, including around 60 WBCSD members and 10 industry initiatives. This represents more than 2,500 companies, which are working on emission transparency by co developing methodological and technological approaches in several connected industry deep-dives.

In addition, to its engagement in these initiatives BASF decided to make its IT tool (SCOTT) for the calculation of the PCF data of its product portfolio available through software partners. Other companies can decide to integrate or implement this into their operations, thereby also contributing to more standardization and harmonization in the practical calculation of the data.

### Levers for PCF reduction

An array of levers has emerged as potent tools for driving reductions in greenhouse gas emissions (Figure 4).

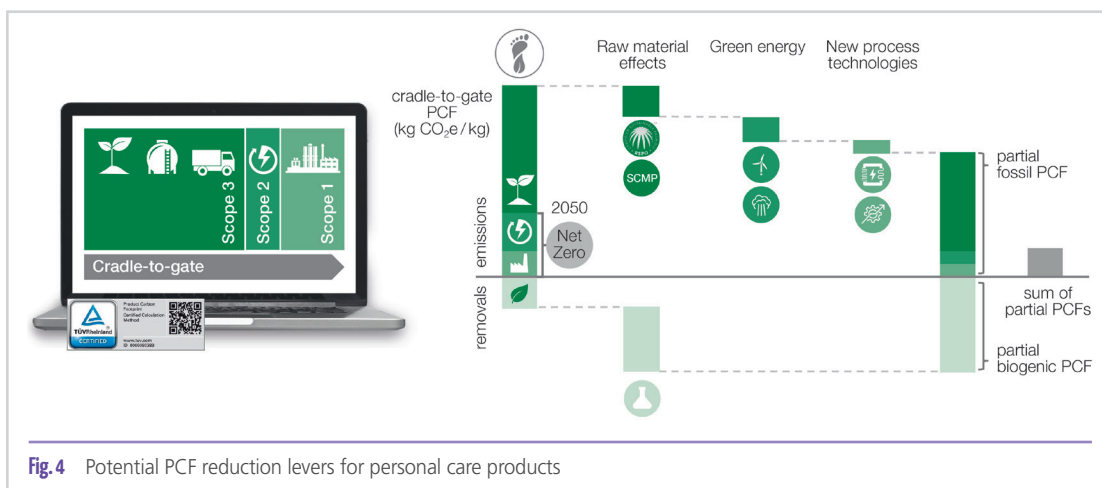


Fig. 4 Potential PCF reduction levers for personal care products

### Raw material-related reduction potentials

From the perspective of the brand owner, the largest contribution to the carbon footprints of personal care products comes from the raw materials. This includes the indirect emissions, scope 3 upstream, as well as the biogenic removals, which are an inherent part of biobased raw materials. Therefore, two years ago, BASF started its supplier CO<sub>2</sub> management program [11]. In the initial phase of the program, the primary focus was to attain transparency regarding the CO<sub>2</sub> emissions associated with the raw materials the company procures from its suppliers. During this phase, support was provided, and knowledge on Product Carbon Footprint (PCF) valuation methodologies and tools was shared with suppliers to establish a shared understanding of the environmental impact of BASF's supply chain. In the subsequent "improvement phase," the company is working closely with its suppliers to identify practical strategies and set targets for reducing greenhouse gas (GHG) emissions.

Another measure applied is to switch from conventional palm kernel oil (PKO) to the sustainable certified alternative: the

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most prominent certification scheme for sustainable certified PKO is provided by the *Round Table of Sustainable Palm Oil* (RSPO) [12]. PKO produced according to the RSPO standards shows around 35% lower global warming impact compared to non-certified production [13]. Where are these differences coming from? One major aspect of the CO<sub>2</sub> emissions of PKO at plantation level is deforestation, or the cutting and possibly burning of biomass to prepare the land for cultivation. This has a significant impact on the emissions due to the LUC. However, according to RSPO standards, after a certain cut-off date, there is no deforestation allowed. Therefore, all emissions related to the deforestation process can be avoided when using RSPO-certified PKO. Furthermore, according to the RSPO standard, there are fewer oil palms cultivated on carbon-rich soils like peat soil, and therefore less emissions due to the drainage of peatland, a process in which a lot of CO<sub>2</sub> is emitted into the atmosphere. There are other aspects like higher yields due to good agricultural practices or a higher level of palm oil mill effluents by using biogas capture technologies when following the RSPO guidelines, which all lead to a reduced PCF of PKO. Equivalent to the PKO content of the final product, its PCF can be decreased by choosing the RSPO certified alternative. One major advantage of this approach lies within the identical product specification and quality of the RSPO certified and conventional products, which allows a reduction of the carbon footprint of the final personal care formulation without any kind of reformulation. A further option to reduce GHG emissions is the Biomass Balance (BMB) approach: The idea of the biomass balance approach is to replace fossil feedstock with renewables. To stick with the example of the FAE: in the BMB approach, the fossil feedstock needed to produce the ethylene oxide part is replaced by renewable raw materials. In concrete terms, a certain amount of renewables is added to the company's production Verbund, and this amount is then allocated to the specific BMB-based product. In the case for BASF, this procedure is audited by an independent third-party certification body – the new REDcert<sup>2</sup> standard, which ensures the correct allocation of renewable resources. [14] The reduction of the PCF of the BMB based product is due to the increased biogenic CO<sub>2</sub> uptake by switching from fossil to renewable raw materials. Also, in the BMB approach, the product specification and performance remain the same, which makes the BMB approach an easy drop-in solution. Additionally, by applying this concept fossil resources can be saved.

### Process and energy-related reduction potentials

In order to achieve Net Zero targets, the process and energy related emissions at every tier along the value chain of personal care products have to be tackled. Exploration of new technologies [15] for almost GHG emission-free production processes to produce energy-intensive basic chemicals might be the most important lever for process-related emissions. One pioneering project in this field at the BASF site is the construction of the world's first demonstration plant for large-

scale electrically heated steam cracker furnaces together with SABIC and Linde. By using electricity from renewable sources instead of natural gas, this new technology has the potential to reduce CO<sub>2</sub> emissions of one of the most energy-intensive production processes in the chemical industry by at least 90% compared to technologies commonly used today.

The two major levers to reduce energy-related GHG emissions are based on green electricity and green steam. A core component in reducing electricity-based GHG emissions is the conversion of the electricity supply from fossil (grey) to renewable (green) sources [16]. The personal care business pursues green energy investments in line with the company's overall scope 1 + 2 targets and offers to work with customers to meet their needs on PCF reduction. Steam generation-based emissions can be cut down essentially by electrifying steam generation [17] with renewable electricity using, for example, technologies like e-boilers or special heat pumps. Furthermore, e-drives (electric motors that will replace existing steam turbines) have the potential to reduce the overall steam demand and thus allow us to replace steam with electricity.

## The Road Ahead

In recent years, there has been significant progress in the chemical and personal care industries towards establishing a common methodology for calculating Product Carbon Footprints (PCF). Key developments include the adoption of international standards such as ISO 14044 and ISO 14067, which provide a consistent framework for PCF calculations. In addition, industry-specific initiatives and guidelines have been developed, such as those launched by organizations like Together for Sustainability. These guidelines offer consistent, industry-specific guidance, ensuring that the unique challenges and nuances of the chemicals and personal care sectors are taken into account.

In view of the future, regulators will have a critical role to play in creating an enabling environment for the industry to support the transition. Engagement with industry stakeholders, environmental groups, and the public is essential to develop effective regulations and accelerate the adoption of innovative and sustainable solutions, and to facilitate international cooperation and information sharing to promote best practices and technology transfer between countries. Overall, a comprehensive and coordinated approach that includes regulations, incentives, research, and cooperation will further accelerate the decarbonization process and contribute to global efforts to combat climate change.

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# Unlocking Sustainable Innovation: How Conditioning Biopolymer AURIST AGC Transforms Hair Care and Body Wash Applications

K. Takenori, P. Pericu

## abstract

While mounting consumer and regulatory pressures due to changing climates are increasing the importance of sustainable materials and a rise in natural and/or bio-based ingredients in the marketplace, market research has consistently shown that efficacy is top of mind for consumers. Consumers who research ingredients are looking to better understand product effectiveness. Product performance will be key to repeat purchase. Bioengineered ingredients provide a solid narrative tool that can provide consumers improved product performance and a desired sustainability profile. This present article describes how AURIST™ AGC, an award-winning conditioning biopolymer enabled by IFF's Designed Enzymatic Biopolymer (DEB) technology, can deliver conditioning and sensory modification properties to various product formats, while being bio-based and readily biodegradable.

## Introduction

Science and beauty are inextricably linked; consumers are turning more to science for validation on product performance. Products featuring a scientific claim is deemed to be developed more rigorously or to be more efficient [1,2]. At the same time, climate change is top priority for consumers around the globe. The quest for readily biodegradable, sustainable and renewable ingredients, coupled with consumers' demand for high performance products is driving innovators to use emerging biotechnology platforms to create novel ingredients that are efficacious, backed by science and exhibit a favourable environmental profile.

In beauty and personal care, polymers are an important class of ingredients and are included in the production of most high-performance BPC products. Their range of properties is as varied as the class of polymers that have been utilized. Among many functions, they contribute significantly to the texture and sensory properties of products and can deliver much-sought-after benefits for both skin and hair [3].

Conditioning polymers can be formulated in skin and haircare products for unique characteristics, such as sensory modification, better hair manageability, wet & dry combing improvement, and softening. Properties such as deposition, adherence and absorption are key to enabling these benefits and depend on fundamental chemical characteristics of the conditioning polymers, most notably molecular weight and cationic charge. Conditioning polymers include the widely used polyquaterniums and quaternised guar gum derivatives, as well as proteins and polypeptides.

This article discusses a novel, bioengineered ingredient, AURIST™ AGC (INCI: Water and Alpha-Glucan Hydroxypropyltrimonium Chloride and Propylene Glycol), and how it can effectively deliver conditioning and sensory modification properties to various product formats, while being bio-based and readily biodegradable.

## Better biopolymers through biomimicry

This award-winning conditioning biopolymer, AURIST™ AGC, is the first personal care ingredient enabled by IFF's proprietary Designed Enzymatic Biopolymer (DEB) technology. DEB is a biocatalysis process that gives rise to a new-to-the-world class of alpha-glucan polysaccharides through the enzymatic polymerization of glucose obtained from sustainable feedstock such as sugar beet or sustainably-farmed sugar cane.

The alpha-glucan molecule has high purity, and as a result of the enzymatic polymerization processes, a multitude of tailored morphologies and functional modifications are accessible, including addition of polar/non-polar, charged, and other functionalities. The DEB manufacturing process operates at ambient temperature and pressure, allowing for the polymerization process to take place in mild conditions without the use of harsh solvents used in conventional processes. DEB thereby reduces overall energy use. It also creates a fructose co-product which can be used for other applications to prevent sugar waste.

Designed Enzymatic Biopolymers bring three important benefits that make the alpha-glucan molecule superior in performance:

1. Highly customizable. DEB is a class of versatile polysaccharides that can be modified with a variety of functional groups including, but not limited to, hydrophobic, hydrophilic, and charged groups. This means they can be specifically designed to be more formula compatible or to provide additional benefit, such as conditioning or rheology modification.
2. Great structural uniformity. The precisely controlled enzymatic process ensures excellent structural uniformity for the DEB polymers. This offers high reproducibility and little batch-to-batch variation.
3. Designed for biodegradability. Biodegradability is an intrinsic feature to polysaccharide chemistry. In fact, the ASTM and ISO standards make polysaccharides the gold standard for biodegradation in all environments (marine, soil, industrial, and soil composting) [4]. Being able to customize the structure allows DEB to integrate performance parameters into the development phase and design a high-performing polymer that is still biodegradable. This is further supported by the excellent biodegradability profile of the alpha-glucan backbone.

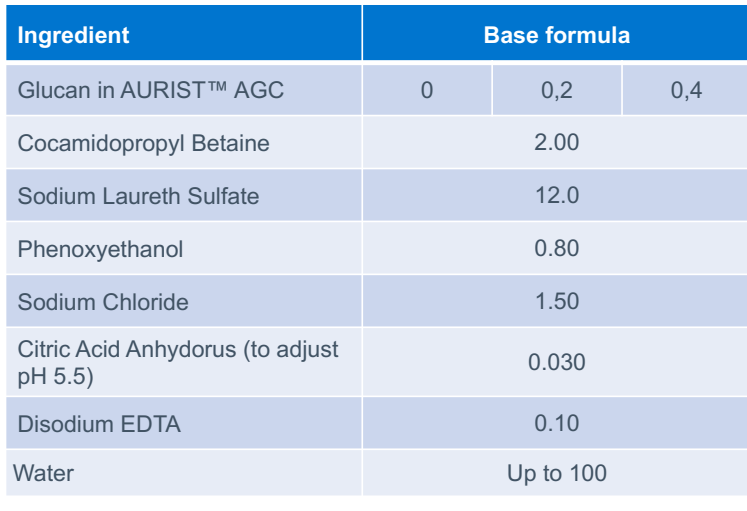
DEB allows the creation of new-to-the-world polymers that can be designed and customized to meet desired performance needs and

product specifications for specific applications. Like natural polymers, these can then be further optimized via chemical modification.

### AURIST™ AGC benefits in hair conditioning

Efficacy is the driving factor for ingredient interest in haircare; results are a top priority for consumers [5].

AURIST™ AGC has been proven to significantly improve both wet and dry combability, in shampoo formulations, when compared with incumbent technology. Its conditioning properties have been investigated in several model shampoos formulated according to the scheme in **Table 1**:



Ingredient	Base formula		
Glucan in AURIST™ AGC	0	0,2	0,4
Cocamidopropyl Betaine	2.00		
Sodium Laureth Sulfate	12.0		
Phenoxyethanol	0.80		
Sodium Chloride	1.50		
Citric Acid Anhydrous (to adjust pH 5.5)	0.030		
Disodium EDTA	0.10		
Water	Up to 100		

**Table 1** Model shampoo formulation used for AURIST™ AGC hair combability tests

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Hair combability tests were performed using an Instron 23-25 according to the following protocol:

**Pre-treatment**

Hair tresses were prepared from virgin Caucasian hair or Kinky hair weighing 2.5 g each and 25 cm long. All tresses underwent a standard pre-cleaning process with a 10% Sodium Laureth Sulfate solution for 1 minute, and then rinsed with running water.

**Base Line**

The wet combability was measured (Wet Baseline). Then, the tresses were dried for 24 hours in a standardised environment at 55 ± 5% relative humidity and 22 ± 2 °C. The dry combability was measured (Dry Baseline). Then each hair tress was treated with the model shampoo shown in **Table 1**.

**Measurement**

Measurements of final wet combability were taken for each tress (Wet Final). Then, the tresses were dried for 24 hours in a standardised environment at 55 ± 5% relative humidity and 22 ± 2°C. The dry combability was measured (Dry Final).

The Energy dissipated during the combing process was calculated for the baseline ( $E_{initial}$ ) and for the treated tresses ( $E_{final}$ ).

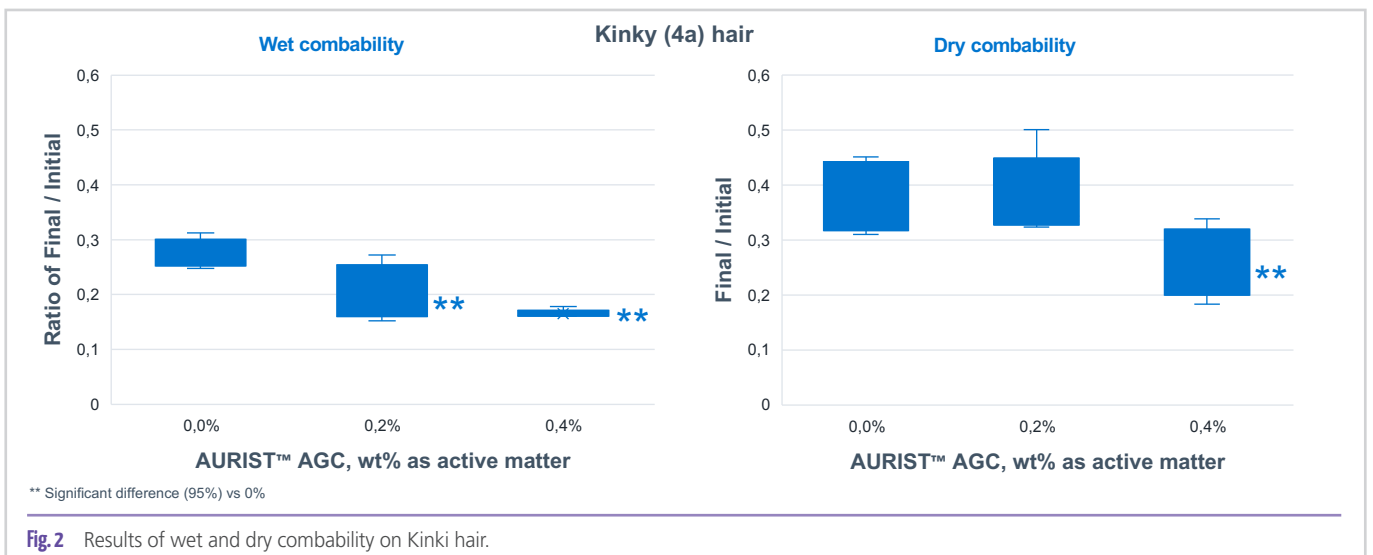
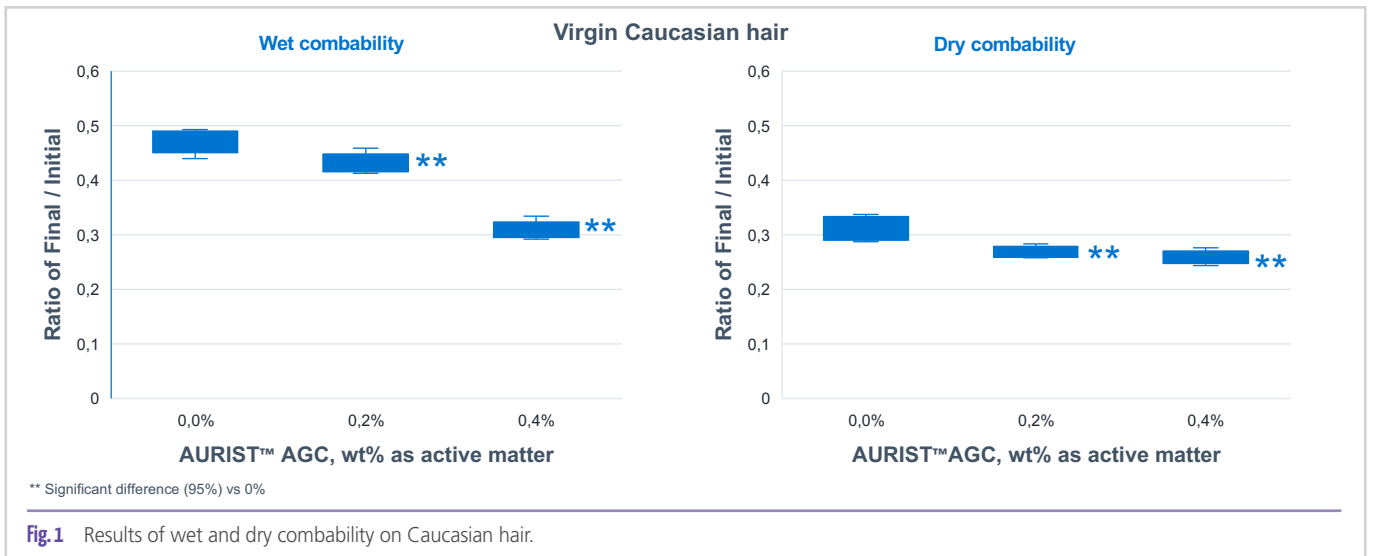
Bimodal, paired Student's t-test (95% confidence interval) analysis of the data showed that the combability energy required to comb the treated tresses ( $E_{final}$ ) was always significantly lower than that required for untreated tresses ( $E_{initial}$ ), both when wet and dry combing the hair.

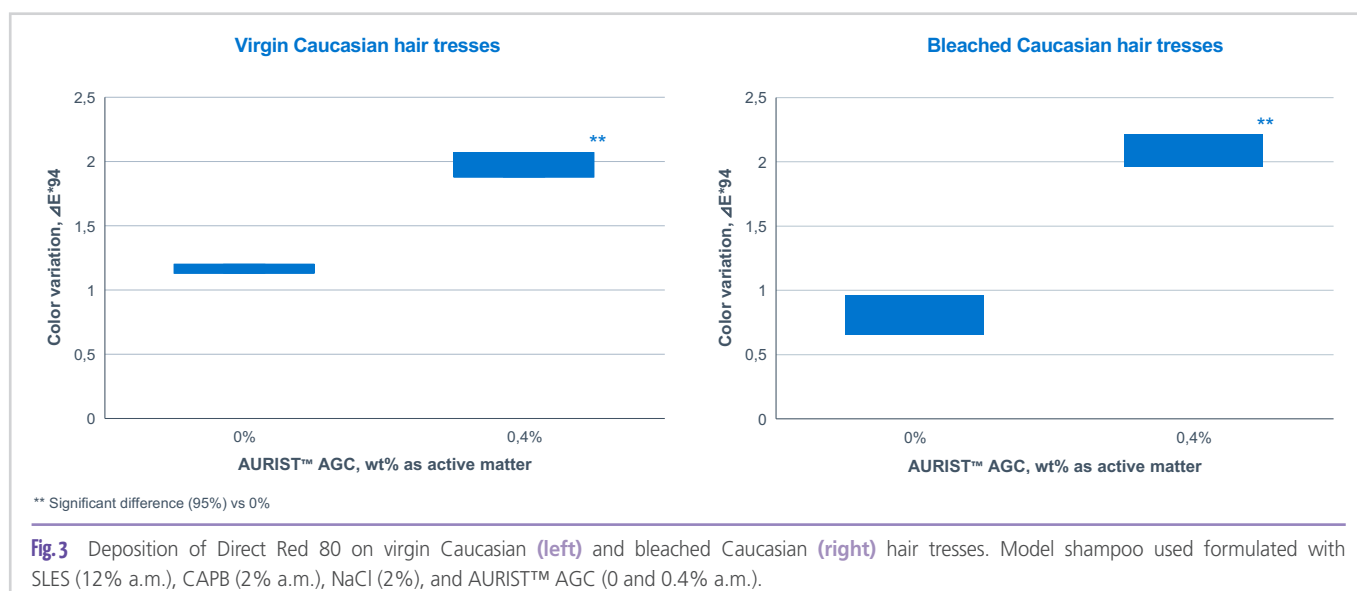
To compare the Energy values obtained by the various study groups in an easier and more insightful manner, the Energy Quotient (Q) was calculated:

$$Q = E_{final} / E_{initial}$$

The Q values obtained were statistically compared using one-way ANOVA followed by Tukey's post-test model (95% confidence interval) to compare the samples analysed.

The results of the combing tests are shown in **Figures 1 and 2**.





Based on the results of these shampoo formulations, AURIST™ AGC has been shown to deliver significant results in improving both wet and dry combability of Caucasian hair when used at as little as 0.2% a.m. When the same test shampoo formulation was used on Kinky hair, significant wet combability results have been achieved when using AURIST™ AGC at 0.2% a.m., while 0.4% a.m. is required for dry combing.

These results and use levels are aligned with other conditioning polymers used in hair care applications. Considering that AURIST™ AGC does not contribute to increasing the viscosity of the system, and neither does it require special steps to enable its hydration (for example, addition of acids in case of non-self-hydrating quaternised guar gum derivatives), one could argue that its use at 0.4% a.m. could anyway be more convenient than some of the benchmark polymers.

From these preliminary studies, we can conclude AURIST™ AGC has superior performance attributes as a conditioning polymer and is also readily biodegradable.

### AURIST™ AGC mode of action in hair care

Deposition is one of the mode of actions for cationic polymers to work for hair. AURIST™ AGC has been proven to be deposited to hair through the Direct Red 80 deposition assay.

- Standardised tresses of either virgin Caucasian or bleached Caucasian hair were prepared, each measuring 2.5 g and 25 cm.
- All tresses underwent a standard pre-cleaning process with a 10%w/w SLES solution for 1 minute, then rinsed with running water.
- The tresses were then dried in a controlled environment at 55 ± 5% relative humidity and 22 ± 2°C for 24 hours.

- Colour measurements of the tresses were made using the spectrophotometer Byk-Gardner Spectro-Guide Sphere Gloss (Baseline).
- After the treatment of the shampoo test sample (apply and wash off), the tresses were immersed in a solution of Direct Red 80 dye (1g/l) for 1 minute, followed by 2 minutes of rinse.
- The tresses were dried in a controlled environment at 55 ± 5% relative humidity and 22 ± 2°C for 24 hours.
- The colour of each tress was then measured (final).

Results of deposition study are shown in **Figure 3**.

Direct Red 80 is an anionic dye that can bind to cationic sites; therefore it can be used to detect deposition of cationic polymers. The Colour Variation, ΔE, was calculated between the final condition (after sample application, wash off and immersion on dye solution) and Baseline (untreated tresses). Higher ΔE indicates a higher substantivity conferred by cationic polymers.

Unlike most incumbent cationic polymers, AURIST™ AGC has been demonstrated not to form coacervates. Such characteristic contributes to ease of formulation, transparency, and low viscosity of the products formulated with AURIST™ AGC. This difference in mode of action can also aid in novel formulation design.

### Benefits in skin cleansing products

In addition to AURIST™ AGC's benefits in haircare applications, a trained panel sensory evaluation has been conducted to investigate the sensorial benefits of using AURIST™ AGC in body wash products through Quantitative Descriptive Analysis.

Evaluation 1: Foaming wash

	Base (%)	AGC (%)
Glucan in AURIST™ AGC	0,0	0,4
Cocamidopropyl Betaine	3,0	
Caprylyl/Capryl Glucoside	5,2	
Sodium Benzoate	0,5	
Citric Acid	0,2	
Water	Up to 100	
Final pH, approx. (as is)	5,3	5,3

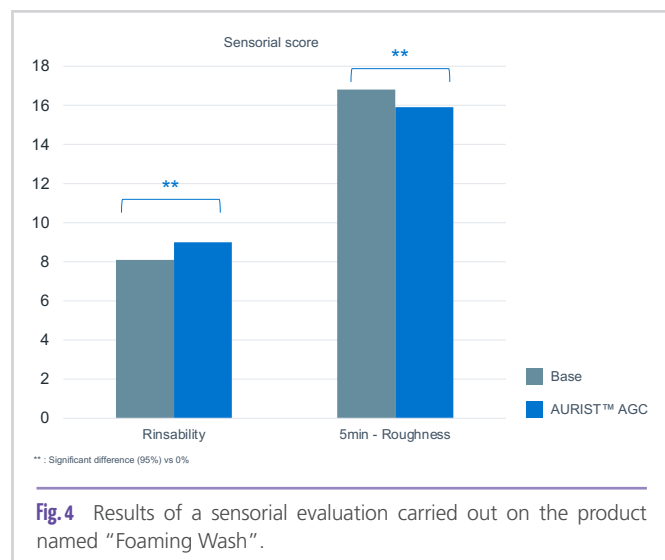
Evaluation 2: Viscous liquid wash

	Base (%)	AGC (%)
Glucan in AURIST™ AGC	0,0	0,4
Cocamidopropyl Betaine	3,0	
Sodium Laureth Sulfate	5,2	
Potassium Laurate	0,5	
Phenoxyethanol	0,2	
Sodium Chloride	2,0	
Water	Up to 100	
Final pH, approx. (as is)	8,8	8,8

**Table 2** Model formulae used to evaluate the effect of AURIST™ AGC in body wash applications.

The expert panel tested variations of the two formulations according to the scheme in **Table 2**:

Results of reduced skin roughness feel and rinsability for the foaming wash formulation are shown in **Figure 4**.



**Fig. 4** Results of a sensorial evaluation carried out on the product named "Foaming Wash".

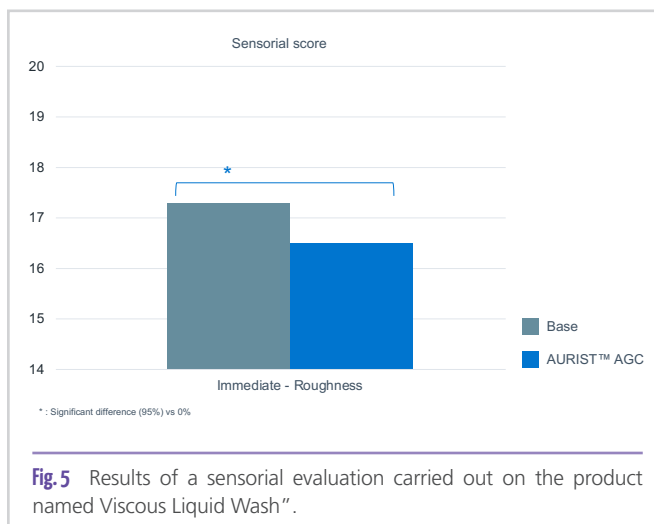
The study showed that the panellists significantly felt a reduction of skin roughness feel when using products formulated with AURIST™ AGC, when compared to the base formulation.

Panellists also observed a substantial reduction in rinsing time when testing the foaming wash formulation containing AURIST™ AGC. As compared to formulas containing soap, formulations at lower pH like the foaming wash, containing, for example, cocoamidoproylbetaine and Caprylyl/Capryl Glucoside tend to have slower rinse speed due to their intrinsic property. And users tend to associate this slow rinsing with unfavorable characteristics, including a slimy, heavy, or unrefreshing sensation. Improved rinsability in this type of formulation is beneficial in mitigating these negative perceptions.

Rinsability for the viscous liquid wash was tested and it showed non-significant difference when compared to the base. This result was expected because formulations containing soaps are typically easier to rinse than those without.

On the other hand, the use of soaps can sometimes induce a harsh sensation, such as skin tightness or dryness, which can accentuate users' perception of skin roughness following rinsing.

Results of reduced skin roughness feel immediately after rinsing for the viscous liquid wash (pH 8.8) formulation is shown in **Figure 5**.



**Fig. 5** Results of a sensorial evaluation carried out on the product named Viscous Liquid Wash".

The panellists noted that the viscous liquid wash formulation containing AURIST™ AGC improved skin roughness feel. This improvement can be attributed to a skin conditioning benefit, as skin roughness is a condition that consumers often associate with skin dehydration or tightness.

In summary, AURIST™ AGC delivers significant results in terms of rinsability and reduced skin roughness feel in both applica-



tions tested. In addition, the residual feel of cleansing formulations containing AURIST™ AGC was rated by the panellists as smooth and silky. These results, in addition to AURIST™ AGC's ease of use, make this ingredient a valuable addition when formulating skin cleansers and body wash products with enhanced rinsability and skin feel.

## Environmental profile of AURIST™ AGC

AURIST™ AGC is a biobased, readily biodegradable highly purified mix of alpha glucan hydroxypropyltrimonium chloride (CatG1), water, and plant-derived propylene glycol. It has been shown to be non-hazardous to aquatic environment.

CatG1 is derived from the enzymatic polymerization of sustainably sourced glucose. Being renewable is not necessarily enough to be sustainable. IFF has performed a cradle-to-gate life cycle assessment (LCA) to quantify the environmental impact of producing CatG1. The polyglucan backbone of the LCA model stems from peer-reviewed LCA for enzymatic polysaccharide production.

## Conclusions

In the present article, we have discussed a collection of tests to substantiate the conditioning properties of AURIST™ AGC, as well as its improved rinsability for body wash formulations. AURIST™ AGC (INCI: Water and Alpha-Glucan Hydroxypropyltrimonium Chloride and Propylene Glycol) is a bioengineered readily biodegradable conditioning biopolymer obtained using IFF's proprietary Designed Enzymatic Biopolymer (DEB) technology.

As demonstrated throughout this article, AURIST™ AGC delivers conditioning properties in a variety of hair and body wash products. Moreover, AURIST™ AGC presents several formulation and processing benefits when compared to other well-established conditioning polymers. For example, AURIST™ AGC does not contribute to increasing the viscosity of the system, and hence suitable for foaming pump packages. AURIST™ AGC also does not require special steps to enable its hydration (for example addition of acids in case of non-self-hydrating quaternised guar gum derivatives).

The ease-of-use, positive environmental profile, and outstanding conditioning and sensorial properties make AURIST™ AGC the new go-to biopolymer to formulate performance-oriented products that meet the discerning consumer's demands.

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# The Next Dimension in Facial Definition Inspired by Microcurrent Devices

M. Valerio-Santiago, C. Garcia, B. Aguirre, R. Subirós, A. Soley, G. Mola, R. Delgado

## Introduction

As technology is becoming more sophisticated in a changing world, the demand for performance-focused skin tech tools and devices is expected to continue growing, since they offer personalization, convenience, and at-home solutions to users. However, factors such as the high cost and concerns related to safety including possible skin damage, irritation, or the tingling sensation, might become a disadvantage or high barrier for consumers, who will look for more convenient topical alternatives that offer similar effects in an efficient and gentle way.

Microcurrent devices work by using low electrical signals (less than 1000 $\mu$ A) to combat signs of aging, like facial sagging and wrinkles, with impressive results. At the tissue level, skin cells respond to microcurrents at different layers of the skin. In the dermis, microcurrents lead to the improvement of extracellular matrix production and the contraction ability of the dermis. At the muscle layer, they help to increase the toning state of the facial muscles. Altogether, microcurrents act to synergistically counteract facial sagginess. Central to this microcurrent-induced mechanism in both the dermal and muscle layers is MBNL1, an RNA binding protein involved in the transdifferentiation process of fibroblast to myofibroblast, a cell type with a higher contraction capacity. Also, microcurrents have been described to increase ATP production by muscle cells and improving their metabolic energization, a process in which MBNL1 is essential, and contributes to enhance muscle tone.

Inspired by the technological advances of at-home devices, we developed a novel tetrapeptide, Uplevity™ e-Lift peptide, that mimics the skin benefits of microcurrent devices for an upper facial lift, demonstrated *in vitro* and *in vivo*. A complete upper face lifted appearance and a reduced severity of wrinkles was demonstrated after the topical application of Uplevity™ e-Lift peptide in human volunteers, with similar performance compared to a microcurrent device.

## Methods and results

### Sustainably developed peptide.

Uplevity™ e-Lift peptide (INCI: Water (Aqua), Tetrapeptide-1, Caprylyl Glycol) is a naturally-derived eco-friendly peptide pro-

duced following the principles of green chemistry. This tetrapeptide brings minimal environmental impact as a result of its high natural origin content (99.5% in the commercial solution according to ISO16128) and readily biodegradable status according to OECD guidelines (98% degradation in 28 days).

### Mimics the skin benefits of microcurrents in the dermis.

We firstly demonstrated that the peptide was able to boost the levels of MBNL1, which is known to promote the transdifferentiation of fibroblasts to myofibroblasts. In turn, this helps to induce collagen contraction in the dermis. To determine this, human dermal fibroblasts (HDFa) were treated with 0.01 mg/mL, 0.1 mg/mL or 0.5 mg/mL of the peptide for 24 hours. Non-treated cells exposed to microcurrents stimulation (C-Dish device, IonOptix) were used as a positive control. MBNL1 protein quantification was measured as fluorescence intensity of MBNL1 normalized by the number of nuclei for each condition using a confocal microscope.

Treatment with the peptide increased MBNL1 protein amount in fibroblasts in a dose response manner and in a similar way to microcurrent stimulation.

To further confirm the microcurrent-like effect of the peptide, we evaluated the ability of the ingredient to induce collagen contraction. HDFa cells were treated with 0.01 mg/mL of the peptide, and after 24 hours they were added to a collagen I hydrogel that included 0.01 mg/mL of the peptide. The collagen I hydrogel was left for 24 hours to allow for contraction. Non-treated cells exposed to microcurrents stimulation were used as a positive control. Hydrogel contraction was quantified by the calculation of the surface area variation.

The peptide induced collagen contraction by 37.5% with respect to the control condition. Further, it showed similar efficacy when compared to microcurrent stimulation.

Finally, we confirmed the appearance of the myofibroblast phenotype modulation after the peptide treatment in HDFa cells by checking EDA-fibronectin, a cell marker implicated in cell contraction and adhesion functions. Cells coming from the assay of collagen gel contraction *in vitro* were used to de-

tect EDA-fibronectin. Briefly, 3D collagen gels were digested by a collagenase treatment and then EDA-fibronectin levels were detected and evaluated in the cells by means of immunofluorescence and quantified by confocal microscopy.

The peptide induced the accumulation of EDA-fibronectin marker in fibroblasts by 72.3%, compared to control, thus confirming the modulation towards the myofibroblast phenotype. Further, the increase of EDA-fibronectin was greater than after microcurrent stimulation.

### Boosts muscle energization in a similar way to microcurrents.

Microcurrent stimulation is known to improve energy production by mitochondria, which is believed to contribute to enhanced muscle tone, providing better skin support, and ultimately, a firmer facial appearance. In muscle cells, MBNL1 protein has been described to be involved in mitochondria energization. Therefore, first we checked whether the peptide could induce MBNL1 protein in muscle cells. To verify this, human skeletal muscle cells (hSkMC) were first allowed to differentiate into myocytes and myotubes. Then, they were treated with 0.5 mg/mL of the peptide for 48 h and total protein content was extracted. The levels of MBNL1 protein were measured by HTRF (Homogeneous Time Resolved Fluorescence).

Our results demonstrated that the peptide treatment induced the accumulation of MBNL1 protein in muscle cells by 28.5%, with respect to the control condition.

With this, we then moved on to determine whether the peptide was able to induce muscle energization. To do this, we checked the mitochondrial membrane potential, a direct indicator of ATP production by cells. For that, hSkMC cells were first allowed to differentiate into myocytes and myotubes. Then, they were treated with 0.1 mg/mL or 0.5 mg/mL of the

peptide for 24 h or stimulated with microcurrents (C-Dish device, IonOptix). Finally, the JC-1 fluorescent probe was added. Mitochondrial membrane potential was evaluated by determining the JC-1 red fluorescence intensity through confocal microscopy.

The peptide boosted the energy status of muscle cells in a dose dependent manner. Moreover, this induction was greater when compared to microcurrent stimulation.

Overall, the peptide demonstrated to activate the molecular targets and the biological functions that take place after microcurrent stimulation at the dermis and muscle layers, which may help to provide an enhanced skin lifting and firming properties.

### Provides a "triorbital" skin lifting effect.

A clinical test was carried out on 36 Caucasian female and male volunteers aged between 42 and 65 years old. These volunteers applied a cream containing 2% peptide solution or a placebo cream on the half upper face, twice a day for 28 days, following a hemi-face design. A second group of 10 volunteers used a commercial microcurrent device, once a day 5 days a week, and applied a placebo cream, twice a day for 28 days. These volunteers were using the microcurrent device daily on their upper face for around 10 minutes in each session. A "triorbital" lift effect was quantified from the clinical study, which consisted of the supraorbital region (eyebrow and eyelid lift), the orbital region (crow's feet lift) and the infraorbital region (upper cheek lift). Moreover, the anti-wrinkle efficacy was also evaluated in the crow's feet region and underneath the eye.

The eyebrow lifting effect was calculated from 2D images generated by Framescan. On each of these images, a horizontal line that goes from the middle point of the eyelashes to the

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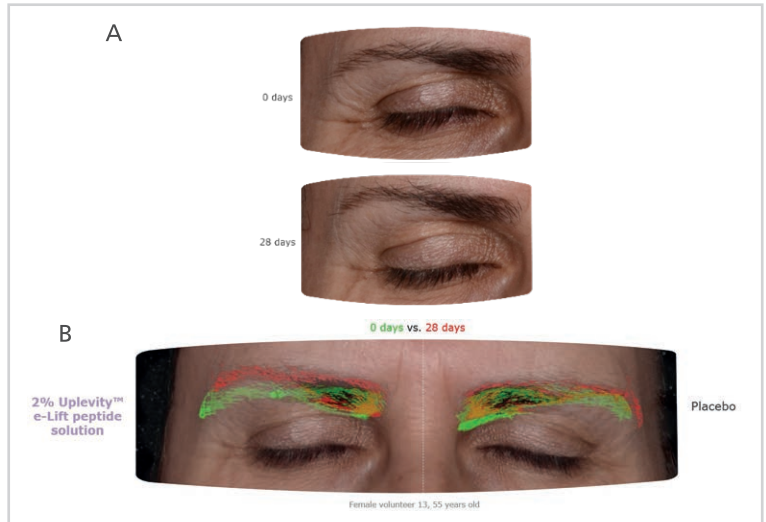
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end of the eyebrow arch was drawn. The longer the distance, the greater the eyebrow lift. The active cream containing 2% peptide solution improved eyebrow lift after 28 days of product application by 2.3% in a statistically significant manner, when compared to initial time. Furthermore, the eyebrow lift efficacy was very similar to the group using the microcurrent device. Finally, we superimposed the before and after images to visually evaluate the difference in the eyebrow position induced by the treatment. As seen in **Figure 1B**, the eyebrow was at a higher position after 28 days of active cream treatment (red) versus initial time (green).

Next, we quantified the eyelid lifting effect. This was measured from 2D images generated by Framescan, where the distance between the base of the eyelashes to the upper eyelid fold was measured. The longer the distance, the more lifted the upper eyelid. A cream containing 2% peptide solution improved the eyelid lift by 6.1% in a statistically significant manner, when compared to initial time, with an even better performance than the group using the microcurrent device (**Figure 2**).

Finally, the lifting of the crow's feet and upper cheek regions were calculated from facial 3D images obtained with Quantificare LifeViz® software, coupled with proprietary Lubrizol computer vision techniques. Using the Quantificare LifeViz® software, firstly the 3D images from the initial and final time points were overlapped. Then, the software created facial images with arrows on the skin surface, which represented the direction and amount of the skin movement between times of measurements (**Figure 3A**). However, this approach does not generate an average value for the lifting effect. To solve this, the Lubrizol R&D team developed a proprietary computer vision technique. It performed 3D imaging processing data analysis and detected and quantified almost 7000 arrows from the images obtained in the facial areas of interest. For each volunteer and facial area, the

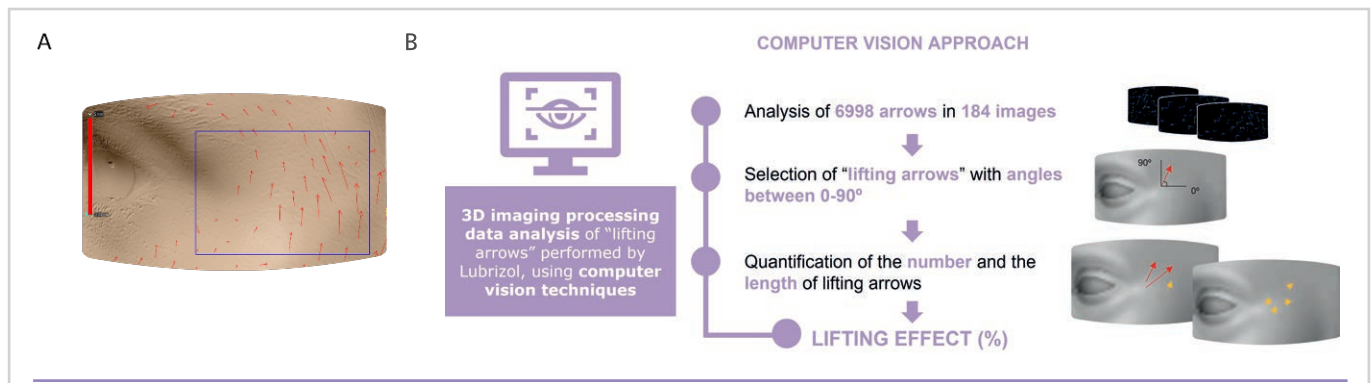


**Fig.1** **A)** Representative images showing eyebrow lifting effect after the use of a cream containing 2% peptide solution for 28 days **B)** Superimposed images showing the upper position of the eyebrow after active and placebo cream application versus initial time.

number of arrows contributing to a lifting effect (arrows between 0 and 90 degrees of orientation) and the length of the arrows was quantified. The % Lifting effect was calculated considering the number of arrows multiplied by their mean length for each facial zone versus the placebo cream (**Figure 3B**).

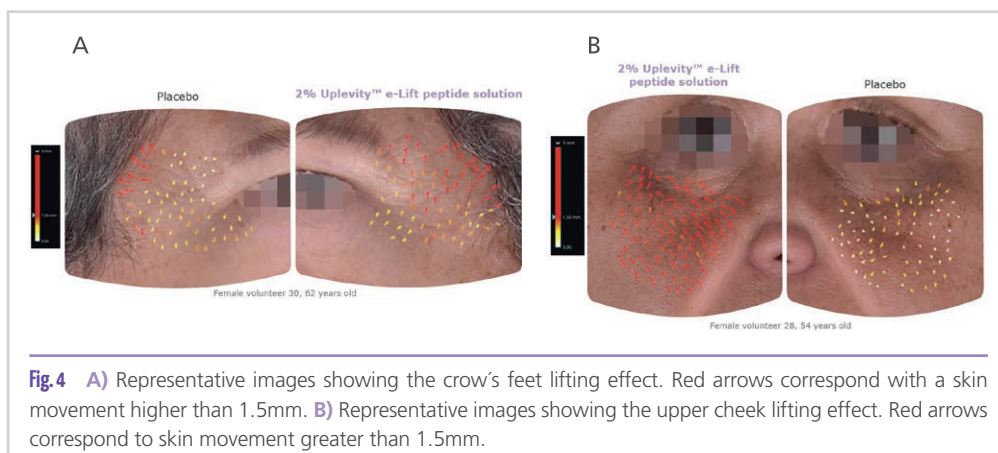


**Fig.2** Representative images showing the eyelid lifting effect after 28 days of active cream application containing 2% peptide solution (upper panel) and after microcurrent device use (lower panel).

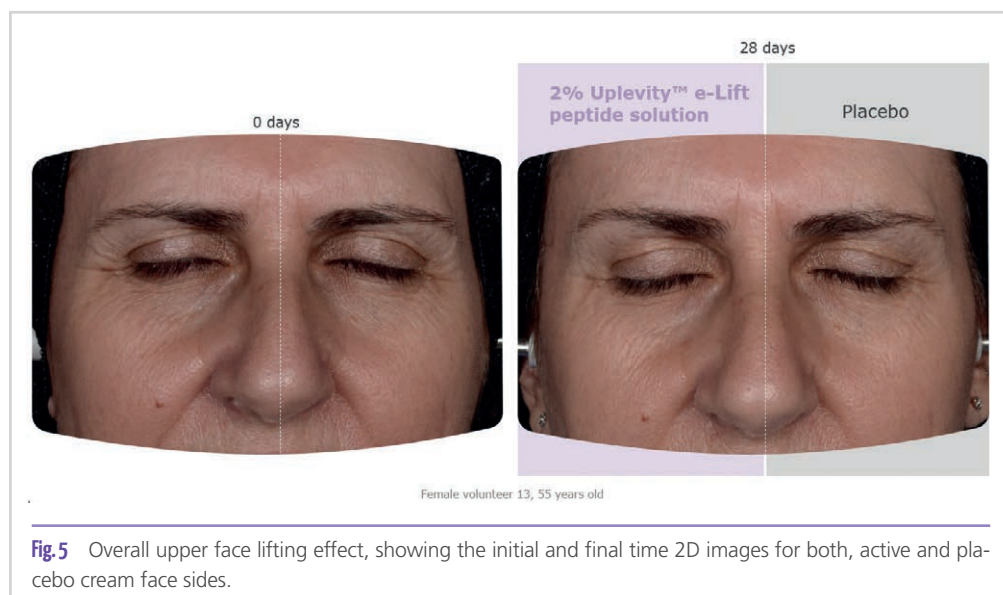


**Fig.3** **A)** Example image of arrows representation over the skin surface, showing the direction and amount of the skin movement between the initial time and the final time of measurement. **B)** Lubrizol R&D Team's computer vision approach to quantify the % Lifting effect.

A cream containing 2% peptide solution generated a lifting effect in the crow's feet area, which can be appreciated by the greater number of upward red arrows over the skin surface on the active cream side of the face versus the placebo side (Figure 4A). Using the computer vision approach, this increase in lifting was quantified to be 16.3% versus placebo cream. Moreover, treatment with the active ingredient showed even better performance than the group using the microcurrent device over the same period. Similarly, in the upper cheek area, the side of the face corresponding to the active cream treatment showed a greater number of upward red arrows compared to the placebo side, where fewer red arrows were found (Figure 4B). With the computer vision technique, the upper cheek lifting effect was determined to be 94.6% versus placebo cream. This effect was similar to the group applying the microcurrent device.



**Fig. 4** A) Representative images showing the crow's feet lifting effect. Red arrows correspond with a skin movement higher than 1.5mm. B) Representative images showing the upper cheek lifting effect. Red arrows correspond to skin movement greater than 1.5mm.

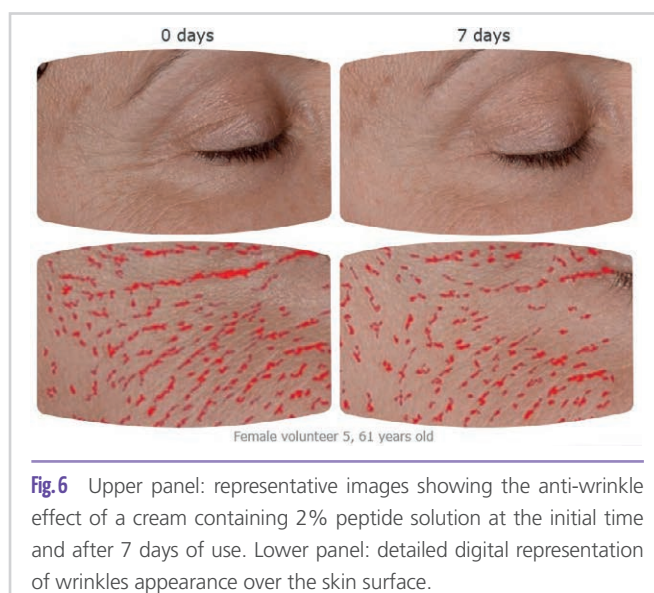


**Fig. 5** Overall upper face lifting effect, showing the initial and final time 2D images for both, active and placebo cream face sides.

A visible lifting effect on the upper face treated with the active cream containing 2% peptide solution versus the initial time is clearly noticed after 28 days of product application, whereas no lifting effect was detected on the placebo side (Figure 5).

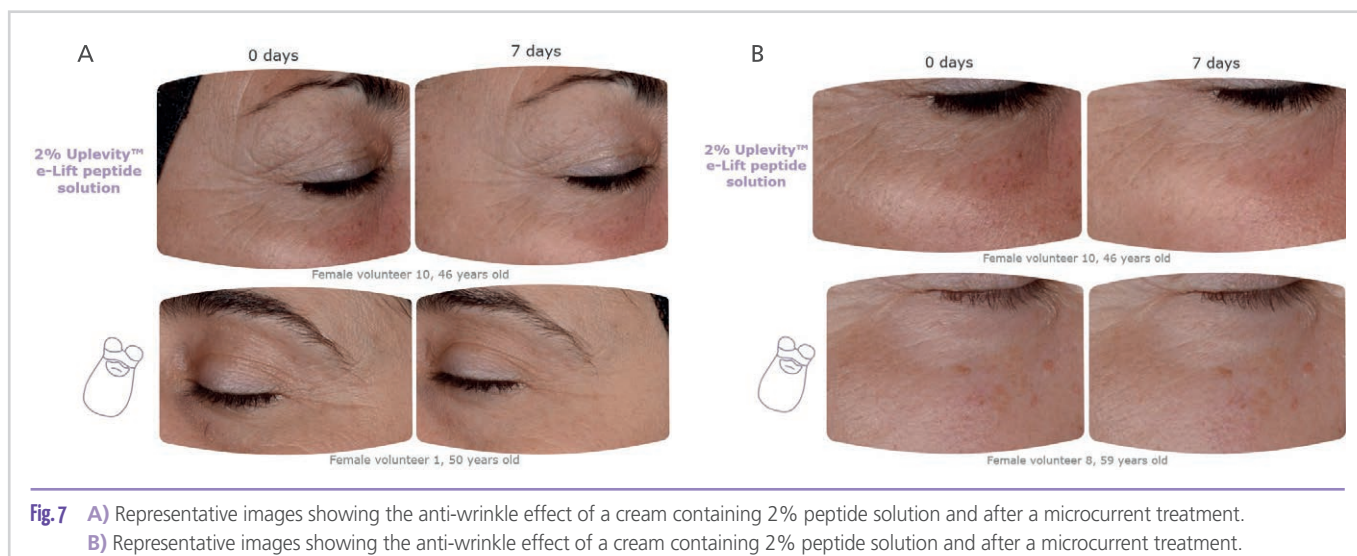
**Anti-wrinkle efficacy of the peptide.**

Visibility of wrinkles was evaluated by Framescan imaging after 7 days of use of a cream containing 2% peptide solution or the placebo cream. Treatment with the active cream showed a reduction of -5.9% in the visibility of wrinkles versus the initial time, which was similar to the group using the microcurrent device. This anti-wrinkle effect can be noticed in the crow's feet region (Figure 6), in which there is a clear reduction of red pixels representing the extension of the wrinkles over the skin surface.



**Fig. 6** Upper panel: representative images showing the anti-wrinkle effect of a cream containing 2% peptide solution at the initial time and after 7 days of use. Lower panel: detailed digital representation of wrinkles appearance over the skin surface.

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**Fig. 7** A) Representative images showing the anti-wrinkle effect of a cream containing 2% peptide solution and after a microcurrent treatment. B) Representative images showing the anti-wrinkle effect of a cream containing 2% peptide solution and after a microcurrent treatment.

In addition, length of the wrinkles ( $\mu\text{m}$ ) in the crow's feet region and underneath the eye was measured by means of a real 3D microtopography imaging system based on fringe projection (PRIMOS) after 7 days of product treatment. The active cream containing 2% peptide solution showed a reduction of the length of wrinkles in a statistically significant manner in both facial zones by -13.1% and -9.6%, respectively. These efficacy results were very similar to the anti-wrinkle improvements found in the group using the microcurrent device. Moreover, a visual improvement of wrinkles can be visualized from the facial images (**Figures 7A and 7B**) after 7 days of treatment with the active cream containing 2% peptide solution, as well as after the use of the microcurrent device over the same period of time.

## Conclusions

Uplevity™ e-Lift peptide emerges as an innovative topical active ingredient which confers a rejuvenated lifting and anti-wrinkle effect, inspired by microcurrents devices. In vitro, Uplevity™ e-Lift peptide has been demonstrated to activate the same biological functions as microcurrent stimulation: improving dermal contraction and muscle tone. Clinically, Uplevity™ e-Lift peptide confers an upper facial lifting effect in combination with anti-wrinkle benefits after 28 days and 7 days of product treatment, respectively. It has been shown to enhance eyebrow, eyelid, crow's feet and upper cheek lifting leading to a "triorbital" skin lifting effect. Furthermore, the peptide reduces the severity of the visibility of wrinkles in the crow's feet region and underneath the eye. In conclusion, Uplevity™ e-Lift peptide is an ideal solution for an overall upper face lifting appearance, inspired by the skin benefits provided by at-home microcurrents devices and showing a similar rejuvenating efficacy.

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# Givaudan Active Beauty Portfolio Grows with Microbiome-friendly Ingredients

## *Givaudan Active Beauty's commitment to certified excellence*

C. Zanchetta, P. Robe, C. Jarrin

### Introduction

With several years of experience in the field of microbiomics, Givaudan Active Beauty continues to pioneer the development of active cosmetic ingredients that activate, protect, or balance the skin microbiota.

In this pursuit, Givaudan is keen to continue introducing innovative solutions that leverage microbiome data to empower customers and consumers. Included among the most recent offerings from Givaudan Active Beauty include a raft of microbiome-friendly ingredients ideal for a range of applications, all of which are sustainably produced, crafted from green fractionation or white biotechnology. These include PrimalHyal™ Hydra[+], a powerful sustainable hyaluronic acid; Mangixyl™ for sebum control and Xyliance™, a natural emulsifier derived from sustainable sources. This portfolio reflects Givaudan's commitment to advancing skincare through sustainable technology whilst fostering a deeper understanding of the skin's microbiome to promote transformative beauty solutions.

In a deeper exploration of Givaudan's innovative approach, the first part of this article explains Givaudan's B-Biome™ Score – a transparent methodology for assessing microbiome impact. The second part showcases the most recently scored active ingredients from Givaudan Active Beauty: PrimalHyal™ Hydra[+], Mangixyl™ and Xyliance™.

### Part I: The B-Biome™ Score: a transparent methodology for assessing microbiome impact

Around 69% [1] of consumers now understand that when the skin microbiome is out of balance, it can result in issues such as acne-prone, sensitive or dry skin. Consumers are seeking microbiome-approved cosmetics and body care to treat these issues. However, the regulatory landscape for microbiome-friendly product labelling and certification is fragmented, characterised by divergent certification systems that do not consistently adhere to stringent scientific scrutiny, making it hard for consumers to navigate.

As existing labelling systems often fell short of Givaudan's scientific standards, and the beauty industry lacked a shared definition of what constitutes 'microbiome-friendly', Givaudan Active Beauty developed the B-Biome™ Score, a pioneering certification tool for assessing the impact of cosmetic ingredients on the skin microbiome.

The B-Biome™ Score, dermatologically approved and scientifically peer-reviewed, evaluates ingredients based on short-term impact, cumulative effects, and microbial viability resilience after use. The score was developed by determining the 'friendliness' of potential microbiome ingredients, using benchmark tests and two compounds that were trialled on volunteers. A neutral compound respecting live bacteria was used, in the form of physiological saline. This was contrasted with chlorhexidine, a broad-spectrum antibiotic which kills bacteria and has a mildly disturbing effect on the skin. As a marker, physiological saline was given the microbiome-friendly score of 'A' and chlorhexidine was given a significantly lower microbiome-friendly score of 'E'.



Now released to the beauty industry, the transparent scoring system (A to E) has gained widespread recognition, with 84% of Givaudan customers acknowledging its appeal. Certificates for each ingredient, available on Givaudan's Active Beauty Lab, include certification date, experimental details, the global B-Biome Score™ and kinetic results and are designed to enhance skincare accuracy and empower industry professionals and con-



sumers. The B-Biome™ Score is progressively being integrated into Givaudan's entire Active Beauty ingredient portfolio.

## Part II: Key active ingredients

Currently, ingredients certified for Givaudan Active Beauty's B-Biome™ Score include PrimalHyal™ Hydra[+], Brightenyl® and Yogurtene® Balance, which have been developed using white biotechnology, as well as Patchoul'Up™ and Mangixyl™, developed using green fractionation, alongside the functional ingredient and emulsifier, Xyliance™. This article explains the significance of these innovations and underscores their relevance for consumers in search of microbiome-friendly products.

### PrimalHyal™ Hydra[+] sets the standard for hydration and microbiome safety

In the anti-aging field, hyaluronic acid is coveted for its plumping properties. Givaudan Active Beauty developed a cationic hyaluronic acid, PrimalHyal™ Hydra[+] which sets a new benchmark in hydration, showcasing superior performance compared to other native hyaluronic acid grades. This unique cosmetic active enhances adhesion and affinity for the skin's surface, delivering unparalleled moisturising efficacy for both rinse-off (e.g., shower gel) and leave-on applications (lotions, sheet masks). Developed using white biotechnology, PrimalHyal™ Hydra[+] achieves 'A' on the B-Biome score, akin to ultra-mild physiological saline, indicating minimal disturbance to the skin – a noteworthy achievement given the ingredient's potency. Given the widespread global demand for hyaluronic acid, and its prominence across beauty categories, the significance of the microbiome-safety of PrimalHyal™ Hydra[+] combined with its potency, is welcome.

### Clinical testing insights for PrimalHyal™ Hydra[+]

PrimalHyal™ Hydra[+] has just 0.1% concentration, yet provides instant hydration and is effective in both rinse-off and leave-on formulations. Prolonged use reinforces the skin barrier by increasing lipid and protein production, ensuring enduring hydration benefits. These benefits persist for up to four days post-treatment cessation establishing a new standard in skincare through white biotechnology. Numerous clinical tests versus a placebo, spanning diverse application formats, substantiate the exceptional attributes of PrimalHyal™ Hydra[+] at this minimal concentration. This leading-edge innovation exemplifies Givaudan Active Beauty's commitment to setting new benchmarks in skincare through white biotechnology, whilst respecting the delicate skin microbiome.

Thanks to its optimal coverage of the skin, PrimalHyal™ Hydra[+] outperforms the benefits of 'standard' grades of hyaluronic acid in leave-on formats:

- instant moisturising effect after just one shower (more than +11% vs placebo);
- flash hydration in a lotion (×2.6 vs placebo), improving over time;
- improvement of the barrier function in a mask format, with impressive moisturisation boost (up to +100% in just 1 application vs T0); and
- proven long-lastingness for up to four days after stopping the treatment.

### Mangixyl™: A sustainable breakthrough for microbiome-friendly sebum control

In another pivotal innovation, Mangixyl™, a green fractionation breakthrough, has emerged as a microbiome-friendly natural sebum harmoniser, acting on oily skin. Approximately 70% of individuals [2] with oily skin express daily concerns about its impact on self-confidence and social interactions. To address this, Mangixyl™ serves as a solution that goes beyond traditional methods of tackling oily skin, such as applying mattifying powders: these often require frequent application throughout the day and can result in visible product build-up on the face.

Mangixyl™, discovered during the bio-guided fractionation of mango leaves, originates from a responsibly sourced and sustainable supply chain in Burkina Faso, West Africa. It stands out among Givaudan Active Beauty's active ingredients for its sustainable community-supporting process and inclusive skincare applications.

Operating through the retinoic acid and PPAR $\gamma$ -regulated genes pathway, Mangixyl™ interacts with specific receptors, reducing lipid synthesis *in vitro*, *ex vivo*, and *in vivo* across all ethnicities. Clinical data further showcases its efficacy in addressing oily skin, regulating scalp sebum, and maintaining microbiome balance. With a B-Biome Score of 'B', Mangixyl™ effectively regulates sebum production, resulting in a 15.9% reduction after one month and a 49.5% improvement in sebum quality.

### Mangixyl™ significantly reduces sebum production (*in vitro*)

Sebocytes were exposed in a 2D culture model to a lipogenic mix stimulating sebum overexpression.

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Cells were then treated with one of the following ingredients:

- reference (Olumacostat glasaretil, at 1µM)
- Mangixyl™ at 0.3%
- pure mangiferin tested at the same amount as contained in Mangixyl™ (5.7µg/ml).

The lipids content was measured by Bodipy® fluorescent probe after seven days. Results: Mangixyl™ at 0.3% significantly reduces lipogenesis by -40%, better than the reference.

Conducted across three ethnicities – Europe (15 women), China (20 women), and South Africa (20 women) – three double-blind clinical studies tested Mangixyl™ against a placebo. Sebum quantity measurements on the cheek and nose areas using a sebumeter or sebuxif apparatus revealed Mangixyl™’s effectiveness. The tested cream, containing 1% Mangixyl™ for Caucasian volunteers and 2% for Asian and African volunteers, demonstrated a substantial reduction in sebum quantity within one month, reducing shininess and enhancing confidence and quality of life. Even in comparison to retinoids, which are widely employed for managing shininess and regulating oily skin, Mangixyl™ demonstrates significant efficacy at a 0.3% concentration. Particularly noteworthy is its substantial impact on reducing sebum production, showcasing up to 90% reduction on Caucasian sebocytes and commendable effectiveness on Asian and African sebocytes. Mangixyl™ serves as a potent inhibitor of sebum overproduction (lipogenesis), surpassing retinoic acid in overall efficacy. These findings position Mangixyl™ as an advanced solution for controlling oily skin, outperforming conventional alternatives such as retinoids.

The impact of Mangixyl™ extends beyond skincare to the sourcing process, exemplified by the collaboration with the Association Bendia in Burkina Faso. This women-led initiative, based on volunteering, not only facilitates the harvest and selection of mango leaves but also improves the daily lives of workers. Young women manage the harvest, while older women oversee the selection, drying, and stirring processes. This initiative has provided employment and enabled access to healthy food and drinkable water, providing continuous development for the community, based in Koro village.

### Microbiome-friendly emulsification with Xyliance™

Finally, Givaudan Active Beauty developed Xyliance™, a natural emulsifier derived from renewable sources, aligning with Givaudan’s commitment to functional ingredients backed by scientific rigour. Approved by Ecocert/Cosmos, Xyliance™ is a polyvalent non-ionic surfactant, requiring no co-emulsifiers, and is approved for emulsifying a diverse range of oil phases. This versatile emulsifier demonstrates exceptional stability even in formulations with high oil content, supporting emulsification up to 50% oil. Notably, Xyliance™ maintains stability across a broad pH spectrum (pH 2 to 12) and is compatible with various cosmetic ingredients, including sunscreens and dihydroxyacetone.

### Emulsifying properties of Xyliance™

► Ability to emulsify vegetable oils as well as silicones.

Vegetable oils	Xyliance™ at 4%
Sweet almond	up to 10%
Macadamia	up to 30%
Cotton	up to 20%
Grapeseed	up to 30%
Joboba	up to 5%
Caprylic/Capric Triglycerides	up to 50%
Silicones	Xyliance™ at 5%
Cyclomethicone	up to 10%
Dimethicone	up to 10%

Table. 1

Additionally Xyliance™ boasts a B-Biome™ Score of ‘A’, making it a microbiome-friendly option. Furthermore, Xyliance™, with the unique advantage of compatibility with a wide range of cosmetic ingredients, can be seamlessly integrated into formulations at concentrations of up to 5%, all while ensuring full respect for the skin’s microbiota (Table 1). This functional emulsifier also contributes beneficial sensory features to formulations, delivering a white, unctuous emulsion with a soft and non-tacky after-feel, highlighting its versatility and microbiome-respecting attributes in cosmetic applications.

### Paving the way for industry-wide innovation

The B-Biome™ Score will be extended across Givaudan’s entire portfolio. This transparent certification offers a valuable reference for all industry players dealing with ingredients or finished formulas and is designed to promote collaboration within the skincare industry. As a scientifically proven evaluation method, the B-Biome™ Score will also empower consumers to make informed choices tailored to their unique skin characteristics. The B-Biome™ Score will highlight microbiome-friendly ingredients, addressing diverse skincare needs, enabling consumers to optimise and care for their skin health in the long term.

### References:

- [1] Givaudan Global Consumer Study Skin Microbiome – November 2018
- [2] Source: Givaudan internal CMI study, unpublished data.

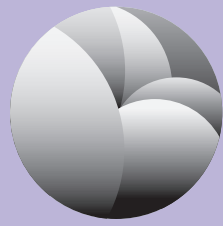
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# Multifunctionals Empowered

## Part 1

B. Koroskenyi, J. Salmen, M. T. Fontan Yanes

### abstract

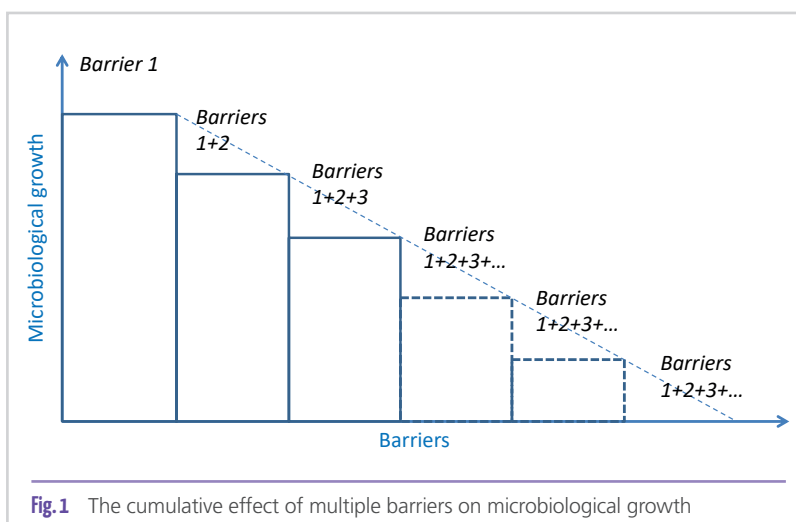
**Symshield®**, also known as barrier technology or hurdle technology, is a concept of combining several physical or chemical factors aiming at inhibiting microbial growth. This systematic approach has been proven successful as it strengthens the microbiological product protection systems of cosmetic formulations, thus ensuring long-term product quality and safety. Relying on this technology, multifunctional ingredients are often used in combination with preservatives or other antimicrobial enhancers and are commonly applied as part of the product protection system. While typically chemical ingredients are used as barriers in these combinations such as organic acids, chelating agents, surfactants, etc., it is important not to overlook the possible beneficial effects of physical parameters. Ultimately, this extensive approach has the potential to create a more robust product protection system or even lower the necessary use level of traditional antimicrobial compounds in the formula. In this series of publications, we present studies to demonstrate how the antimicrobial product protection effectiveness of multifunctional cosmetic ingredients, which are known product protection enhancers, can be optimized by combining them with additional barriers, such as pH, water activity, organic acids, chelating agents, etc. In the first part of the series, we examine the effect of pH and organic acids.

### Introduction

It is scientific general knowledge that microorganisms need a certain amount of water to stay alive and function. Most personal care formulations are water-based systems or contain enough water to be susceptible to microbial growth. Microbial proliferation can have several undesired consequences, making the effective preservation of cosmetic formulations critical to alleviate safety concerns and to maintain product quality. Various strategies exist to protect formulations [1]. Traditionally, preservatives have been used to counteract the growth of microorganisms. As some preservatives have come under increased scrutiny, there has been a growing interest in alternative preservation technologies aiming at reducing the amount of preservatives in personal care products where possible.

The need to prevent spoilage of foods is a quest as old as mankind itself. Personal care represents a relatively young field, but one with strikingly similar concerns, needs, and solutions. It is not uncommon to see concepts that are successful in preserving food find applications in personal care products. Akin to some other trends and methods, barrier technology, also dubbed “combination technology” or “hurdle technology”, has also been adopted from food preservation to cosmetics product protection [2,3].

As its name suggests, the concept of barrier or hurdle technology entails applying various obstacles concurrently to inhibit or retard microbial growth in a formulation [4]. Even though the single barriers are not strong enough alone, the cumulative effect of several can provide sufficient product protection. In fact, some combinations have the potential to reduce or even eliminate the need for using traditional preservatives in the formula. The number of combinations can be as little as two barriers or more, depending on the efficacy of the individual barriers and the possible synergism between them (Figure 1).



Modern product protection addresses a multitude of requirements coming from different directions within the cosmetic industry: formulators, consumers, and regulatory bodies. While formulators look for lean, effective, and cost-conscious solutions that meet local and regional regulatory rules, consumers demand robust and reliable protection that will not diminish the safety or sensorial quality of the market product. Cultural preferences also need to be considered. Multifunctional ingredients are ideal in this respect as they offer the versatility to potentially meet all of these requirements. Due to their multiple benefits in cosmetic formulations, such as solubilization, emulsion stabilization, wetting, etc., just to name a few, they are excellent choices for minimalist formulas. The use of multifunctionals in the cosmetic industry has been growing rapidly in recent years. 1,2-Alkanediols, a very important chemical class of multifunctional ingredients, have seen increasing interest, particularly from formulators. They are known to have a stronger effect on inhibiting microbial growth with increasing chain length. Pentylene glycol, 1,2-hexanediol, and caprylyl glycol are mainly used as support/enhancers in modern product protection. 1,2-Heptanediol, a most recent addition to the multifunctionals product range on the cosmetic market, has significant potential due to its optimum chain length for the greatest efficacy while retaining a liquid form at normal temperatures.

The great additional benefit of multifunctionals is that they can enhance microbiological protection. They can be very effective at supporting the product protection system, in some cases even in the absence of traditional preservatives. Another option is to combine them with preservatives resulting in a more robust protection or even lower effective use levels. Such premixed commercial blends have long been available on the market and are great examples of barrier technology in practice. It is intuitive to recognize the potential of multifunctionals as important elements of this technology representing one of the possible barriers.

In general, the barriers that inhibit or retard microbial growth can be physical methods, often environmental conditions, such as temperature, treatments, or sterile packaging, or chemical methods, such as adding preservatives, multifunctionals, or other ingredients, or varying the acidity/alkalinity.

The combination of barriers discussed in this article excludes preservatives other than organic acids and focuses on how multifunctional ingredients can be combined with other barriers to afford alternative product protection systems.

## pH

Selecting the right pH for a formulation is critical as it has a significant effect on various aspects of the product, such as a) stability of the formulation, b) function of certain ingredients, c) sensory properties, d) esthetics, and e) skin irritation potential. In addition, acidity or alkalinity can have a profound effect on biological systems and ultimately on the survival of microorganisms. This is especially relevant in the extremes as microorganisms have distinct pH tolerance regions. Bacteria are generally more sensitive to variations of pH, while fungi tend to be more resilient. Even though the natural skin pH is most commonly 4.7 [5] with variations based on the individuals, health, and environmental conditions, most personal care products have a pH close to 5.5.

## Organic acids

Organic acids are widely used in cosmetics to support the product protection system. They are included in the positive list of Annex V (allowed preservatives) of the European Cosmetics Regulation, as well as other regulations. The most common organic acids used in cosmetics today are benzoic acid and sorbic acid. Other acids, such as natural phytic acid, can also be found in some formulas. Organic acids are neutral molecules that can dissociate into an ionized form. Through this process, they can protonate other molecules or ions. Their mode of action is protonation inside the cytoplasm of microorganisms, which disrupts cellular metabolism [6]. For the acids to be effective, they have to be able to diffuse across the cell membrane. Due to the lipid bilayer composition of the membrane, only neutral molecules are able to diffuse across. Therefore, the acid must be in its neutral, non-dissociated form. Consequently, the efficacy of organic acids diminishes above their  $pK_a$ .

## Experimental

### Materials:

The multifunctionals used were Hydrolite® 5 green (Pentylene Glycol), Hydrolite® 6 (1,2-Hexanediol), Hydrolite® 7 green (1,2-Heptanediol), Hydrolite® CG (Caprylyl Glycol), SymDiol® 68 (Caprylyl Glycol and 1,2-Hexanediol), and SymSave® H (Hydroxyacetophenone) from Symrise.

### Microbial challenge tests:

The microbial challenge tests were performed according to the standards proposed by the Personal Care Products Council (PCPC) and European Pharmacopoeia (E. Ph., 1996) methods.



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### Emulsion preparation

The challenge tests were performed using an O/W emulsion according to **Table 1**. Phase A and C were heated separately to 80°C. Phase B was dispersed in A, followed by adding Phase AB to C and emulsifying using an Ultra Turrax Stirrer (3 min/ 6000 rpm) until the emulsion was homogeneous. It was allowed to cool by using a vane stirrer. The pH value was set with Phase D.

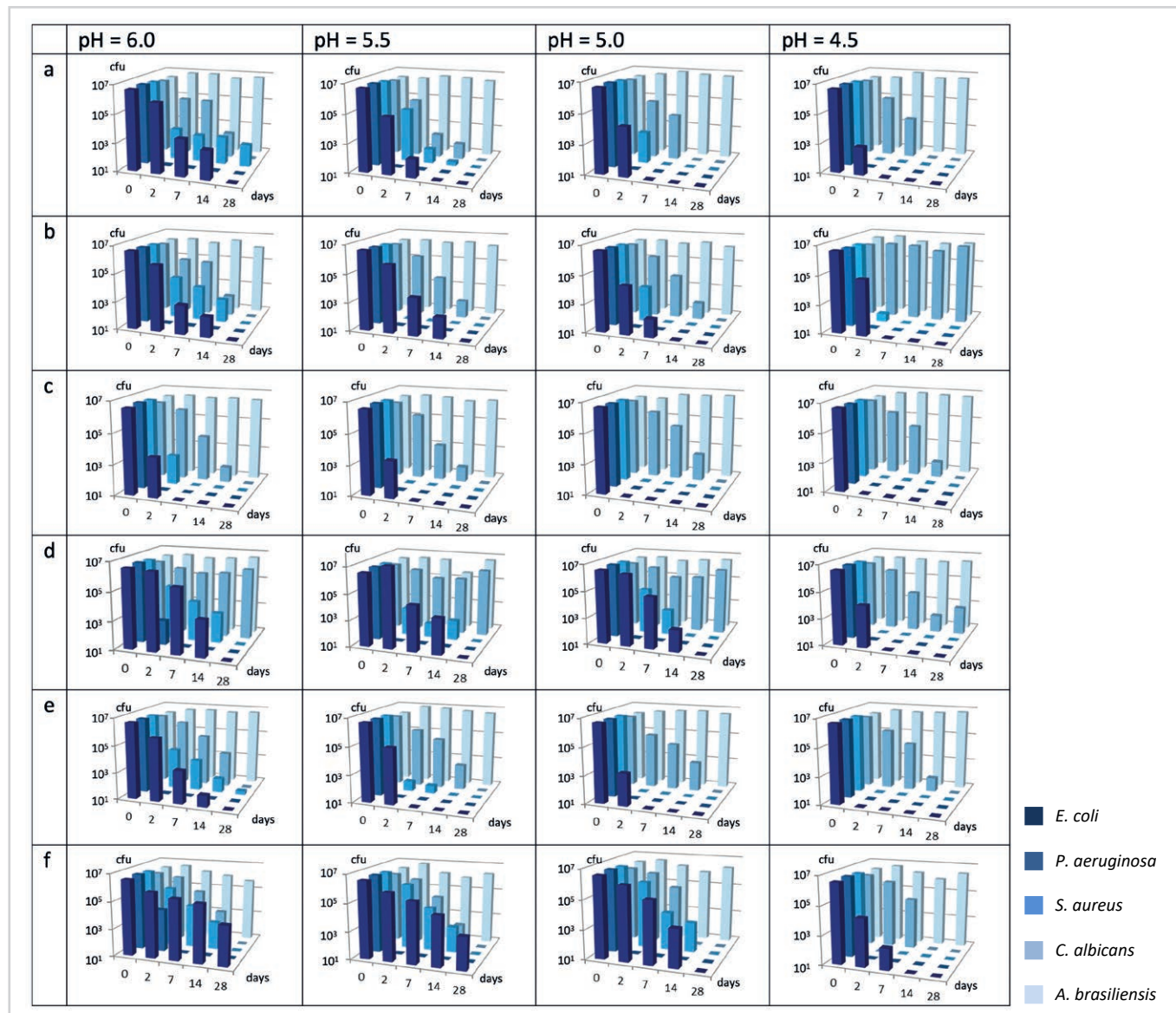
### Results

The impact of the different barriers varies. It is important to examine them one by one. Multifunctional ingredients are very effective barriers to microbiological proliferation and are a good choice in many multicomponent product protection systems. When favorably combined

with other barriers, smart combinations may allow the use of lower concentrations of multifunctionals while still achieving similar efficacies.

	Raw Material	INCI	w/w %
A.	Emulsiphos® (#677660)	Potassium Cetyl Phosphate, Hydrogenated Palm Glycerides	2.00
	Cutina PES ex. BASF	Pentaerythrityl Distearate	1.50
	Cutina GMS ex. BASF	Glyceryl Stearate	1.50
	SymMollient® S (#181598)	Cetearyl Nonanoate	3.00
	Neutral oil (#192060)	Caprylic/ Capric Triglyceride	7.00
	Dragoxat® 89 (#109854)	Ethylhexyl Isononanoate	3.00
B.	Keltrol CG ex. CP Kelco	Xanthan Gum	0.15
	Aristoflex AVC	Ammonium Acryloyldimethyltaurate/VP Copolymer	0.50
C.	Water dem.	Water (Aqua)	q.s.p. 100
	Multifunctional		X
	SymSave® H	Hydroxyacetophenone	0.60
	Glycerin 99,5%	Glycerin	1.00
D.	Sodium Hydroxide, 10% sol.	Sodium Hydroxide	q.s.
	Citric acid 30% sol.	Citric Acid	q.s.
	SUM		100.00

**Table 1:** O/W anionic emulsion formula



**Fig. 2** The cumulative effect of pH. a) 3% Pentylene Glycol; b) 1% 1,2-Hexanediol; c) 0.3% Caprylyl Glycol; d) 0.3% 1,2-Hexanediol/Caprylyl Glycol; e) 0.3% 1,2-Heptanediol; f) 0.2% 4-Hydroxyacetophenone.

### Effect of pH

A range of multifunctional ingredients was looked at, including various 1,2-alkanediols and Hydroxyacetophenone. The study was limited to a practical working pH range of 4.5 to 6.0. Although there are cosmetic formulations with lower (down to 4.2) and higher (up to 8.5) pHs, they represent a small fraction of commercial products. To maintain skin balance, most formulations tend to be close to pH 5.5.

Challenge test results show that pH is a very effective barrier in all cases. There is a gradual reduction of the count for both bacteria and fungi with the most obvious and sometimes apparently somewhat abrupt change between pH 5.0 and 4.5 (Figure 2).

Multifunctionals have a dose-dependent effect on microbial growth, as already known. With pH being an additional barrier, lower concentrations of multifunctionals are required at lower

pH values compared to neutral pH. This observation was validated using different multifunctionals: Pentylene Glycol (Figure 3), 1,2-Hexanediol (Figure 4), 1,2-Heptanediol (Figure 5), Caprylyl Glycol (Figure 6), and Hydroxyacetophenone (Figure 7). They also exhibit the same trend.

As expected, the effect of pH value is more apparent at low enough multifunctional concentrations where the ingredient itself does not have a strong effect, but high enough concentrations for the multifunctional to be able to act as a barrier.

Combined with pH as a barrier, the tested multifunctionals are able to inhibit microbial growth at much lower concentrations than their general recommended use level. Therefore, adjusting the pH of the formulation can be an effective tool for a formulator. Smart combinations include a stronger barrier for fungi to achieve complete protection.

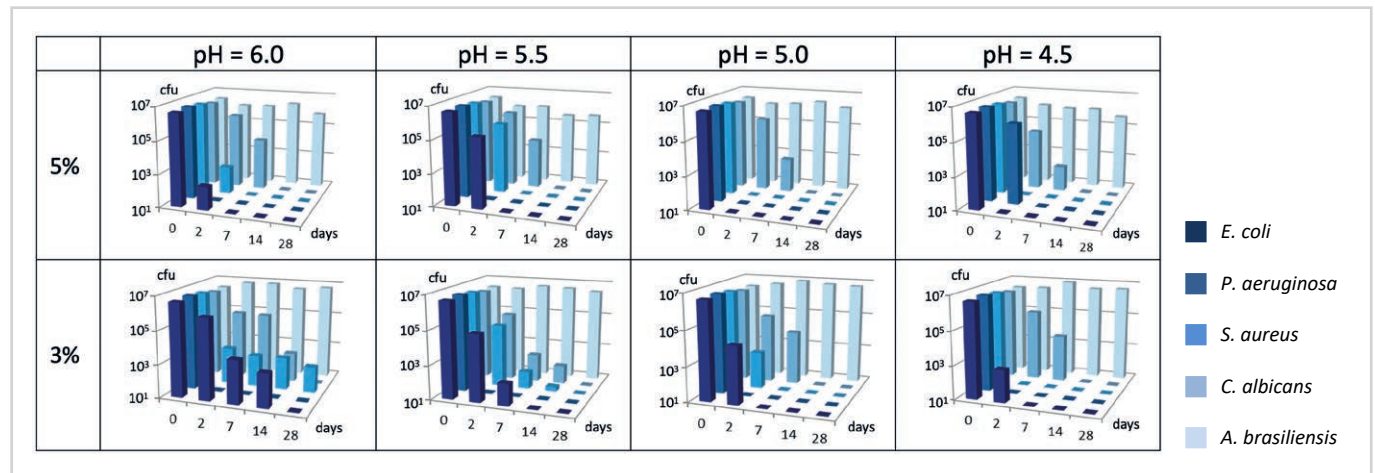


Fig.3 Effect of pH and concentration of Pentylene Glycol on microbial growth.

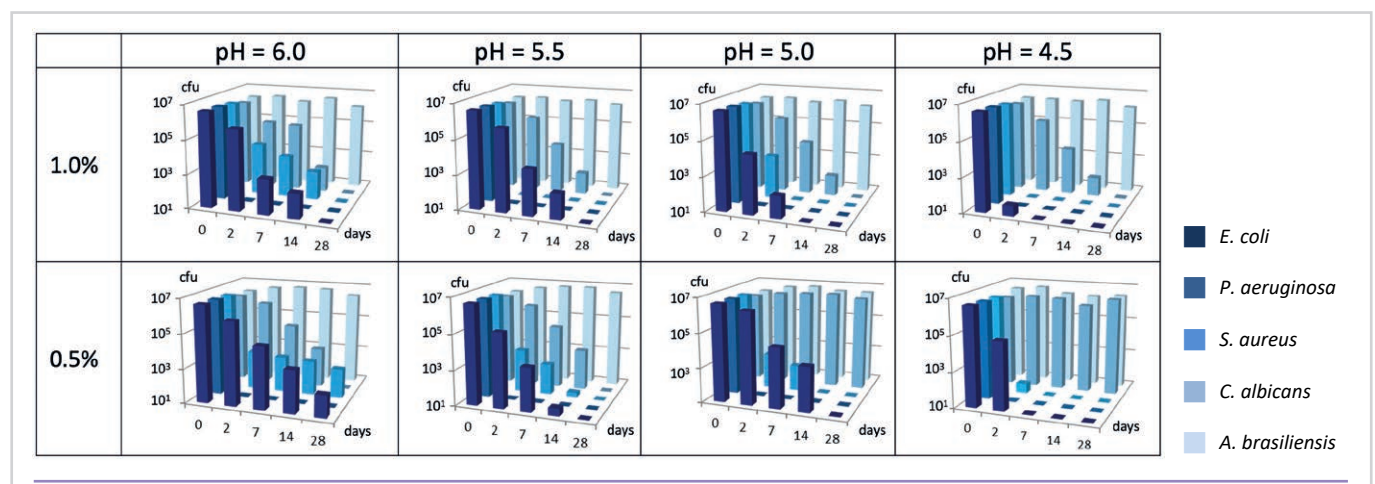


Fig.4 Effect of pH and concentration of 1,2-Hexanediol on microbial growth.

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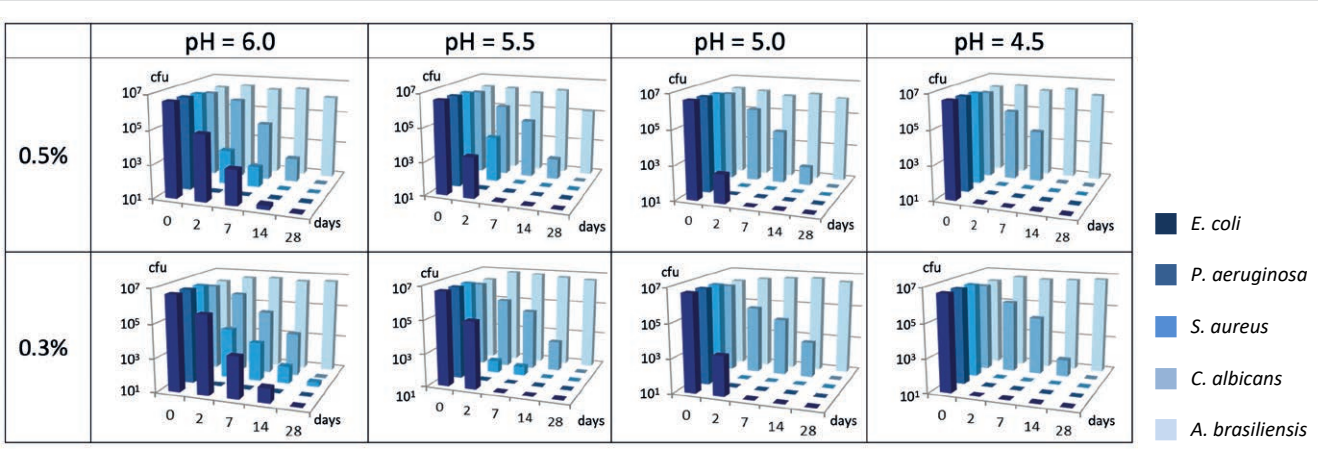


Fig.5 Effect of pH and concentration of 1,2-Heptanediol on microbial growth.

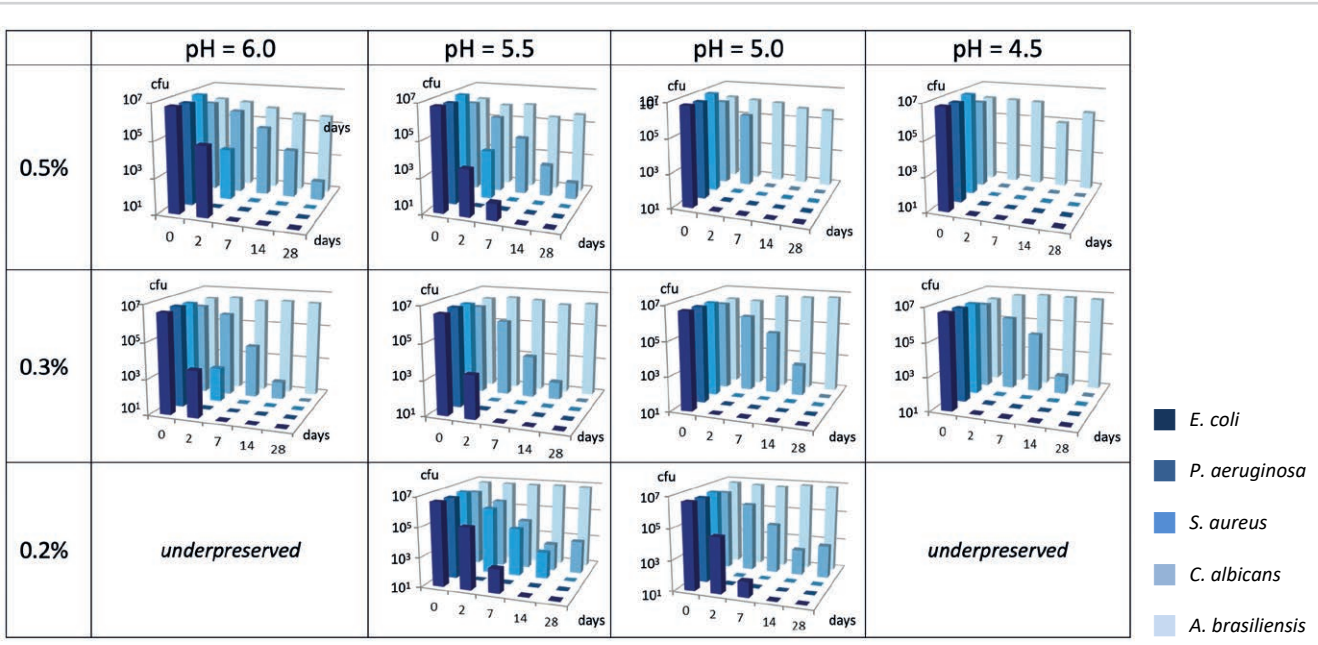


Fig.6 Effect of pH and concentration of Caprylyl Glycol on microbial growth.

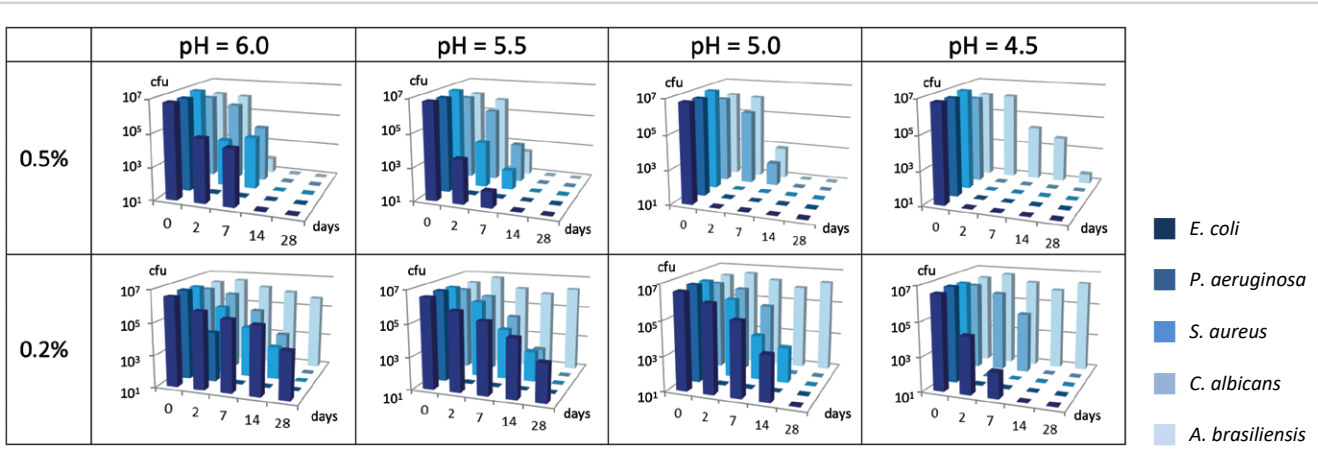


Fig.7 Effect of pH and concentration of Hydroxyacetophenone on microbial growth.



	pK <sub>a1</sub>	pK <sub>a2</sub>	pK <sub>a3</sub>	pK <sub>a4</sub>	pK <sub>a5</sub>	pK <sub>a6</sub>	pK <sub>a7</sub>	pK <sub>a8</sub>	pK <sub>a9</sub>	pK <sub>a10</sub>	pK <sub>a11</sub>	pK <sub>a12</sub>
Phytic acid	1.1	1.5	1.5	1.7	2.1	2.1	5.70	6.85	7.60	10	10	12

**Table 2** pK<sub>a</sub> values of Phytic Acid [7]

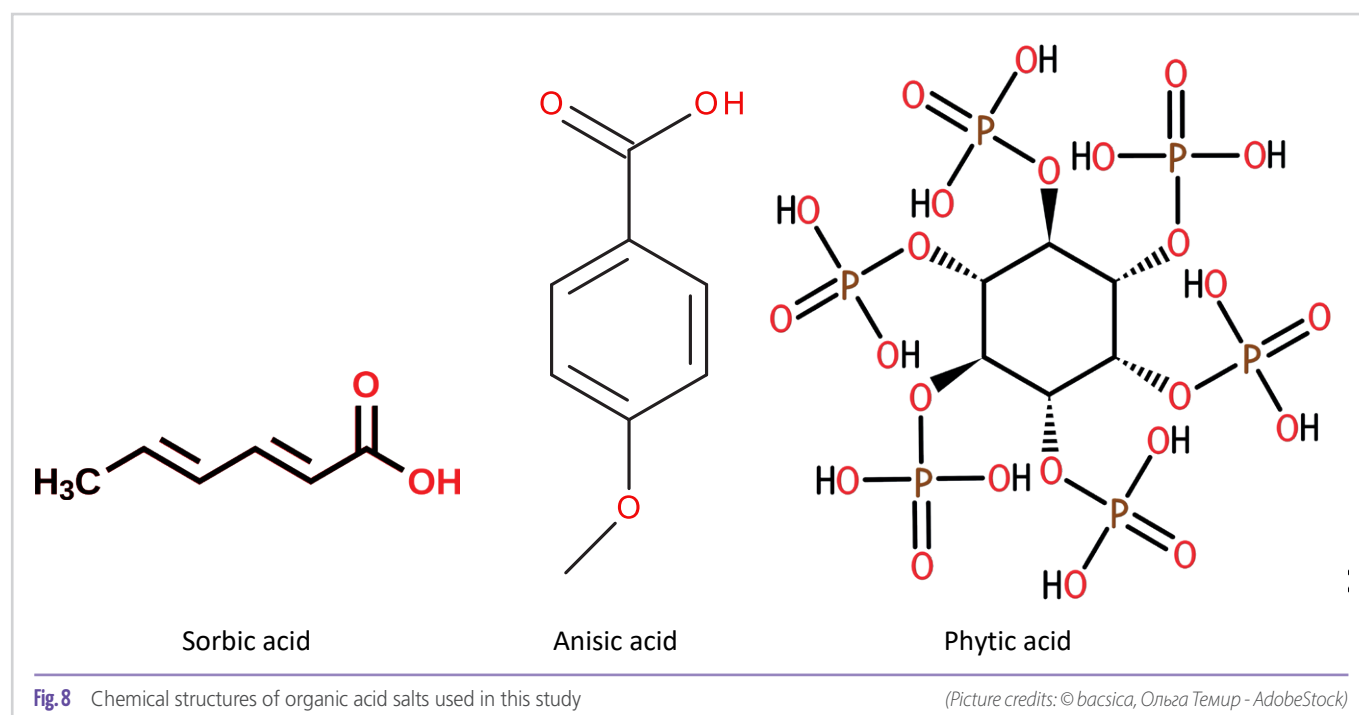
### Effect of organic acids

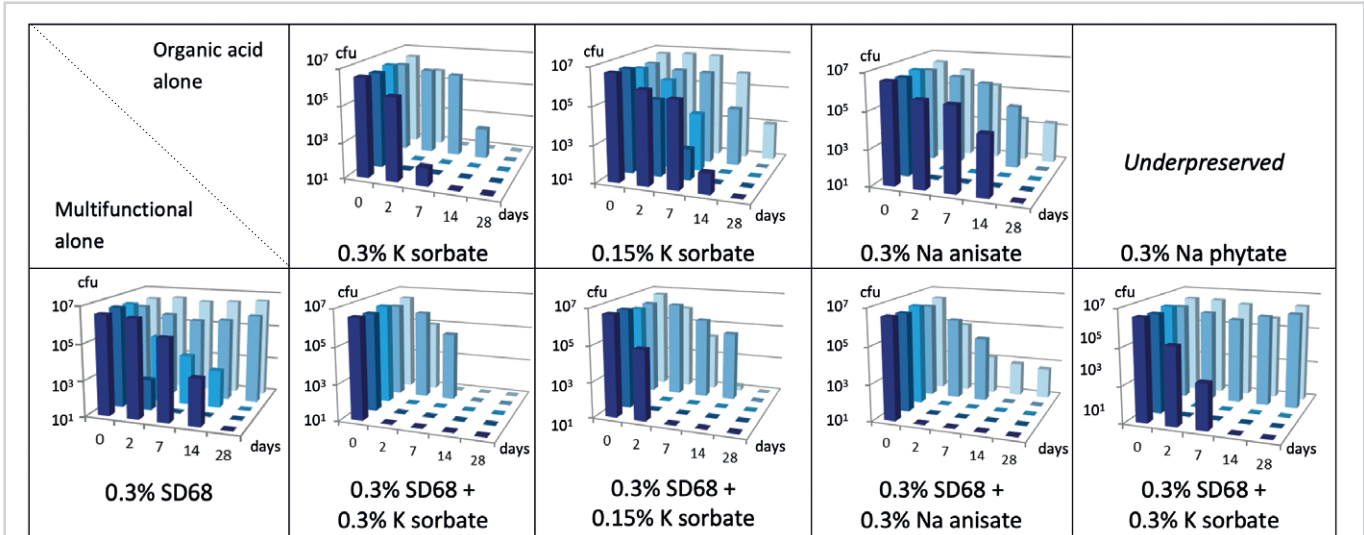
Potassium sorbate and sodium benzoate are the two most common organic acids used in personal care products. They are used in combination with preservatives or multifunctionals due to their antimicrobial effect. A significant factor that determines their efficacy is pH. Organic acids dissociate at a certain alkalinity determined by their chemical structure. Therefore, they are most effective below their pK<sub>a</sub>, where most of the carboxyl groups remain protonated. The pK<sub>a</sub>s of sorbic acid and anisic acid are 4.76 and 4.47, respectively. The pK<sub>a</sub> values of phytic acid are listed in **Table 2**. Unlike sorbic acid and anisic acid, which have only one dissociable proton, phytic acid, with its six phosphate groups and twelve dissociable protons, can be characterized by twelve pK<sub>a</sub>s that spread over almost the entire pH scale.

A lower pK<sub>a</sub> value is unfavorable in terms of the acid's contribution as a barrier to microbial growth, as only the protonated form exerts a meaningful chemical attack on the bacterial or fungal cell wall. According to this argument, sorbic acid is expected to work better in the studied pH range of 4.5-6.0. Anisic acid is less protonated even at the lowest pH, while phytic

acid represents a completely different chemical entity, having phosphate groups rather than carboxylic groups, which are much stronger acids (**Figure 8**). This introduces another variable beyond a simple consideration of the pK<sub>a</sub>s. In the studied pH range, however, a portion of the phosphate groups are in the conjugate form reducing the capacity of the acid to harm the microorganisms.

Organic acids can be quite effective in enhancing product protection systems. Of the three acids studied, sorbic acid at a 0.3% use level was capable of reducing microbial growth by itself to a low enough level to pass Ph. Eur. Criteria B. With all acids and multifunctionals studied and at even the low use levels of sorbic acid (0.15%), the combination of the acid with a multifunctional worked better than either alone (**Figures 9, 10, 11**). This combination, in fact, provides more broad-spectrum protection, being very effective even against the highly resilient *A. brasiliensis*. It is important to note that the direct impact of acidic pH on microbial growth, as demonstrated above, cannot be overlooked and must be considered in addition to its effect on the dissociation of organic acids.





■ *E. coli*, ■ *P. aeruginosa*, ■ *S. aureus*, ■ *C. albicans*, ■ *A. brasiliensis*

Fig. 9 Additive effect of organic acids and 0.3% Caprylyl Glycol/1,2-Hexanediol blend (SD68) at pH 5.5 on the inhibition of microbial growth.

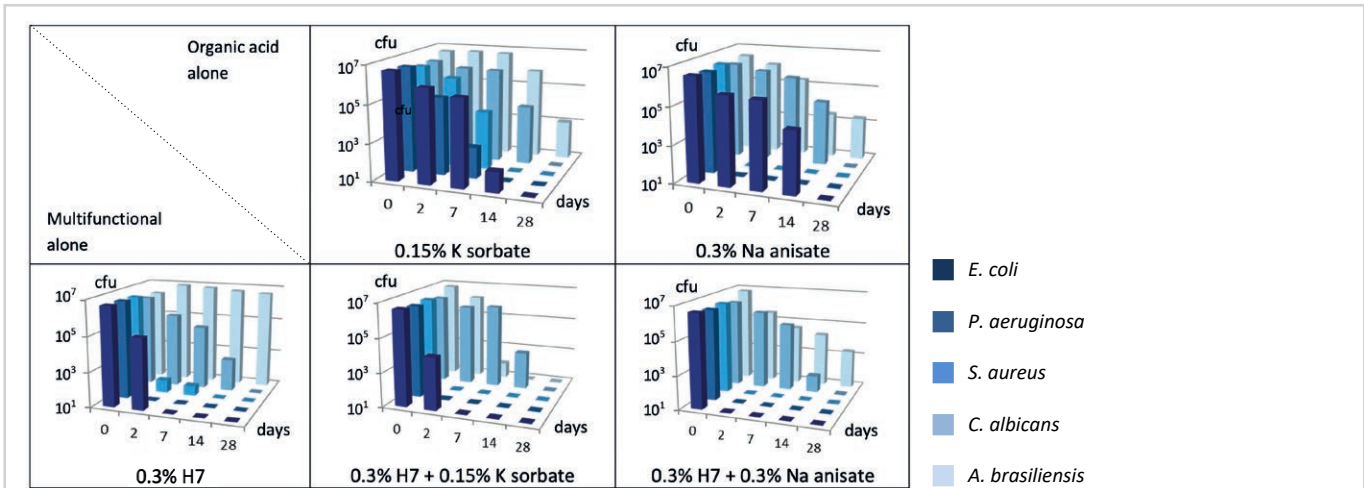
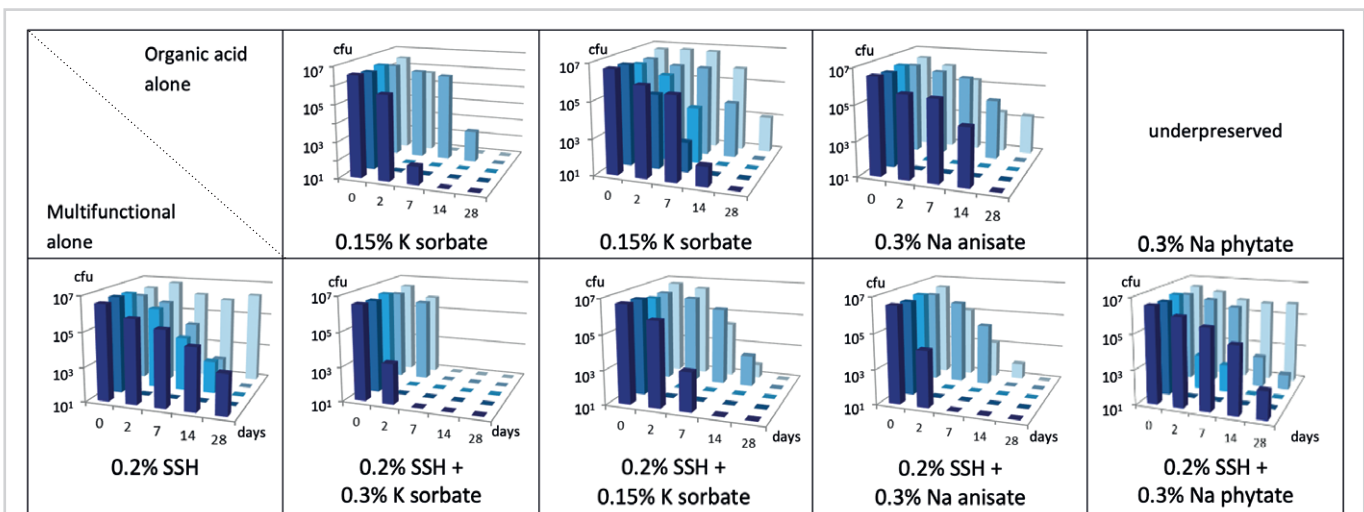


Fig. 10 Additive effect of organic acids and 0.3% 1,2-Heptanediol (H7) at pH 5.5 on the inhibition of microbial growth.



■ *E. coli*, ■ *P. aeruginosa*, ■ *S. aureus*, ■ *C. albicans*, ■ *A. brasiliensis*

Fig. 11 Additive effect of organic acids and 0.2% Hydroxyacetophenone (SSH) at pH 5.5 on the inhibition of microbial growth.

Since the  $pK_a$  of anisic acid is 4.47, lowering the pH from 5.5 to 4.5 has a dual effect: 1) it presents another barrier due to the increased acidity, and 2) it allows more of the anisic acid to be in the more active protonated form, thereby strengthening the effect of the organic acid barrier.

This would normally manifest itself in efficacy against microorganisms. However, this is hardly perceivable at the use levels of the acids and multifunctionals in this study, because the antimicrobial effect is already very strong at pH 5.5 (Figure 12).

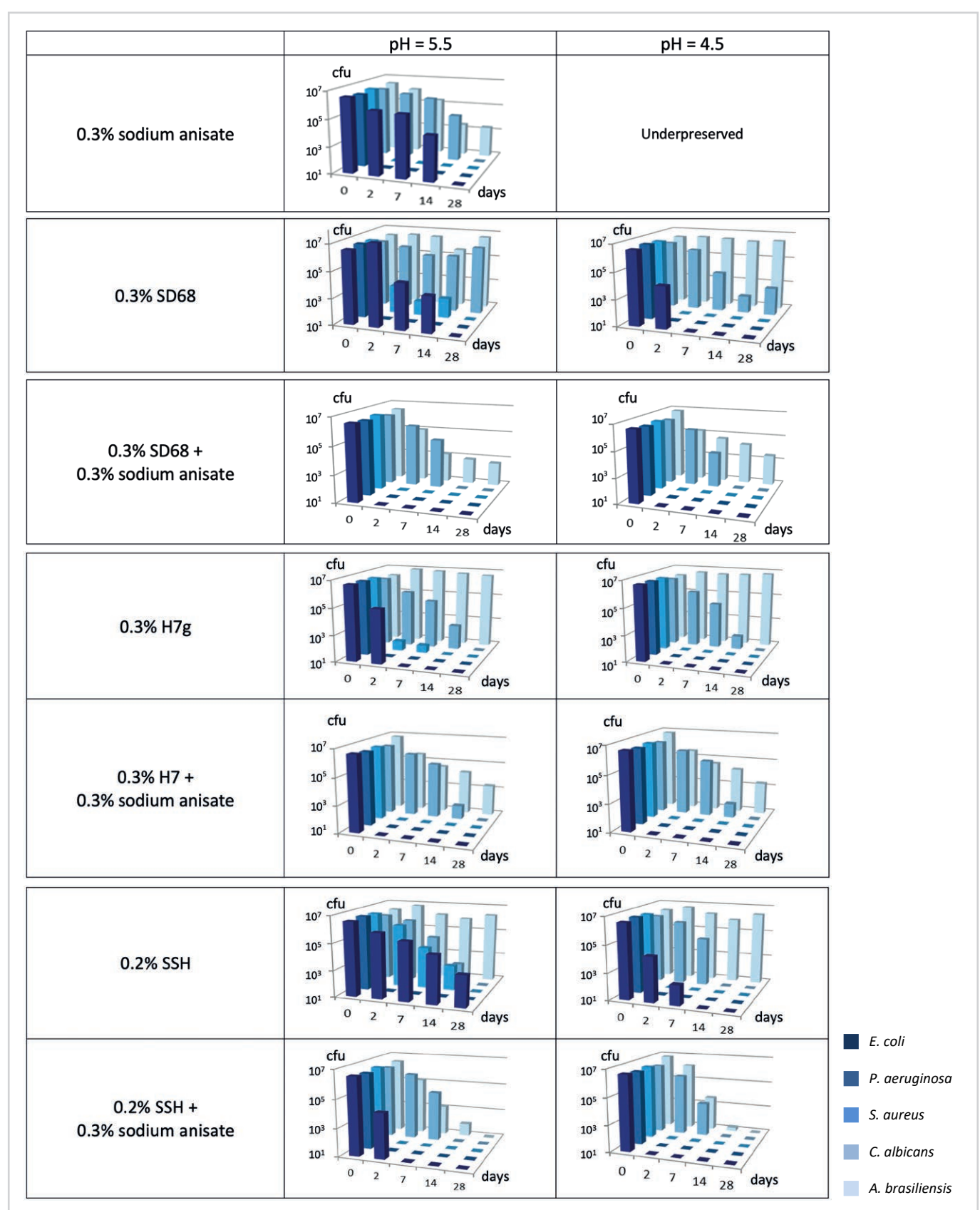


Fig. 12 Effect of pH on the efficacy of combinations of 0.3% Sodium Anisate with multifunctionals.

## Conclusions

Multifunctional ingredients are very effective product protection enhancers. Their ability to support the inhibition of microbial growth can be further increased by combining them with additional barriers. These can be conditions such as pH or chemical means such as organic acids. Even within the skin-friendly 4.5-6.0 pH range, a substantial improvement can be achieved at lower pH values. Such barrier combinations can be quite powerful and may allow the use of lower concentrations of the multifunctional and/or preservative in a formula to still achieve adequate and robust protection. Barrier technologies like Symshield® afford multifunctional ingredients even greater versatility and the possibility of broader applications. This approach supports the concept of minimalistic formulas to an even greater extent and thus answers the growing consumer need for robust and safe products with shorter ingredient lists at the same time. While these studies only looked at a small set of potential barriers, there are undoubtedly more ways to empower multifunctionals. Additional studies involving other parameters will be reported in further installments of this publication series.

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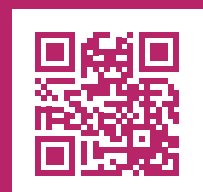
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# TETRANYL L15-85E.

## A new Laundry Additive for Clothes Protection to Provide Longer Life to Your Clothes.

# KAO

Kirei—Making Life Beautiful

Interview with **Marc Bernat**, Business Unit Manager, Surfactants for Consumer Applications, **Kao Chemicals Europe**



Marc Bernat

***You are part of the Kao Chemicals' team for surfactants for consumer applications. What are your responsibilities?***

My responsibility is to lead a commercial team that is customer and solution focused, motivated for bringing the innovation to our customers in EMEA and Americas regions. It is also my responsibility to delivery financial and

non-financial objectives to KAO Chemicals Europe from my Business Unit of responsibility, assuring full alignment.

***What is the latest innovation product aligned with this objective in the Home Care area?***

KAO is a global leader in the segment of Fabric Softeners, offering a broad range of Esterquat variants which has been evolving over last 30 years according to the needs of the market in terms of performance, cost and sustainability. Particularly for this last point, recent developments include TETRANYL L6-90E as ECOCERT certified, biodegradable and with high naturality content (80% according to ISO16128 guidelines); or TETRANYL L9-90, based on European Oils, with excellent odour and colour stability and reduced Carbon Footprint compared to standard vegetable grades.

Fabric Softeners are known to provide lubricity to the fabrics, and hence protecting them against abrasion and pilling. That is a very important contribution to sustainability as by protecting clothes, we can extend their lifetime of usage. Production of new garments and disposal of old clothes is at the moment a very important sustainability issue for the fashion industry; in terms of landfill waste, water usage and pollution.

Considering our technical strengths and identifying a particular issue, KAO Chemicals Europe has developed a water soluble modified Esterquat, **TETRANYL L15-85E**, as a **Laundry Care additive**.

***What are the main benefits of Tetranyl L15-85E?***

As uniqueness, this liquid modified Esterquat can be incorporated into a water liquid detergent without affecting the detergency efficacy.

TETRANYL L15-85E provides to the Laundry Detergent the property of Lubricity to cotton fabrics, directly resulting in fiber protection against abrasion and pilling. Also colour can be protected to maintain the good appearance.

***Could you give an example of applicability in formulation with TETRANYL L15-85E?***

It is our ambition to bring innovation as part of a solution to our customers, and for that it implies to develop final formulations that can be used as guideline for our customers or inspire them for reformulating their current market products.

All formulations have been developed by our R&D according to the market requirements of ingredients, performance and possible market claims.

In the case of TETRANYL L15-85 as additive for Laundry Detergent, we have designed specific complete laundry detergent formulations in combination with other sustainable surfactants (i.e. LEVENOL SF-200 from European oil) which can be Ecolabel or provide softness to clothes.

All this information is available in our Sell Sheets and Formulation Guidelines.

***What will come next in KAO Chemicals Europe?***

We have different new lines of development in Home Care that have been introduced during SEPAWA event this October 2023, all aligned with the same sustainability targets explained before. That includes from lowering the carbon footprint of LEVENOL F-200 and EMANON XLF by using

BIO-EO and reaching the 100% naturality content; to expand the new formats to the Softener category.

Additionally, as a continuous improvement process in KAO Chemicals Europe, it was recently announced the investment in a new biomass thermal power generation plant in our Ole-sa de Montserrat site that will cut the emissions by 95%, as a move towards carbon zero operations.

**What is the contribution of Kao Chemicals Europe to the Sustainability?**

Kao Chemical Europe takes a responsible approach to the environment, health and safety throughout the life cycle of its products, from their design, production, distribution and consumption to their scrapping or disposal for the treatment of generated by-products.

We combine our strengths with those of our customers and partners, promoting the shift towards decarbonization and the circular economy by developing sustainable materials and new solutions that are more respectful of the environment and people.

To achieve the objectives set, we work in all the business units of the organization in:

- The continuous improvement of processes to reduce the environmental impact both in material consumption and reduction of emissions and waste.
- The development of formulations with a good environmental profile, biodegradable and with low aquatic toxicity.
- Optimization of the type of packaging to reduce material consumption.

As a mode of example, in 2022 the activities carried out included the full development of ultra-concentrated detergents for direct use or for dilution, using exclusive surfactants, reducing hence water consumption, the size of containers and the cost of transport, and overall reducing the carbon footprint of the entire process.

[www.kaochemicals-eu.com](http://www.kaochemicals-eu.com)



**More and More Legislation in the Chemical Industry... Who Can Keep Track of it All? We Can Help!**

Interview with **Sven Rosendahl**, Head of Regulatory Affairs at **CLC GmbH**

*CLC GmbH is as a consultant for cosmetics, detergents, cleaning agents and other consumer goods as well as biocides. As part of our product consulting services, we support our customers in the implementation of European and national legal regulations.*



Sven Rosendahl

**What does CLC mean?**

The abbreviation CLC stands for "Chemistry Legal Consulting" and represents chemical legal advice in the field of "Regulatory Affairs".

**What special services do you offer?**

We prepare safety data sheets for our customers in accordance with 1907/2006/EC, Article 31 in the respective European national languages.

After that we register the products with the relevant authorities, such as the BfR, BAuA or ECHA. Finally, we also help with the creation of the labels and then check them for their marketability.

When it comes to the marketing of cosmetics, we create the product information file in accordance with Article 11 of Regulation (EC) 1223/2009 and the associated safety assessment. Here again we register the products with the CPNP portal and check the labels so that the products are finally marketable and can be offered for sale.

The services listed here only provide a rough overview. We endeavour to offer our customers an all-round service and provide individual advice.

#### ***What background do you have?***

Our employees come from the chemical and food chemistry sectors and are specialised in many areas of regulatory matters relating to cosmetics, detergents, cleaning agents and cleaning products, consumer goods and biocides.

#### ***What experience do you have in this area?***

CLC GmbH was able to benefit from the many years of experience of the consultant "Chemisches Labor & Consulting Dr Bönig", which has been established for over 20 years. Well-known companies from the fields of cosmetics, detergents, cleaning agents and other consumer goods rely on his expertise in regulatory matters. In order to continue to benefit from the many years of experience, the company Chemisches Labor & Consulting Dr. Bönig was taken over on 1 April 2020 and officially continued under the new name CLC GmbH. We have succeeded in retaining and even expanding the loyal customer base.

#### ***What characterises you?***

Our team specialises in responding to individual customer requests. If you have a question, please do not hesitate to call us. You will be assigned a dedicated contact person who can help you within a short period of time. Our decision-making

processes are short and our customers benefit from this. Take a look at our response times for yourself.

#### ***Why should we use you as a consultant?***

In particular, the ever-increasing requirements for all regulations are making work and progress in the chemical industry more difficult. Either you have your own "Regulatory Affairs" department and it would be happy to be relieved of its duties, or you are happy if you have nothing to do with it and can hand it over to the professionals. This is where we come in and we are happy to help you. Our prices are fair, with no unpleasant surprises.

The exchange with us takes place at eye level and we impart our knowledge to you in a way that you can understand. It is important to us to provide you with the best possible support for your success.

#### ***How do you see the future in the regulatory area?***

The legal requirements are constantly increasing due to the specifications of the authorities, such as the Green Deal. The complex struts of the legal requirements can present small companies in particular with sometimes unsolvable tasks, so it is better to be safe than sorry.

#### ***What exactly do you mean by this and what would you like to see in the future?***

Unfortunately, there are still very many small and medium-sized companies that are unaware of the area of "Regulatory Affairs" or even consider it superfluous. As a consultant, we are very often only called in by companies once the authorities have issued a complaint. Only then do they realise that the legal part in particular has been neglected. That's why I would like companies to deal with the issue proactively and call us if necessary. This minimises the costs of a complaint and reduces the risk of your product being withdrawn from circulation. Furthermore, as a consultant, we can assist companies with official or customer enquiries, which gives you more freedom for other important activities in your company.

[www.clc-gmbh.com](http://www.clc-gmbh.com)

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### Audience

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### Languages

At present the SOFW Journal is published in English and German. This ensures that all the information is available to the readers worldwide.

# Advances in Skin Evaluation, Measurement Techniques and Claims

## The two-day seminar of the SGS proderm Academy



When developing raw materials and topical end products, it is crucial that studies are conducted directly on the living skin of humans. Without advanced *in vivo* methods, reliable and trustworthy statements on skin tolerance and efficacy are often impossible to achieve.

The Academy of SGS proderm has invited international experts to give a comprehensive overview of selected methods and technologies that are focusing on *in-vivo* skin testing and enable the generation of meaningful results in the context of dermatological studies.

The seminar '**Advances in Skin Evaluation, Measurement Techniques and Claims**', which will take place from 29.2.-1.3.2024 in Hamburg, combines theory with practice. All methods will first be presented in a lecture aimed at conveying basic know-how as well as special characteristics. Afterwards, the technologies will be presented live with hands on, so that the participants of the seminar can directly gain application experience.

*"When selecting the methods to be presented, we attached great importance to corresponding to the versatility of dermatological methods,"* says **Stephan Bielfeldt**, Course Director of the seminar. In this respect, the seminar program takes into account long-established and frequently used procedures as well as innovative premium approaches.

### The topics at a glance:

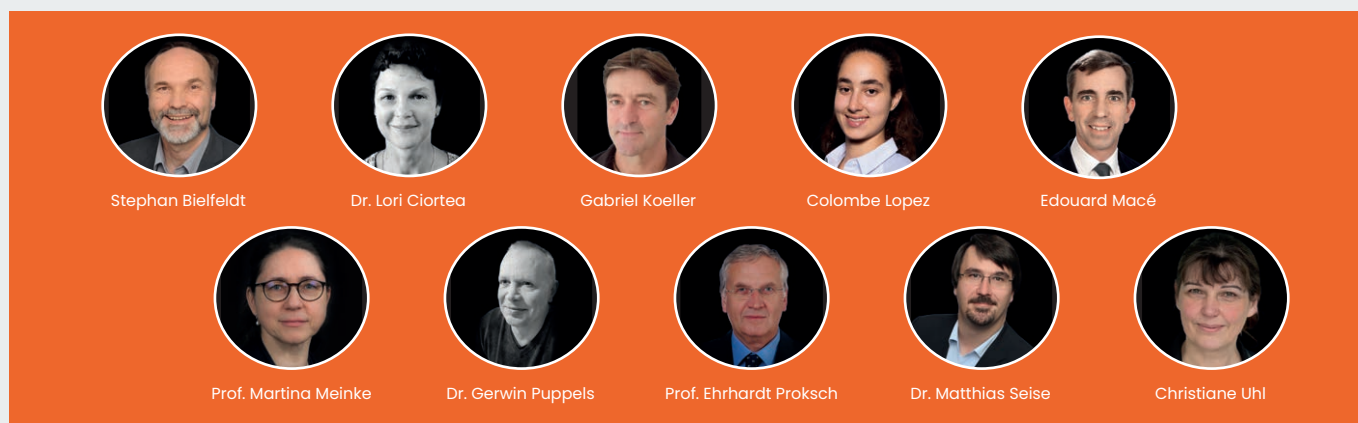
- Standard instruments (capacitance, skin elasticity, skin pH)
- *In Vivo* Confocal Raman Spectroscopy
- Transepidermal Waterloss
- Photographic Techniques
- Line-field Confocal Optical Coherence Tomography
- Skin Profilometry
- Alternative *in vivo* Sun Protection Measurement (HDRS)
- Image Evaluation and Analysis

Both days of the event will start with a keynote lecture on the science of skin. For this, SGS proderm could win two well-known scientists and experts in dermatological research: **Prof. Ehrhardt Proksch** (Christian-Albrechts-University Kiel) and **Prof. Martina Meinke** (Charité, Berlin). In addition, the faculty consists of expert representatives of the different dermatological device manufacturers and scientists from SGS proderm.

**The program at a glance:**

Day 1 – 29.2.2024		
9:45 am Keynote Lecture on Skin Science	11:00 am – 2:00 pm Short Lectures on Measurements	2:00 pm – 4:30 pm Practical Demonstrations
Structure and function of skin, including epidermis, dermis, DEJ, SC barrier including lipids, NMF, antimicrobial barrier, papillary and reticular dermis, appendages.	Standard instruments <i>In Vivo</i> Confocal Raman Spectroscopy Transepidermal Waterloss (Aquaflex), 2D Capacitance (Epsilon) Photographic Techniques	
Day 2 – 1.3.2024		
9:00 am Keynote Lecture on Skin Science	10:25 am – 1:00 pm Short Lectures on Measurements	1:00 pm – 3:30 pm Practical Demonstrations
Healthy skin, Aging skin (incl. photoaging), pigmentation, ethnic skin, dry skin, compromised skin conditions.	Line-field Confocal Optical Coherence Tomography Skin Profilometry (AEVA-HE) Alternative Sun Protection Measurement (LED-HDRS) Image Evaluation and Analysis	

**The faculty:**



- **Stephan Bielfeldt** | Senior Expert Science & Innovation | SGS proderm
- **Dr. Lori Ciortea** | Biox Systems
- **Gabriel Koeller** | Application Engineer | Eotech
- **Colombe Lopez** | Application Engineer Damae Medical
- **Edouard Macé** | CEO | Eotech
- **Prof. Martina Meinke** | Group Leader Experimental Skin Physiology | Charité Berlin
- **Dr. Gerwin Puppels** | Managing Director | River D
- **Prof. Ehrhardt Proksch** | Christian-Albrechts-University Kiel
- **Dr. Matthias Seise** | Group Leader Development and Technical Services | SGS proderm
- **Christiane Uhl** | Head Sales | Courage & Khazaka

„We want to make the seminar as attractive as possible for the participants,” says **Birte Wehr**, Seminar Manager at SGS proderm. In addition to a high-quality program content, the event team relies on the centrally located Hotel MADISON, Hamburg as the venue for the event. Here, participants have access to an infrastructure that combines the seminar’s core elements of lectures, practical examples, networking, dinner and accommodation in one place.

Further information is available on the SGS proderm website:

[sgs-proderm.de](https://sgs-proderm.de)



Date	Event	Website
<b>2024</b>		
16-17 January	<b>Cosmet' Agora</b>	<a href="http://www.cosmetagora.fr/">http://www.cosmetagora.fr/</a>
18-19 January	<b>HPCI India</b>	<a href="https://www.hpci-india.com">https://www.hpci-india.com</a>
23-25 January	<b>Cosmoprof North America Miami</b>	<a href="https://cosmoprofnorthamerica.com/">https://cosmoprofnorthamerica.com/</a>
13-16 February	<b>Vivaness</b>	<a href="https://www.vivaness.de/en">https://www.vivaness.de/en</a>
20-22 March	<b>PCHi China</b>	<a href="https://www.pchi-china.com">https://www.pchi-china.com</a>
21-24 March	<b>Cosmoprof Worldwide Bologna</b>	<a href="https://www.cosmoprof.com">https://www.cosmoprof.com</a>
16-18 April	<b>in-cosmetics Global</b>	<a href="https://www.in-cosmetics.com/global">https://www.in-cosmetics.com/global</a>
01-02 May	<b>NYSCC Suppliers' Day</b>	<a href="https://nyscc.org/suppliers-day/">https://nyscc.org/suppliers-day/</a>
22-24 May	<b>China Beauty Expo</b>	<a href="https://www.chinabeautyexpo.com/">https://www.chinabeautyexpo.com/</a>
05-06 June	<b>Cosmetic Business Munich</b>	<a href="https://www.cosmetic-business.com/en">https://www.cosmetic-business.com/en</a>
23-25 July	<b>Cosmoprof North America Las Vegas</b>	<a href="https://cosmoprofnorthamerica.com/">https://cosmoprofnorthamerica.com/</a>
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14-17 October	<b>IFSCC Congress Brazil</b>	<a href="https://www.ifsc2024.com/">https://www.ifsc2024.com/</a>
16-18 October	<b>SEPAWA® CONGRESS</b>	<a href="https://sepawa-congress.de/en/">https://sepawa-congress.de/en/</a>
28-30 October	<b>Beautyworld Middle East Dubai</b>	<a href="https://beautyworld-middle-east.ae.messefrankfurt.com">https://beautyworld-middle-east.ae.messefrankfurt.com</a>
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12-13 November	<b>SCS Formulate</b>	<a href="https://www.scsformulate.co.uk">https://www.scsformulate.co.uk</a>
13-15 November	<b>Cosmoprof Asia</b>	<a href="https://www.cosmoprof-asia.com">https://www.cosmoprof-asia.com</a>
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March	<b>Raw Materials and Processes (R&amp;P)</b>
09-10 April	<b>Section Austria</b>
22-23 April	<b>Legislative-Environment-Consumer (LUV)</b>
25-26 April	<b>German Association of Perfumers in SEPAWA® e.V. (DGP)</b>
15-16 May	<b>Cosmetic Applications and Technologies (CAT)</b>
03-04 June	<b>Professional Cleaning &amp; Care (PRP)</b>
13 September	<b>Section Switzerland</b>
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23–24 April	<b>DGK/IKW Kurs „Allgemeine und systemische Toxizität“</b>
12–14 June	<b>Forum Cosmeticum</b>
tba	<b>DGK/IKW Safety Bits</b>
29 February	<b>DGK Ringversuch</b>
tba	<b>DGK Expertenrunde</b>
tba	<b>DGK/IKW Reproduktionstoxikologie</b>
tba	<b>DGK/IKW Mikrobiologische Produktsicherheit kosmetischer Mittel</b>
online	<b>DGK/IKW Exposure / Percutaneous Penetration</b>
online	<b>DGK/IKW Skin Compatibility and Sensitization</b>
online	<b>DGK/IKW General / Systemic Toxicology</b>
online	<b>DGK/IKW Essentials of Metabolism Informing Human Health Risk Assessment</b>
online	<b>DGK/IKW Carcinogenesis and Mutagenesis</b>
online	<b>DGK/IKW Reproduction Toxicology</b>
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