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Cosmetic Ingredients with the Power of Plant Defense Mechanisms

D. Leistl, S. Kiese, A. Springer

abstract

Cocoa butter is very popular as an ingredient in cosmetic products. However, cosmetic cocoa butter is often offered in food quality, which tightens the market supply. At the same time, large parts of the cocoa crop are discarded due to diseases, even though the plant produces particularly interesting ingredients while combating diseases. These ingredients could provide valuable properties for cosmetic products as protein or secondary plant metabolite extracts or cocoa butter and would be safe to use. This will create a second raw material stream that will relieve the supply of food-grade raw materials and provide many other dermatological and environmental benefits.

Traditional cocoa bean processing for the production of cocoa powder and chocolate

The cocoa tree, *Theobroma cacao*, originates in Central and South America and main product is its seeds. Healthy cocoa beans are primarily used for manufacturing of any kind of chocolate products. The traditional way of cocoa fruit processing is illustrated in **Figure 1**.

After processing of the cocoa mass cocoa butter and cocoa press cake are available. Main field of application for both fractions is the food industry. Cocoa butter is one of the main ingredients in chocolate production, while the cocoa press cake is proceeded to chocolate powder – a raw material for the production of sauces, pastries or ice cream, among others. In addition, cocoa butter is already broadly used in the cosmetics industry as an ingredient for various product fields ranging from make-up to body and hair care.

Main aim of the cocoa fruit processing is the availability of cocoa butter and chocolate powder. The specific settings of the process conditions during fermentation, drying and roasting influence the storage stability of the cocoa beans as well as characteristic sensory properties of the cocoa bean products such as aroma and color. Therefore, these process steps, which have a strong influence on the quality of the product, are optimized for the production of cocoa butter and chocolate powder for food applications [1].

Fig. 1 Traditional cocoa bean processing according to [1]

Influence of cocoa specific diseases on cocoa beans composition

Unfortunately, cocoa is affected by a range of pests and diseases responsible for losses of up to ~1.5 Mt/a around the world [2,3].

Two of the major diseases causing considerable losses worldwide are black pod rot and witches´ broom disease, which strongly affect beans size and fat content as well as the composition of cocoa butter and thus negatively influence product properties and finally chocolate quality [4,5]. However, for cosmetic products these characteristics are not necessarily an exclusion factor. Instead, it could be an advantage due to a reduced purchase price for damaged cocoa beans and a unique selling feature due to the additional active ingredients produced by the plant.

Component	Function in infected tissue	Content compared to healthy beans Data collection occurred from 3 to 61 days after infection
Ethylene	Ethylene serves as inducer for the production of specific defense proteins.	Up to 14 days after infection, the ethylene content is comparable. Afterwards ethylene emission of infected beans is constant and significantly higher than in healthy beans, where the ethylene content steadily decreases.
Alkaloids (caffeine and theobromine)	Alkaloids are known as substances of plant defense responses.	21 days after infection, the content of caffeine and theobromine is about ten times higher in infected plants. From that point it sharply decreases but is still higher than in healthy plants.
Tannins	Tannins as phenolics are involved in plant pathogen interactions.	The content of condensed tannins in infected plants is significantly higher during the first 35 days after infection. After 14 days, the content is almost 3 times larger. Before and after the differences are not that strong.

Table 1: Changes in ethylene, alkaloid and tannin content due to diseases compared to healthy cocoa beans [5].

Table 1 shows a selection of cocoa bean components, which may contribute to successful valorization of damaged cocoa beans for cosmetic industry.

Proteins from healthy cocoa beans consist predominantly of storage proteins, with vicilin (globulin) and albumins making up for 43 and 52% of total cocoa seed proteins [6]. The proteins show molecular weights of 10–47 kDa and can be extracted from cocoa seeds after defatting, by aqueous extraction. In damaged cocoa fruits the level of free amino acids increases, which could be beneficial for healing and repairing processes in the skin [5].

Additionally, the plant-fungus-interaction with *Moniliophthora perniciosa* and *P. palmivora* may have further benefits, such as the synthesis of plant-cell degrading substances by the fungus leading to the production of antifungal and protective substances by the plant [7-11]. *Scarpari et al*. demonstrated that proanthocyanidin levels increased during witches´ broom infection, which are considered powerful antioxidants [5]. Higher levels of secondary plant substances were also found during infection with the *P. megakarya* fungus [5,12]. *Aneja & Gianfagna* found that this infection can generate biochemical defense mechanisms, evidenced by increased levels of methylxanthines and phenolic compounds, similarly effective antioxidants [13]. Furthermore, hydrolysis of cell walls occurs by enzymes, releasing polyphenols, organic acids, bioactive peptides and vitamins [14].

Potential of damaged cocoa beans

While the use of damaged beans in chocolate processing may cause a loss in quality, this raw material with the described changes in composition offers an attractive source for the non-food industry – mainly due to the ingredients produced by plant defense mechanisms.

Due to the high demand of cocoa butter, prices have been increasing in recent years. Thus, valorizing the stream of damaged beans for cosmetic use offers a promising solution in favor of farmers, industry and the environment. Furthermore, the defatted cocoa powder may be used for the extraction of proteins and secondary plant metabolites, to offer new and renewable resources for cosmetics or the chemical industry [15].

Besides their important role in aroma formation, proteins have shown bioactive and functional properties, such as foaming and emulsifying properties [16,17]. Furthermore, various studies have shown the suitability of plant-based proteins as acrylate substitutes with high gelling, thickening and stabilizing properties and as antimicrobial, antioxidant and antiaging ingredients [18-25].

The extraction of the increased content of secondary plant metabolites in damaged cocoa beans may provide potent extracts, which exhibit a positive influence on the stability of oils or emulsions [25-28]. Alternatively, the extracts can find application for cosmetic products as a microbial and oxidative stabilizer or as a skin care ingredient.

Process development for the recovery of damaged cocoa beans

Against this background, the Cornet project ***"Damaged Beans"***, aims to identify new value-added potential for damaged cocoa beans. Fraunhofer IVV and its Brazilian partner UNICAMP contribute as research partners to this project. In order to fractionate the damaged cocoa beans to exploit their value added potential, traditional cocoa bean processing might not be the optimum route. One example for this assumption is the roasting. While this process step is essential to chocolate manufacturing, it induces protein denaturation and cross-linking to other components [1].

In consequence, protein stability and extractability may be reduced [29].

To begin with, the project will focus on the effect of fermentation, drying, roasting and pressing on yield and properties of cocoa butter, -proteins as well as secondary plant metabolites in order to develop a new value chain for damaged cocoa beans that requires even fewer processing steps (e.g. skip roasting) and is therefore more efficient and cost effective.

Additionally, suitable processing parameter for the extraction of cocoa butter, -proteins and secondary plant metabolites will be identified. While cocoa butter usually is extracted by pressing the cocoa mass, the work planned in ***"Damaged Beans"*** also includes solvent as well as supercritical CO_2 extraction processes. Besides the chemical characterization of the different fractions, their yield as well as their applicability and functionality in cosmetic applications will be evaluated. Some of the main quality parameters for cocoa butter, -proteins and secondary plant metabolites are listed in **Table 2**.

Cocoa fraction	Quality parameters
Cocoa butter	• Oxidative stability • Viscosity • Optics • Sensory properties
Proteins	• Solubility • Protein size distribution • Particle size analyses • Swelling and gelling properties • Film forming properties
Secondary plant metabolites	• Identification of lead substances • Antioxidative properties • Antimicrobial properties • UV-blocking properties

Table 2: Quality assessment of different cocoa bean fractions.

Conclusion

Climate change and increasingly scarce resources call for greater efficiency in raw material processing and a reduction in waste. As the demand for cocoa products and their price have steadily increased in recent years, the existing scarce resources in the growing regions must be optimally utilized. Optically damaged cocoa fruit cannot be used for food, but is promising for cosmetic products. The plants' defense mechanisms can produce new active ingredients, such as secondary plant substances, fatty acids and proteins, that could be applied as innovative ingredients in the cosmetics industry. This is why major corporations and SMEs from the raw materials, cosmetics and food industries are working together in this project to achieve sustainable use and recycling of cocoa fruit as well as improvement of environmental and living conditions in the growing countries. The advantages for the industry are cost savings by using sustainable cheaper raw materials and increased competitiveness with innovative active ingredients. Additionally, ecological and social responsibility supports the image of a brand. Redesigned production processes can efficiently utilize by-products, save energy and avoid waste. Overall, the project makes a contribution to sustainability and resource efficiency.

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Damaged cocoa pods for cosmetics - Fraunhofer IVV:

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User-Friendly Ceramide to Rebuild the Skin

G. Fattorini, E. Altieri

abstract

Ceramides constitute a heterogeneous category of sphingolipids characterized by subtle structural disparities, which play an important role in the formation of the *stratum corneum*. The aim of this article is to introduce a novel concept for the repurposing of ceramides, known as CeraFluid®, which is entrapped within a lipophilic matrix obtained through an upcycling process. This innovative substance possesses the capability to rejuvenate the skin barrier, incorporating anti-aging and antipollution attributes, thereby facilitating a more streamlined formulation process.

Introduction

Ceramides constitute a key group of lipid components located within the intercellular spaces of the *stratum corneum*, where they contribute significantly to the construction of the epidermal permeability barrier [1]. They comprise more than 50% of the epidermal layer, playing a crucial role in influencing skin complexion and demonstrating the capacity to respond to environmental stressors.

Ceramides possess the ability to uphold skin integrity, thereby ensuring an overall state of health and serving as the fundamental "building blocks" that enhance skin compactness. They also serve the key function of preventing Trans Epidermal Water Loss (TEWL), thereby maintaining the requisite level of skin hydration. Furthermore, these structures transmit signals associated with cell apoptosis, proliferation, and differentiation. Consequently, they contribute to harmonizing the turnover of skin cells, maintaining the skin in optimal conditions to effectively counteract the impacts of exposome-related aggressions.

Ceramides originate from two distinct sources: natural and synthetic. Natural ceramides are present in the outer layers of the skin, as well as in animals such as cows and plants like soy. Synthetic ceramides, also referred to as pseudoceramides, are artificially manufactured. Due to their freedom from contaminants and enhanced stability compared to natural ceramides, synthetic ceramides are more commonly employed in skincare products.

Ceramides constitute a structurally diverse and intricate category of sphingolipids, encompassing derivatives of sphingosine bases linked by amide bonds to various fatty acids. Variations in chain length, types of hydroxylation, and degree of saturation contribute to the diversity observed within epidermal sphingolipids. Depending on the form of sphingosine and the linkage with fatty acids, various types of ceramides emerge, including Ceramide EOS, Ceramide NS, Ceramide NP, Ceramide EOH, Ceramide AS, Ceramide NH, Ceramide AP, Ceramide AH, Ceramide OS, and Ceramide OH [2].

Among these, the NP class of ceramides stands out as the most crucial for reconstructing the skin barrier, making it a prominent choice in cosmetic product formulations. Nevertheless, the reintroduction of ceramides into the skin presents challenges, as they are not entirely bioavailable and necessitate a biocompatible delivery system to effectively reach the skin barrier in its entirety.

Revolutionary dermo-mimetic ceramide from sustainable upcycling

Consumer preferences in the cosmetics market are currently focused on ethical, environmental, and eco-friendly trends. Consequently, there is a heightened interest in nature-friendly solutions that not only align with these principles but also offer comparable or superior performance compared to conventional compounds.

In pursuit of finding a suitable carrier for ceramides, ROELMI HPC has pioneered the development of a dermo-mimetic ceramide known as CeraFluid® – a groundbreaking innovation in the world of ceramides. It is a user-friendly liquid ceramide with well-documented anti-aging properties, crafted using environmentally sustainable technology sourced from Mediterranean upcycled materials.

The process begins with Italian food industry by-products, specifically non-edible fractions of olive oil. These materials

are skillfully employed to "encapsulate" Ceramide NP within a lipidic matrix derived from olive oil remnants. This exceptional matrix, composed entirely of natural olive glycerides, serves as a specialized carrier capable of enhancing the bioavailability and effectiveness of pure ceramides.

CeraFluid® enhances the effectiveness of ceramides within the layers of the skin, striking an ideal balance between serving as an active ingredient and adhering to ethical principles in food production and environmental sustainability. Moreover, this ingredient perfectly mimics the physiological functions of the skin barrier, bolstering the *stratum corneum*'s ability to maintain moisture levels over an extended period. Notably, a key characteristic of CeraFluid®'s technology is its low melting point. In contrast to standard ceramides, it enables formulation at a mere 40°C, resulting in significant time and energy savings.

Furthermore, to ensure the highest level of excellence, this product adheres to the ROELMI HPC's SAF-e-CACY® concept, designed to achieve maximum efficacy while maintaining the highest safety standards. This includes rigorous efficacy checks on each production batch, providing consistent quality assurance.

Antipollution activity – *in vitro* dossier

ROELMI HPC's laboratories have conducted a specific test to assess the ceramide's ability to counteract the lipoperoxidation effects induced by a pro-oxidant agent following a 24-hour treatment period. Specifically, the endpoint measured in this assay is the malondialdehyde (MDA) content, a specific marker indicative of oxidative stress within the lipid component.

The dermo-mimetic ceramide has undergone rigorous testing to evaluate its efficacy in fortifying the skin barrier against the deleterious effects of environmental pollutants. The results of these tests have demonstrated the following:

- A notable protective activity against urban dust aggressions, exhibiting a significantly higher cell viability compared to the control group (CTR+) by an impressive margin of 46.5%.
- A substantial protective potential against the toxic effects of urban dust, as it proved effective in shielding against oxidative stress induced by polluting agents, resulting in a reduction of 46.1% when compared to the control group (CTR+).

Antiaging activity – *in vivo* dossier

Due to the swift pace of industrialization and urban development, environmental pollution has emerged as a pressing global public health concern. It is closely associated with the degenerative aspects of skin aging. Air pollution, in particular, is recognized as a detrimental environmental hazard for human skin, with established links to the acceleration of aging and inflammation within this tissue. This, in turn, contributes to the development of skin disorders, as well as the emergence of issues such as wrinkles and pigmentation problems [3].

To assess CeraFluid®'s capacity to mitigate signs of skin aging, a clinical-instrumental study was conducted involving 20 female participants aged between 18 and 35 years, all of whom displayed clinical evidence of fine lines in the periocular area. In this study, a formulation containing 1.0% of the dermo-mimetic ceramide was compared to a placebo. Volunteers, in a blind manner, applied the active product to one half of their face and the placebo product to the other half, following a predefined randomization protocol. Targeting younger skin for pro-aging treatment, various parameters were measured after 28 days of treatment using the Cutometer® MPA 580 (manufactured by Courage + Khazaka Electronic, Köln, Germany).

The results revealed the following significant findings:

- An augmentation in the skin's moisturizing index, registering an increase of 15.4%.
- An enhancement in skin elasticity, specifically a 6.4% increase (as indicated by the R2 parameter).
- An improvement in skin firmness, with an 8.2% increase (measured by the R0 parameter).
- An increase in skin smoothness by 9.4% (as per the Ra parameter).

Furthermore, the instrumental results received corroboration through clinical analysis conducted by a dermatologist, who observed the following:

- An enhancement in skin smoothness was observed in 65% of the study participants at the 14th day (T14), and this improvement increased to 70% at the 28th day (T28).
- There was an improvement in the appearance of fine lines, noted in 60% of the enrolled subjects at T14, and this percentage increased to 65% at T28.

At the culmination of the study, volunteers were asked to provide feedback on the tested products through a questionnaire. Impressively, more than 80% of the participants expressed their satisfaction with the positive effects demonstrated by the dermo-mimetic ceramide **(Figure 1)**.

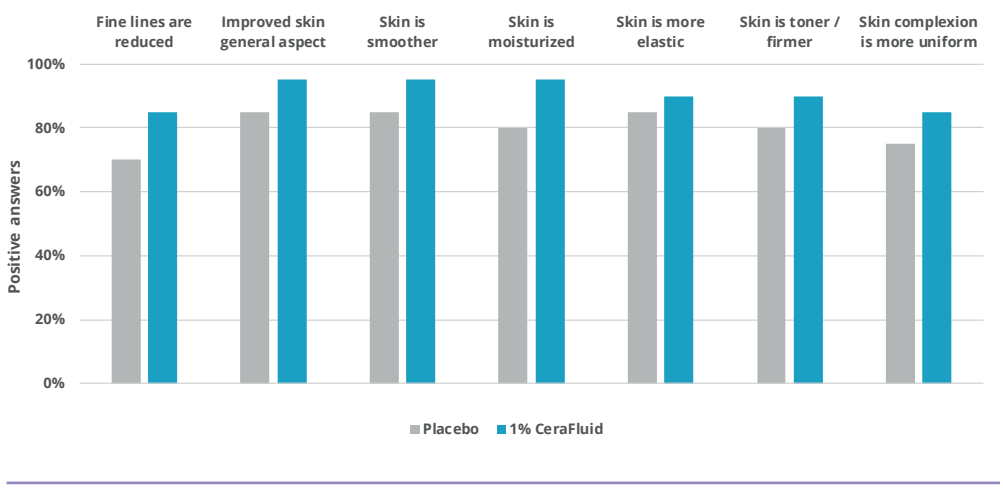

Fig. 1 Self-assessment evaluation of the subjects taking part in the study, at T28.

Another clinical study was carried out, involving 20 female participants ranging in age from 30 to 65 years, with the aim of assessing the anti-wrinkle properties of the ingredient on mature skin. The tested cream contained 2% of CeraFluid®.

The cream was applied to the cleansed facial skin twice daily, both in the morning and evening. The study evaluated various parameters, including skin elasticity, skin profilometry, and clinical analysis of skin smoothness and wrinkling.

Skin elasticity was quantified using the Cutometer® SEM 575, manufactured by Courage + Khazaka electronic GmbH. Skin profilometry measurements were performed utilizing the Visioscan® VC 98 to assess skin surface characteristics, specifically focusing on skin microwrinkles and smoothness.

In addition, a clinical assessment was conducted under the guidance of a dermatologist, revealing the following observations regarding the bioavailable ceramide:

- An impressive enhancement in skin elasticity was discerned, exhibiting a remarkable increase of 14.24% within just 30 minutes.
- This enhanced elasticity was sustained over time, with a notable maintenance rate of up to 25.22% observed after 30 days of treatment.
- The presence of skin microwrinkles showed a noteworthy reduction, with a decrease of up to 11.63% recorded over the course of 30 days.
- The improvement in skin smoothness was consistently evident at 7, 15, and 30 days into the treatment regimen.

Conclusions

The innovation inherent in CeraFluid® lies in its heightened compatibility with the skin and its ability to penetrate deeply into the skin, facilitated by the synergy between olive glycerides and ceramides. This synergy enhances the bioavailability of Ceramide NP, thereby yielding augmented moisturizing effects and expeditious results. An added benefit of this technology is its straightforward applicability in production, eliminating the necessity to elevate the temperature, as is the case with standard ceramides.

It is important to note that the dermo-mimetic ceramide is environmentally non-toxic and considered biodegradable. Consequently, the result is a sustainable, high-performance cosmetic ingredient that aligns with environmental safety standards.

The active cosmetic product is exclusively distributed in Germany by S. GOLDMANN GMBH & CO.

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Tackling Under-Eye Dark Circles with a Responsibly Sourced Root Extract

C. Gonindard, P. Warnault, A. Salwinski, N. Rombaut, A. Guillaumin, B. Leyre, S. Delaunois, B. Mignard, H. Chajra, M. Frechet, A. Werle

abstract

This paper aims to demonstrate that using an eco-responsible technology called Plant Milking it is possible to produce a new active ingredient from the roots of *Ipomoea batatas*. Rich in dicaffeoyl quinate esters (DCQEs), this extract efficiently tackles several pathways leading to under eye dark circles to improve the eye contour aspect. A full transcriptomic study was done and demonstrated that genes involved in the main biological pathways leading to dark circles formation were downregulated. This study was completed by an evaluation of the effects of the active on vascularization using an innovative 3D vascularized dermis model, showing the active ingredient helps modulate the formation of new vessels. An *ex-vivo* assessment demonstrated it can re-densify the dermis. To confirm the benefits for consumers a clinical evaluation showed eye contour color was improved in only 7 days and eye stiffness was increased thanks to this *Ipomoea batatas* root extract.

Introduction

The growing global awareness of environmental concerns and the need for responsible consumerism has driven the market for sustainable cosmetic products in recent years. Consumers have become increasingly conscious of the impact their choices have on the planet and are demanding products that align with their eco-conscious values. As a consequence, it has become essential for cosmetic ingredients manufacturers to find new ways to produce responsibly sourced ingredients. A French biotech company, Plant Advanced Technologies, has developed an innovative and patented technology to source active molecules from plant roots without destroying the plant, offering new possibilities for the development of responsibly sourced active ingredients. In partnership with Plant Advanced Technologies, Clariant has started to create a full range of products to respond to major consumer needs, while taking into consideration their demand for sustainable products.

Using Plant Milking technology to responsibly source new active ingredients

Plant milking technology is an innovative and eco-friendly approach for harvesting active ingredients from plant roots using a non-destructive method. Traditional methods of extracting active compounds from roots often involve uprooting or damaging the plant, leading to ecological disruption. In contrast, plant milking technology operates on the principle of obtaining valuable compounds without harming the plant's integrity. Using this method, the plants are cultivated in aeroponic conditions, leaving the roots exposed. This makes it possible to stimulate the production of specific molecules of interest by spraying nutritive solutions directly on them, increasing molecule yield at an economically viable level. Plant Milking technology also positively impacts the root system architecture (RSA), which is the spatial configuration of the plant's roots. The root biomass produced can therefore also be increased compared to traditional soil culture, making the yield even higher. As the roots are directly accessible, they can be cut without destroying the plant which is afterwards put back into culture, allowing the roots to grow again and making possible several harvests per year. By combining the increase in molecule yield at each harvest and the number of harvests, it is then possible to reach high levels of production using a limited surface, reducing the need for large agricultural surfaces.

In addition, Plant Milking technology is conducted in greenhouses where the environment is fully controlled, avoiding the use of pesticides. The water is recycled, thus reducing its consumption compared to traditional culture with up to 90% less water used thanks to aeroponic cultivation. As well, the entire cultivation process, from seedling and plant multiplication, is done inhouse to fully control the production process and ensure full traceability. The extraction of the active molecules from the roots is also done at the same location, thus limiting the need for transportation. Due to all this, the *Ipomoea batatas* root extract (IBRE) was recognized as a highly green ingredient and was awarded the gold prize of the green ingredient awards granted by in-cosmetics in 2023.

Root-extracted active that tackles under eye dark circles and puffiness

Dark circles, a major cosmetic concern, impacts how our faces look and therefore may lower self-confidence and well-being. They are caused by many etiologic factors including excessive

pigmentation, thin and translucent lower eyelid skin [1], shadowing due to skin laxity and loss of skin firmness, periorbital oedema, and superficial microvasculature associated or not with a neovascularization. Moreover, as the occurrence of dark circles is a clear indicator of aging and of an unbalanced lifestyle (such as a lack of sleep or stress), people are looking for efficient cosmetic solutions to get rid of them.

DCQEs found in IBRE (INCI: Propanediol, Water, Ipomoea Batatas Root Extract, Sodium Sulfate) are potent molecules able to act at different levels of dark circles etiology by inhibiting several biological pathways such as angiogenesis, inflammation and extracellular matrix reinforcement. Moreover, efficiently targeting the vascular network, a leading parameter in dark circles formation and maintenance, they contribute to the improvement of all dark circle's features: color, puffiness, and sagging.

Proven to act on 5 causes of dark circles

Regulation of genes involved in dark circles etiology

IBRE biological activities were studied on human skin explants through a full transcriptomic study using Affymetrix technology [2]. In this study we found that several genes involved in inflammation, extracellular matrix and vascular network alteration were downregulated **(Figure 1)**.

First of all, a statistically significant downregulation of the transcription of several genes involved in the inflammatory process was observed in IBRE condition. IBRE mitigates ALOXE3 (Arachidonate Lipoxygenase 3), ALOX12B (Arachidonate 12 Lipoxygenase 12R type) and LTC4S (Leukotriene C4 Synthase), three enzymes implicated in lipoxins and leukotriene synthesis known to be potent lipidic inflammatory mediators [3]. IBRE also downregulates TBXA2R, the receptor of thromboxane A2, which is a key element of the signal transduction of a lipidic inflammatory mediator leading to inflammation [3]. Moreover, IBRE inhibits the transcription of NFkB2, a subunit of NFkB, a central transcriptional nuclear factor [4,5] implicated in inflammation cell signal transduction. The active also decreases ICAM-1 expression, a key adhesion molecule for leukocytes recruitment during the inflammatory process [6,7]. This cell recruitment, also known as the diapedesis phenomenon, sustains inflammation. IBRE also reduces LITAF (Lipopolysaccharides Induced TNF Factor) expression, a protein involved in the upregulation of the potent TNF-α pro inflammatory cytokine [8,9].

Secondly, a statistically significant down regulation of the transcription of several genes involved in extra-cellular matrix remodeling was observed in IBRE condition. The active ingredient decreases the transcription of proteolytic enzymes such as ADAM15, implicated in adhesion molecules degradation and inflammation [10], ELANE (elastase Neutrophil Expressed) a serine protease degrading elastin [11], and several matrix metallopeptidases (MMPs) responsible for collagen

and/or elastin degradation (MMP1, MMP3, MMP10, MMP19). The down regulation of these enzymes will likely prevent dermal thinning and attenuate the visibility of the underlying vascular network of dark circles.

Finally, a statistically significant down regulation of the transcription of several genes involved in vascularization and lymphatic processes was observed in IBRE condition. For example, NRP2 (neuropilin 2), PGF (Placental Growth Factor) and VEGFB (Vascular Endothelial Growth Factor B), are three ligands of vascular receptors (VEGFR3 and VEGR2) [12–14]. SOX18 (SOX18 SRY-box Transcription Factor 18) is a key transcription factor implicated in the synthesis of proteins responsible for vascular and lymphatic remodeling [15] and TGFB1 (Transforming Growth Factor β1) is one of the growth factors implicated in the vascularization process [12]. Moreover, we found that IBRE inhibits the transcription of ACTB (actin β), a highly conserved protein implicated in cell motility and in the structure of endothelial one [16].

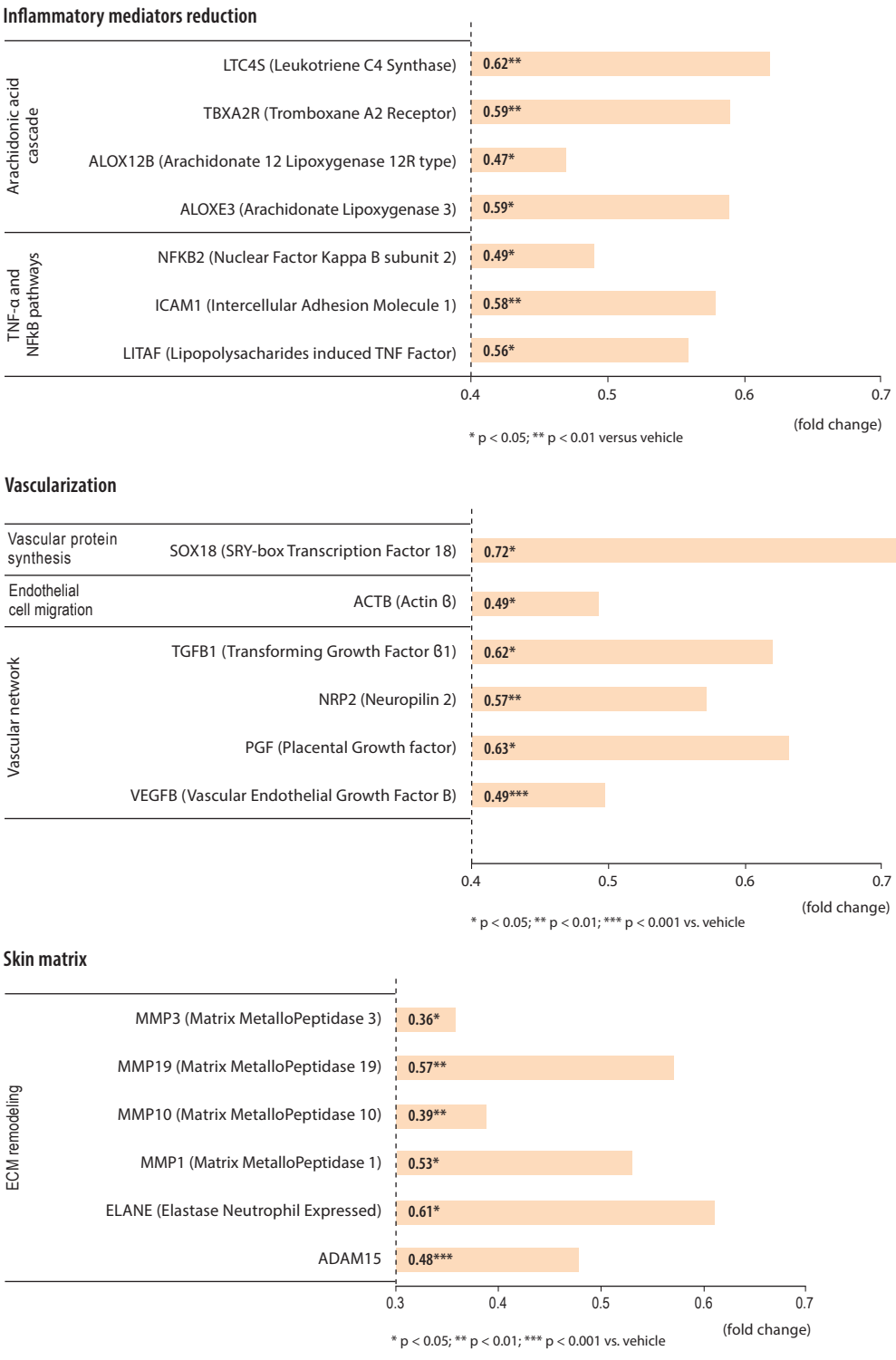

Fig. 1 Genes related to inflammatory mediators, vascularization, and skin matrix regulated in human skin explants after 24 hours of topical treatment with Ipomea batatas root extract (IBRE).

Vascular network control

The anti-angiogenic effect of IBRE was evaluated using an innovative 3D vascularized dermis model developed by the French company, CTI biotech **(Figure 2)**. In **Figure 2A**, the green staining represents HDMEC cells and the blue the nuclei of all cells (NHDF and HDMEC). This picture shows a homogenous repartition of both cell types. Without VEGFA stimulus, the HDMECs slowly proliferate, some rare and random structures are made. The **Figure 2B** shows the condition representing the bio-printed dermis model treated with VEGFA a pro-angiogenic factor.

The **Figure 2B** confirms the functional validation of this newly developed model. Indeed, under VEGF, the HDMECs showed an organized tubular network looking like vascularization. The **Figure 2C** (anti-angiogenic condition) confirms this functional validation. Indeed, under VEGFA and in the presence of endostatin, less vascularization is observed **(Figure 2C)**. IBRE (0.75% or 0.125%) or 3,5 DCQE (tested at the same concentration found in IBRE 0.75%) are efficient to inhibit the vascularization process **(Figures 2D** and **2E)**. The effect is dose dependent as we can see a stronger inhibition in the highest IBRE concentration tested. We demonstrated also that this inhibition is probably due to its 3,5 DCQE content **(Figure 2F)**.

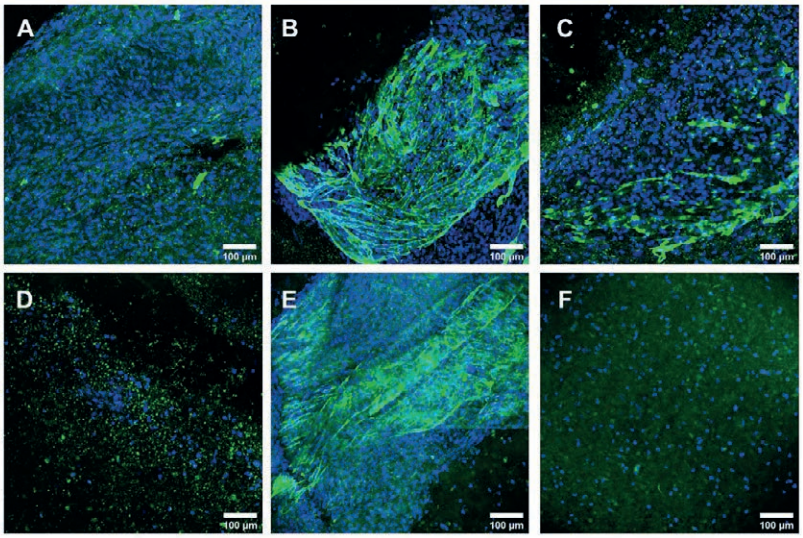

Fig. 2 3D bio-printed vascularized dermis observed by confocal microscopy before **(A)** and after VEGFA 20ng/ml **(B)**, after VEGFA 20ng/ml + Endostatin 3 µg/mL **(C)**, after VEGFA 20ng/ml + IBRE 0.75% **(D)**, after VEGFA 20ng/ml + IBRE 0.125% **(E)**, after VEGFA 20ng/ml + 3.5 DCQE (equivalent content as in IBRE 0.75%) **(F)**. Cell nuclei (DAPI staining, blue) and HDMEC cells (CD31 staining, green).

Dermis densification

IBRE's effect on skin dermis was observed on human skin explants topically treated each day for 6 days with a formula cream containing either 0.75% IBRE or 0.75% DCQE or the vehicle control. The major compound 3,5-DCQE was used in the experimental assay to demonstrate if the biological activity provided by IBRE is effectively due to its DCQE content. We observed that IBRE densifies the dermis through the stimulation of collagen synthesis **(Figure 3)**.

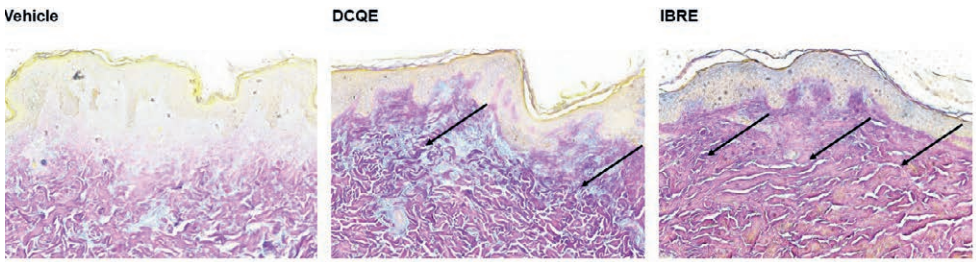

Fig. 3 Skin explants stained by Herovici dye after 6 days of topical treatment with vehicle (80% 1,3 propane diol + 0.5% sodium sulfate), DCQE (0.75%) or IBRE topical applications (0.75%). Arrows indicates the dermis densification.

Clinical tests show a strong improvement in under eye aspect

A clinical study was carried out through a double-blind randomized trial which enrolled 18 women aged between 18 to 35 years old, presenting persistent dark circles (11 vascular, 4 pigmented or 3 both ones). Participants were asked, following consent, to apply a test formulation active at 1% or a placebo treatment, twice daily, for 28 days on eye contour.

The clinical efficacy was evaluated by a hyperspectral imaging system using a SpectraCam (Newtone, QIMA Life Sciences, Lyon, France), which investigated the spectral reflectance of the skin, producing a qualitative map of the underlying blood vessel structures for evaluation. It was completed by an evaluation of the skin mechanical properties on dark circles area using the EasyStiff® device, developed by Biomeca (Lyon, France), based on atomic force microscopy technology (AFM). Measurements were realized at D0, D7 and D28.

Dark circles often appear dark due to a local hyperpigmentation and redness. We analyzed the evolution of the a* parameter, known to be associated with skin redness and inflammation, and of the L* parameter, known to be correlated to a brighter skin. The results showed a significant decrease of the a* parameter by -18% and a significant increase of the L* parameter by +1.5% after 7 days, confirming that IBRE is efficient to quickly improve dark circles color. These results were confirmed after 28 days. In contrast, and as expected in the placebo group, there is no skin color improvement.

In addition, the redness observed in dark circles is also due to the development of a vascular network in this sensitive area. With the use of the SpectraCam device we demonstrated that the vascular network was reduced in IBRE treated dark circles, while this was not the case for the placebo group **(Figure 4)**.

As a result, a visible improvement of under eye dark circle was observed in the IBRE treated group **(Figure 5)**.

Eyelid skin is known to be the thinnest skin on the face [17]. This typical characteristic makes it very mechanically weak. Interestingly, we observed that IBRE significantly reinforces the skin stiffness mechanical property of this very fragile skin area by 95% after 7 days. This effect is improved over the time of IBRE use and reaches +149% after 28 days. This result might be explained by the effects of the active ingredient on protecting extracellular matrix integrity. Indeed, we demonstrated *in vitro* that IBRE inhibits several enzymes, mainly MMPs, responsible for collagen degradation.

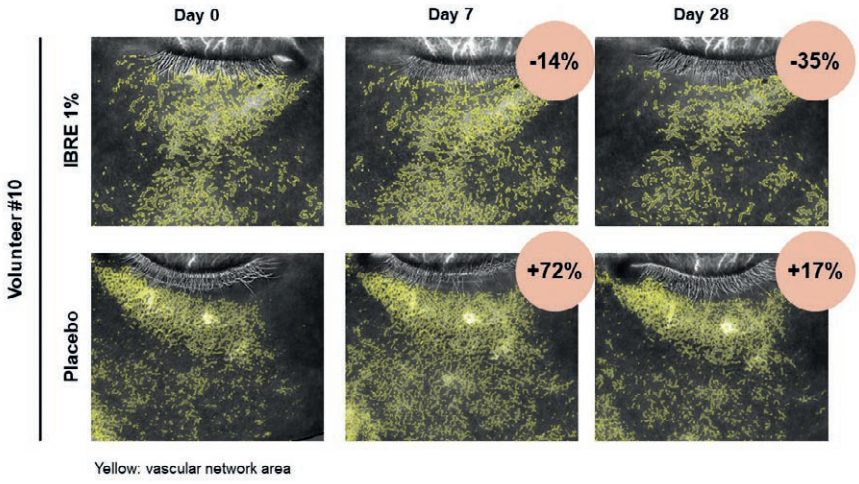

Fig. 4 Illustrative pictures taken with the SpectraCam® device (Newtone technologies, France) showing the vascular network reduction in IBRE treated dark circles (yellow masks highlight the vascular network).

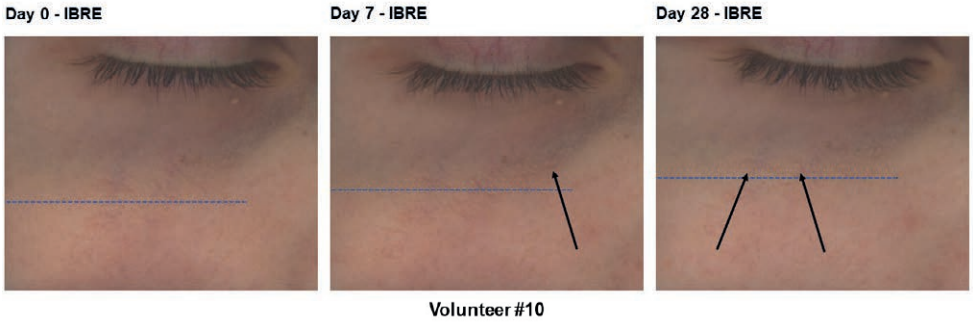

Fig. 5 Illustrative pictures taken with the SpectraCam® device (Newtone technologies, Lyon) showing dark circles improvement after 7 and 28 days of IBRE use.

Conclusion

The innovative and eco-responsible Plant Milking technology was used to obtain a root extract from *Ipomoea batatas* plants enriched in DCQEs. Our *in vitro* and *in vivo* investigations highlight the strong biological activities of this new active ingredient to improve dark circles etiology. A clinical study confirmed the *in vitro* results and clearly states that the *Ipomoea batatas* root extract at 1% reduces dark circles visibility by reducing skin redness and increasing skin brightness. In addition, this fragile skin is reinforced, as confirmed by the improvement of eyelid stiffness. The efficiency was achieved very quickly, after just 7 days and the results were maintained after 28 days of use. This active ingredient can therefore efficiently respond to the needs of consumers for improving the eye contour, often affected by daily stress or the lack of sleep, and that affect their image, while responding to their growing demand for sustainably sourced beauty products.

Acknowledgements

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Superiority of a Standardized Black Seed Oil versus a Non-Standardized Black Seed Oil on Acne Mechanisms and Occurrence

L. von Oppen-Bezalel, J. S. Jurenka

abstract

Nigella sativa Seed Oil, branded B'utyQuin™ by TriNutra® Ltd., is a stable cold-pressed black seed oil standardized to 3% thymoquinone and <2% free fatty acids. It is a cosmetic active ingredient that optimizes mitochondrial functions including fat metabolism, ATP production and cell respiration, balances the inflammatory response, and has antioxidant and antimicrobial benefits. These functions were shown in previous research to contribute to relief of seborrhea and dandruff, as well as antiaging and scalp soothing benefits. In this publication, we show how B'utyQuin™ mitigates specific causes of acne in a manner superior to non-standardized black seed oil. Previously, antimicrobial activity against *Malassezia furfur*, an opportunistic pathogen associated with seborrhea and other dermatological conditions, was shown. This study focuses on B'utyQuin's ability to significantly inhibit many of the opportunistic pathogens, in particular *Propionibacterium acnes*, commonly associated with acne and oily skin, in a superior fashion to non-standardized black seed oil. The current study also demonstrates the superiority of B'utyQuin™ compared to non-standardized black seed oil in modulating the microbial diversity present in acne by targeting several key mechanisms of action associated with acne and oily skin.

Introduction

Acne, also known as *Acne vulgaris*, is a skin condition that occurs when hair follicles become clogged by dead skin cells and excessive sebum, an oily substance secreted by the sebaceous glands that may cause inflammation and dysbiosis of the microbial community. This can result in blackheads or whiteheads, pimples, papules, pustules, oily skin, inflammation, and possible scarring [1,2] **(Figure 1)**. Acne is the eighth most common skin disease in the world according to *Heng, et al* [3], and is an immune-mediated, inflammatory and sometimes chronic condition [4]. Primary causes of acne can include genetic predisposition [5], and dysfunction in skin metabolism resulting in increased sebum production [6]. Other factors contributing to the prevalence of acne in the general population include hormonal changes, bacterial, yeast, or fungal skin infections, stress, diet, and lifestyle [7].

Nigella sativa (*N. sativa*, family Ranunculaceae), is an annual flowering plant native to southeastern Europe, western Asia, the Middle East, and northern Africa. Oil from its small black seeds, black seed oil (BSO), has been used for centuries as both medicinal and beauty treatments. Black seed oil has been studied more recently for its many health, anti-inflammatory, antioxidant, antifungal, and dermatologic benefits [8-12]. Identification of *N. sativa*'s primary constituent, thymoquinone (TQ), has resulted in a growing interest in its powerful and wide-ranging pharmacological activities [11-17].

To harness the incredible power of thymoquinone, TriNutra® Ltd., has cultivated a full-spectrum, cold-pressed BSO standardized to 3% thymoquinone and very low free fatty acids (FFAs), the highest quality and most powerful thymoquinone concentration available on the market.

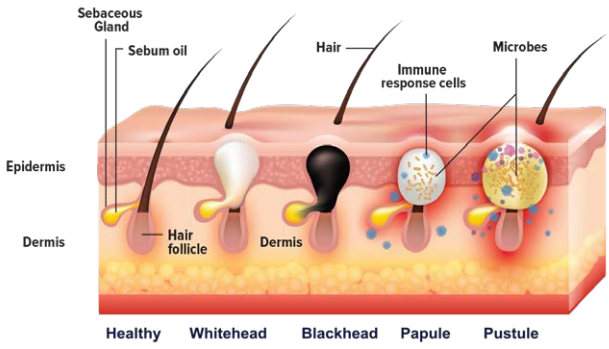

Fig. 1 Types of Acne

Nigella sativa seed oil produced by TriNutra® Ltd., is a stable, cold-pressed, standardized black seed oil with 3% thymoquinone, the powerful primary active constituent, and a low percentage (<2%) of free fatty acids. This specific formulation is branded as B'utyQuin™ and is a uniquely powerful cosmetic active ingredient. B'utyQuin™ optimizes mitochondrial functions including fat metabolism, ATP production and cell respiration, balances the inflammatory response, and has antioxidant and antimicrobial benefits. It has been shown to target several key mechanisms associated with acne and other cosmetic and dermatologic conditions. This current study's summary demonstrates the influence of B'utyQuin™ versus Non-Standardized Black Seed Oil (NS-BSO), containing less than 1% thymoquinone and high (>2% to +9%) FFAs, on

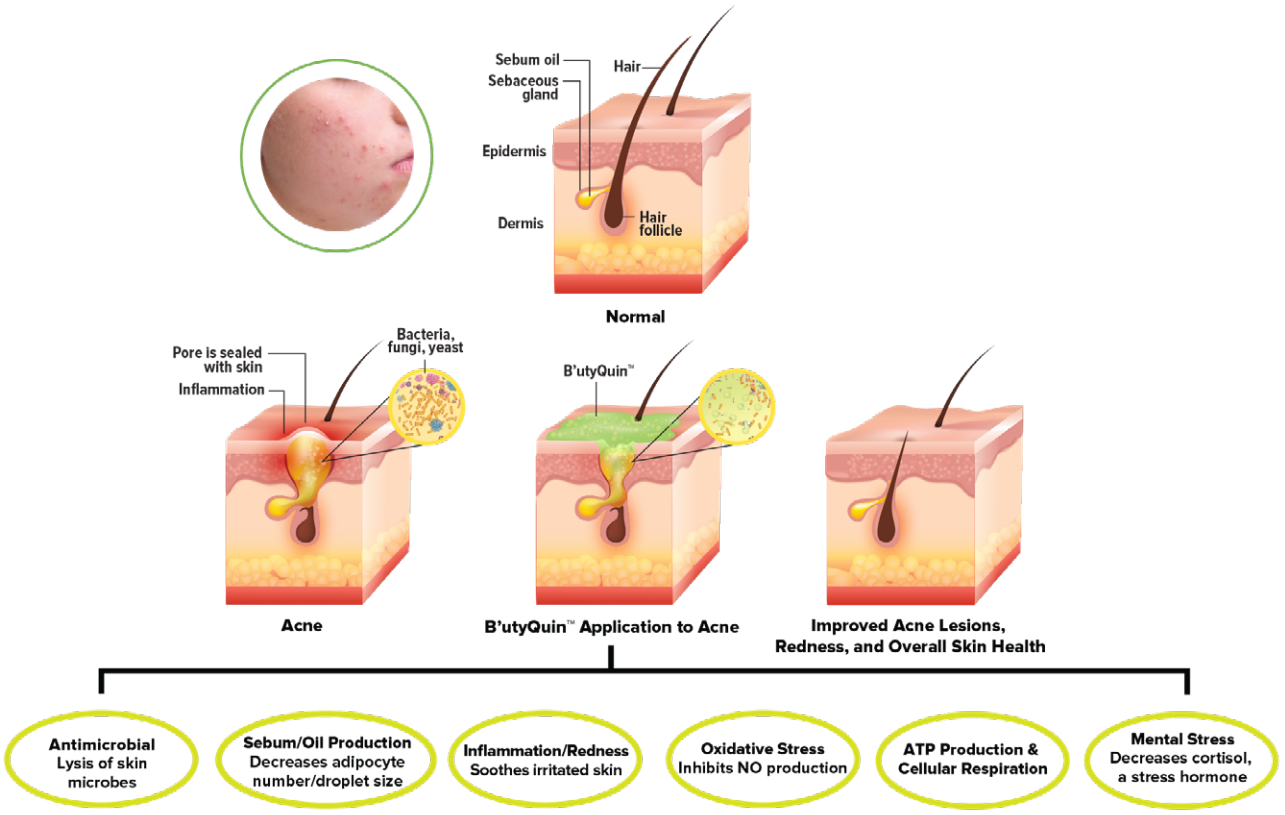

Fig. 2 Mechanism of Action Elucidating B'utyQuin's (Black Seed Oil with 3% Thymoquinone) Effect on Acne Occurrence.

multiple causes associated with acne occurrence, in particular overgrowth of microorganisms.

Mechanisms behind B'utyQuin's effect on acne occurrence

The black seed oil composition of TriNutra's B'utyQuin™ featuring a high thymoquinone content along with low free fatty acids, has been shown to beneficially impact several key modulators of acne. In vitro studies were conducted to determine the mechanisms of action behind BSO's remarkable benefits for acne. Results highlight the power of thymoquinone's antimicrobial activity against *Propionibacterium (Cutibacterium) acnes* **(Figure 2)**, *Malassezia furfur*, *Malassezia globosa*, *Candida albicans*, and *Staphylococcus aureus*, opportunistic pathogens associated with acne, seborrhea, dandruff and other dermatological conditions [7].

Thymoquinone's anti-inflammatory properties, via inhibition of nitric oxide production **(Figure 3)** [11], its modulation of fat/sebum metabolism via reduction of adipocyte number and lipid particle size **(Figure 4)** [12], and its immune-modulating

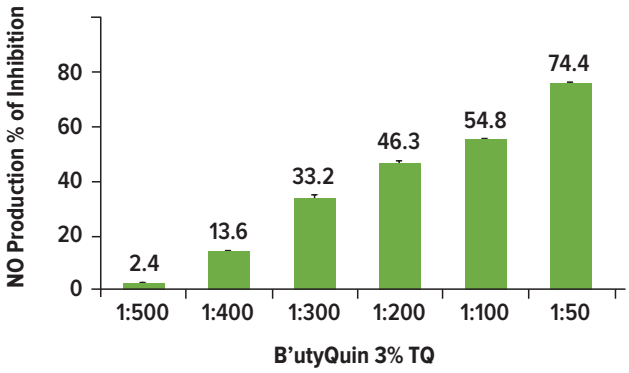

Fig. 3 Anti-inflammatory effect of B'utyQuin™, BSO with 3% TQ and <2% FFA on NO production in LPS stimulated macrophages *(unpublished data)*

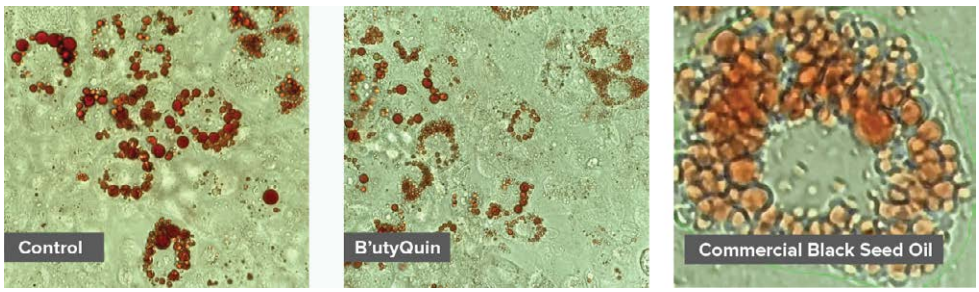

Fig. 4 Effect of B'utyQuin™ (standardized BSO with 3% thymoquinone and less than 2% FFAs) on oil droplets formation in 3T3 adipocytes showed a significant reduction of lipid droplets formation, while a commercial, non-standardized BSO did not.

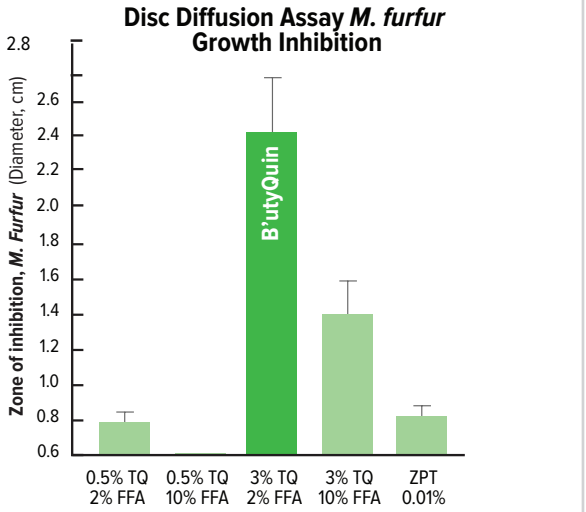

Fig. 5 Antifungal activity of various BSOs containing different levels of thymoquinone and FFAs on *Malassezia furfur*

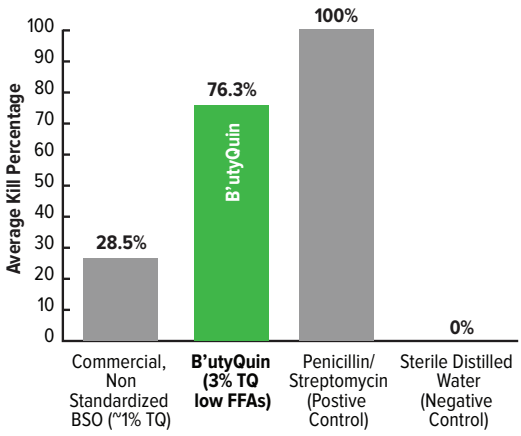

Fig. 6 Growth inhibition of *Propionibacterium acnes* by B'utyQuin™, compared to non-standardized BSO, positive, and negative controls.

properties may help mitigate the inflammatory responses that occur during acne outbreaks. Thymoquinone also modulates sebum production [6] which the microorganisms causing acne use for nourishment. Additionally, B'utyQuin's active ingredient, thymoquinone, can soothe redness, as well as calm and restore harmony to sensitive skin [15,16]. Emotional and mental stress are often a contributing factor to acne outbreaks and thymoquinone has been shown to beneficially impact stress, via modulation of the stress hormone, cortisol, when consumed orally [17].

Previous studies have demonstrated B'utyQuin's antimicrobial activity against *Malassezia furfur*, **(Figure 5)** an opportunistic pathogen associated with seborrhea and other dermatological conditions including acne [10]. In this study we focus on its ability to significantly inhibit many of the opportunistic pathogens, in particular *Propionibacterium acnes* **(Figure 6)**, commonly associated with acne and oily skin in a superior fashion to non-standardized black seed oil. The current study also demonstrates the superiority of B'utyQuin™ over a non-standardized black seed oil in modulating the microbial diversity present in acne-prone skin.

The following study investigates and compares the influence of standardized black seed oil (B'utyQuin™) and Non-Standardized Black Seed Oil (NS BSO), which contains less thymoquinone and much higher levels of FFAs, on the diversity of microorganisms present on oily skin and often observed with acne.

Organism selection

For this study, the organisms *Corynebacterium simulans, Malassezia globosa*, *Propionibacterium acnes*, *Staphylococcus capitis*, *Staphylococcus epidermidis*, *Staphylococcus hominis* and *Streptococcus mitis* **(Table 1)**. were selected based on their properties related to skin health. The seven test microorganisms used in this study are strains predominantly found on oily skin [18-27].

The co-culture of different species was adjusted accordingly so that the fast-growing species would not overgrow the slow-growing species and that each species would still be

STRAIN	PROPERTIES
Corynebacterium simulans	Part of the commensal flora of humans but can be opportunistic pathogens in some populations.[18,19]
Malassezia globosa	Commensal on scalp and skin. Reduced abundance in dandruff scalp.[18,20,21]
Propionibacterium acnes	Part of the skin flora and commensal but is also involved in the pathogenesis of acne as a secondary factor.[18,22,23]
Staphylococcus capitis	Commensal on human skin. Multi-resistant strains that can be difficult to treat.[18,24]
Staphylococcus epidermidis	Colonizes the skin and mucous membrane of humans.[25]
Staphylococcus hominis	Ubiquitous human skin commensal, most frequently isolated from healthy skin. Protects against opportunisticpathogens such as *S. aureus*.[18,26]
Streptococcus mitis	Commensal on human skin and oropharynx. Opportunistic pathogen in immunocompromised patients.[18,27]

Tab. 1 Microorganisms Used in this Study and Their Properties.

present after four hours of incubation in liquid culture. Dilutions were dispensed on agar plates and incubated under appropriate conditions for the strains. After incubation, the colony forming units (CFU) were counted on each plate and the CFU/ml for each strain were calculated in percent, with respect to the control.

Preparation of B'utyQuin™ and non-standardized black seed oil solutions

A 5% solution of each product was prepared in squalane under sterile conditions with the constituent profiles below:

- B'utyQuin™ – *Nigella sativa* Seed Oil, by TriNutra, is a stable cold-pressed black seed oil with 3% thymoquinone and less than 2% FFAs
- Non-Standardized Black Seed Oil – from N*igella sativa* seeds, containing 0.45% thymoquinone and 9.3% FFAs
- Control - containing 500 µl of phosphate-buffered saline (PBS)

Primary outcome goals

The primary goal of this study was to evaluate the influence of standardized B'utyQuin™ BSO versus a NS-BSO material on the diversity of the key microorganisms present on oily skin and with acne. The evaluation was conducted to determine whether the standardized black seed oil material (B'utyQuin™) had selective and/or stronger antimicrobial effects than the non-standardized material on organisms commonly found on acne prone oily skin.

Study results

Influence of B'utyQuin™ on the Diversity of the Key Microbes of Oily Skin

In a co-culture of seven different microbial species incubated with a 5% solution of B'utyQuin™ or NS-BSO in squalane for four hours, B'utyQuin™ demonstrated a selective effect on the microorganism's diversity. *P. acnes* was most sensitive to B'utyQuin™, as it was completely absent in the diversity culture at the end of the incubation period, while NS-BSO has no inhibitory effect on it. In fact, the growth of *P. acnes* was enhanced to 108% of the original culture count in the presence of the NS-BSO **(Figure 5)**. This result lends support to an earlier analysis in which B'utyQuin™ inhibited *P. acnes* by 76%, as shown in a zone-of-inhibition study on plated agar, compared to NS-BSO or an antibiotic control (**Figure 6)**.

S. mitis was found to be very sensitive to both B'utyQuin™ and NS-BSO, as only about 5% of the original bacterial count remained at the end of the incubation period with either material. The Staphylococcus organisms reacted strain specifically to the B'utyQuin™ and NS-BSO materials.

S. epidermidis was the bacterial strain most resistant to incubation with B'utyQuin™ as demonstrated by ~25% of the original bacterial count remaining. However, no statistically significant difference in the growth inhibition of *S. epidermidis*, *S. capitis*, *S. hominis*, *S. mitis* was observed between the B'utyQuin™ and NS-BSO materials. *C. simulans* incubation with the two materials yielded similar results to *S. epidermidis*. In total, all bacterial species showed significantly reduced bacterial counts after four hours of incubation with B'utyQuin™. The lowest effect of B'utyQuin™ (yet still significantly inhibitory) was observed for the fungal species, *Malassezia globosa*, which was inhibited by more than 60% when measured against the starting bacterial culture count. This compares to less than 20% inhibition when incubated with the NS-BSO. **(Figure 7)**. In a separate study, B'utyQuin™ was also very effective against another Malassezia species, *M. furfur*, an opportunistic pathogen found on oily skin and acne lesions **(Figure 5)** [10].

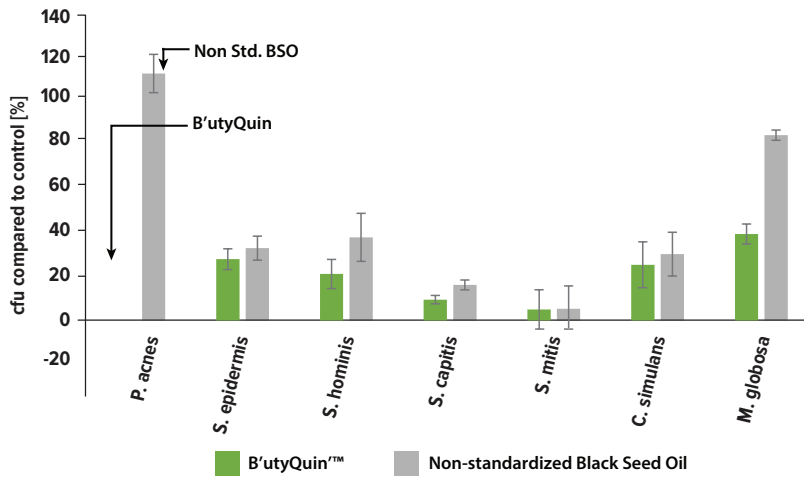

Fig. 7 Direct comparison of the effect of B'utyQuin™ and Non-Standardized Black Seed Oil on Microbial Diversity.

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Discussion and conclusion

In the current study, standardized Black Seed Oil with 3% thymoquinone and low content (<2%) of free fatty acids (B'utyQuin™), was analyzed to determine its effect on the diversity of microorganisms commonly found in those with oily skin and/or acne. The results were compared to a Non-Standardized Black Seed Oil (NS-BSO) that contains low amounts of thymoquinone (0.5%) and higher amounts of free fatty acids (9%). The different concentration of the active, thymoquinone, between the two materials was postulated to influence its effectiveness on microbial diversity.

For this purpose, using a co-culture of seven organisms, incubated with B'utyQuin™, NS-BSO, or phosphate-buffered saline (PBS) control, the effect on microbial growth was measured and calculated in percentage.

B'utyQuin™ demonstrated a complete inhibitory effect on *P. acnes* (100%), which was no longer detectable in the culture after the incubation period, Conversely, NS-BSO actually enhanced the growth of *P. acnes* to 108%, when compared to the control. A similar effect was noticed in a separate Zone of Inhibition study of P. acnes comparing B'utyQuin™ and NS-BSO and an antibiotic.

A strong inhibitory effect on *S. mitis* was observed for both materials, with only about 5% of the original bacterial count being present after incubation. No statistically significant different effect between the BSO materials was observed in regard to growth rates of *S. capitis*, *S. epidermidis*, *S. hominis*, and *C. simulans* strains. While the two materials showed the weakest effect on *Malassezia globosa*, B'utyQuin™ still reduced *M. globosa* growth by more than 60%, compared to just 19% for the NS-BSO. B'utyQuin's inhibitory effect on *Malassezia globosa* is similar to its effect on another opportunistic Malassezia species found on oily skin, *Malassezia furfur*.

In summary, these results indicate that the standardized Black Seed Oil (B'utyQuin™) has a significantly stronger effect on the microbial growth of microorganisms associated with oily skin and acne than the non-standardized version of black seed oil. The observed strong inhibitory effect is likely attributed to B'utyQuin's unique standardized composition of its powerful primary constituent, 3% thymoquinone, with a low free fatty acid content. This composition affects sebum/fat production which is a primary source of food for these microorganisms. Other benefits of the standardized BSO and its key active component, thymoquinone such as anti-inflammatory properties [11], modulation of fat/sebum [6] as a result of mitochondrial functions boost, reduce skin oiliness and subsequent acne occurrences [15].

Thymoquinone may also facilitate increased oxygen and nutrient supply to tissue surfaces via improvement of mitochondrial functions, enhance surface tissue metabolism and turnover, restore and tighten the skin barrier and increase the skin's resistance to opportunistic pathogens Additionally, B'utyQuin™ has been shown to soothe redness, calm and restore harmony to sensitive skin [11]. Stress is often a contributing factor to acne outbreaks and thymoquinone has been shown to significantly impact stress via modulation of cortisol, the stress hormone, when consumed orally [17].

This study and previous research highlight the superiority of a standardized BSO (B'utyQuin™ with 3% thymoquinone and <2% FFA) over non-standardized BSO in mitigating several of the key factors involved in acne occurrence as illustrated in **Figure 2**.

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Formulating for Professional Automotive Cleaning

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The automotive industry is growing with global sales of motor vehicles at $2.3 trillion in 2021. Regionally, Mainland China is the largest market at 37% of global sales, followed by North America at 20% and Western Europe at 17% [1]. As such, it is no surprise that automotive cleaning products are in demand; therefore, having effective, efficient solutions is critical.

Ingredient basics

Surfactants

Surfactants are Surface Active Agents and at the core of every formulation and are said to make "water wetter." They reduce the surface tension of aqueous-based formulations allowing the water to have better contact with hydrophobic soils such as asphalt, diesel, and oils. Surfactants improve the detergency of the formulation and prevent the soil from redepositing back onto clean areas.

Surfactants are amphiphilic, meaning that they have a head group that is attracted to water and a tail group that is attracted to oils. Surfactants are grouped into four categories based on the charge of the head group: non-ionic, anionic, cationic, and amphoteric.

Nonionic surfactants have no formal charge and are typically effective on oily soils. They tend to have moderate foam properties and low CMCs (critical micelle concentrations) making it easier to reach cleaning targets. Usually, nonionic surfactants are used as primary surfactants driving the performance of a cleaning product. They also have good compatibility with other ingredients and improve the wetting properties.

Anionic surfactants have a negative charge. They tend to be higher foaming and help with detergency. The functionality of anionic surfactants is heavily impacted by water hardness.

Cationic surfactants have a positive charge making them effective on particulate soils (that tend to have a negative charge) like asphalt and clay. Cationic surfactants are used as emulsifiers in rinse aid formulations to improve drying time and reduce water spots. Cationic surfactants work synergistically with other types of surfactants, especially nonionics to improve detergency. Cationic surfactants are considered more co-surfactants than primary surfactants. They are used in combination with nonionic surfactants to boost detergency. They can also function as hydrotropes helping to solubilize other ingredients.

Zwitterionic or amphoteric surfactants are surfactants that carry both a positive and a negative charge. As stated, these charges can either be permanent or dependent on the pH value. They are often used in combination with anionic surfactants to produce high-foaming/foam-stable formulations.

Different surfactants are used for different cleaning applications. For example, in high-pressure or touchless cleaning, efficiency and performance is important. Many kinds of surfactants are available, and we found that a combination of a narrow range ethoxylate with a cationic hydrotrope is an ideal blend for pre-soaking. The narrow range ethoxylate provides superior degreasing while the cationic contributes to degreasing and is highly effective on particulate soils.

In the case where a water-based high-pressure cleaner is required, surfactant systems are available and are designed to especially address summertime and/or wintertime traffic film removal.

Further, there are more sustainable options such as alkylglucosides since they have hydrotropic properties, excellent solubility in high alkaline systems and provide superior wetting.

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Solvents

Solvents are used to penetrate and soften tenacious soils like asphalt, tar, and oils. These are usually petroleum based. Solvents are the main component in the cold degreasing agents used for engine washing and car paint degreasing. Solvents are also used in rinse aid formulations to reduce water spots and improve drying.

Builders and Complexing agents

Chelating agents are used to bind free metal ions in water thus preventing them from interfering with the surfactants. They will usually help to maintain the foam properties, especially in the presence of anionic surfactants, and increase the cleaning effect.

Tetrasodium EDTA has long been used in this application, but it is being replaced with "greener" counterparts: MGDA (methylglycine N, N-acetic acid, trisodium salt) and GLDA (glutamic acid, N, N-diacetic acid, tetrasodium salt). These "greener" chelating agents have a high biobased content and are readily biodegradable making them a good choice for heavy metals control. Further, MGDA can be found in either liquid or solid forms depending upon the required formulation. GLDA is available as a liquid form in concentrations up to 55%.

Phosphates and phosphonates are also good dispersing agents that find use in professional car products. They help with the cleaning process and can manage some water hardness. If they are released in surface waters, they can act as fertilizers (eutrophication), so their use may be restricted in some states and areas.

There are many forms of silicates and metasilicates that can be used to improve detergency, add alkalinity, and help to prevent corrosion.

Alkaline

It is well known that caustic will improve grease removal and enhance the cleaning effect. Sodium and potassium hydroxide are the common ingredients. These can raise the pH to high levels and can also corrode some materials. Frictionless pre-soaks often contain high levels of alkaline ingredients.

Alkyl glucosides are effective by improving the performance of caustic-based detergents by increasing the wetting power of the caustic solution. Alkyl glucoside surfactants are soluble and will remain in one phase, in up to 50% caustic solutions.

Narrow Range Ethoxylation: Providing Formulator Advantage

Conventional base-catalyzed fatty alcohol ethoxylates are used in many cleaning formulations. In certain circumstances they provide good performance. However, in high-performance cleaning applications, the use of an advanced narrow range ethoxylation (aka NRE) process can provide significant cleaning benefits to car washing.

In **Figure 1** we show the typical degree of ethylene oxide polymerization of three alcohols reacted with an average of 5 moles of ethylene oxide.

- In orange – a C 9-11 synthetic alcohol ethoxylated using a narrow-range process
- In grey – a C 9-11 synthetic alcohol ethoxylated with a conventional base-catalyzed process
- In blue – a nonyl-phenol synthetic alcohol ethoxylated with a conventional base-catalyzed process

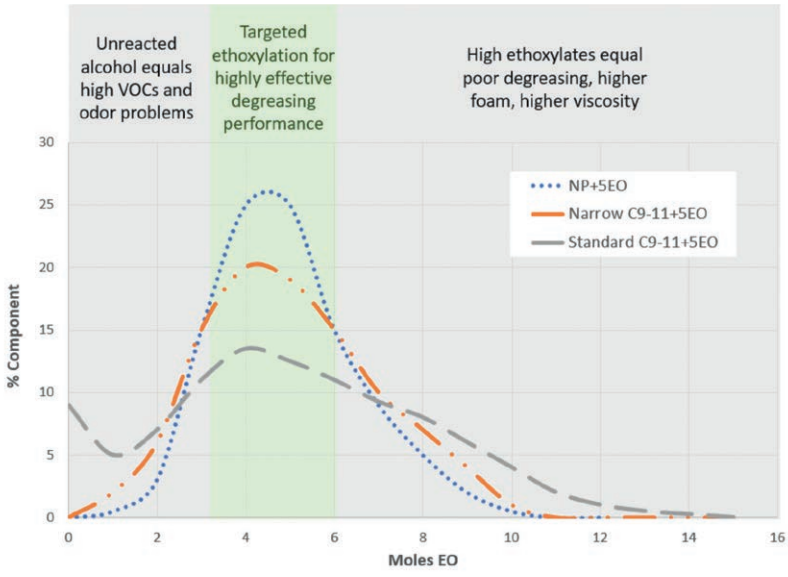

Fig. 1 Molecular distribution of various alcohols ethoxylated to provide an average 5EO via standard and narrow range processes

5 EO was chosen as a benchmark as it is at around this degree of ethoxylation that the performance of the surfactant molecule as a degreaser is optimal i.e., the hydrophilic/lipophilic balance (HLB) is ideal for hard surface cleaning. Thus, a maximum yield of the 5EO surfactant is the most desirable with the area given in green background for contrast. Low amounts of EO and unreacted alcohol are not desirable. This creates poor solubility, poor degreasing performance, and the unreacted alcohol gives off unwanted odors. In an enclosed space, like a tunnel wash, this would be noticeable. With excessive ethoxylation unwanted components are added diluting the functionality of the 5 mole EO and adding issues with viscosity and higher foam. The less desirable portions of the surfactant distribution have a grey background in **Figure 1**.

The nonyl phenol ethoxylate (NPE) is added as a benchmark only, as it is banned in Europe and under scrutiny in other areas. Due to its particular chemistry, the NPE does form a tightly peaked distribution with a high percentage in the target 5 EO range.

It is the peaked distribution that provided the excellent performance characteristics that made NPE usage so ubiquitous in the past, and which made its replacement so challenging to achieve.

As can be seen, the narrow range ethoxylates (NREs) most closely match the peaked distribution of the NPEs, without, of course, the major environmental and toxicity burden. Narrow-range ethoxylates have a strong peak around the target 5EO with very low residual alcohol and smaller amounts of higher ethoxylates. Because the average MW of the molecule is smaller than the standard ethoxylates, the rate of diffusion is faster, promoting faster spreading and wetting, and giving the water-free product, as sold, a much lower viscosity.

The standard process ethoxylates have a very different, and much broader profile than the other process exemplified, with a much wider molecular distribution. On the low MW end, a significant amount of starting alcohol remains unreacted. This alcohol is volatile and leads to odor in the final product, detectable by users of the final formulation. The yield of the optimized 5 EO product is also much lower with

the profile skewed to the higher degree of ethoxylation. The higher MW fractions have far less degreasing power than the optimized 5EO components (poor HLB), contributing mostly to undesirable characteristics in the finished product, such as higher viscosity and foaminess.

Narrow-range ethoxylates are the building blocks for many of our optimized cleaning products. Nouryon offers several different hydrophobes with varying degrees of ethoxylation.

Sustainability

Sustainability is important and so is selecting appropriate ingredients for those formulations. Nonionics such as alkyl glucosides are readily biodegradable and have a high renewable carbon index (RCI). Chelants such as MGDA and GLDA are, also, readily biodegradable and have a high RCI. In many cases, third-party certifications exist such as Ecocert, Nordic Swan, Safer Choice, etc. and we recommend checking with your local sales representative to obtain more information.

Concept formulations

Water solubility is important for formulations since it is basic to car cleaning, both in the cleaning and rinsing processes. Also important is water conservation. Recently there has been much attention on reducing the amount of water needed in the cleaning industry. The following formulas are typically used in concentrate form to reduce the amount of water needed in vehicle cleaning formulations.

Pre-soak 1	F1 (EU)	F2 (Global)	F3 (Global)	F4 (non-EU)
Ingredients	10% Berol® ENV226 Plus	10% Berol® EZ-1	10% Berol® DGR 81	10% Berol® 226
	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S
	4% Na-Metasilicate pentahydrate	4% Na-Metasilicate pentahydrate	4% Na-Metasilicate pentahydrate	4% Na-Metasilicate pentahydrate
	80% Demin	80% Demin	80% Demin	80% Demin
Appearance	Clear	Clear	Clear	Clear
Cloud point	> 70°C	51°C	59°C	> 70°C
pH	13.1	13.0	13.0	13.1
Dilution & pH	1/20 – Clear, pH 12.0	1/20, Clear/slightly hazy, pH 12.0	1/20 – Turbid, pH 11.9	1/20 – Clear, pH 12.0

Pre-soak 2	F5 (EU)	F6 (non-EU)
Ingredients	4% Ethylan® 1005	4% Ethylan® 1005
	4% Berol® R648 NG	4% Berol® 556
	3% Dissolvine® GL-47-S	3% Dissolvine® GL-47-S
	1% Na-Metasilicate pentahydrate	1% Na-Metasilicate pentahydrate
	1% NaOH	1% NaOH
	87% Demin	87% Demin
Appearance	Clear	Clear
Cloud point	> 70°C	> 70°C
pH	12.9	12.9
Dilution & pH	1/60 – Clear, pH 11.4	1/60 – Clear, pH 11.3

Water-based high-pressure shampoo	F7 (EU)	F8 (non-EU)
Ingredients	10% Berol® ENV226 Plus	10% Berol® 226
	2% Berol® R648 NG	2% Berol® 556
	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S
	2% Na-Metasilicate pentahydrate	2% Na-Metasilicate pentahydrate
	80% Demin	80% Demin
Appearance	Clear	Clear
Cloud point	> 70°C	> 70°C
pH	12.9	12.9
Dilution & pH	1/60 – Clear, pH 11.4	1/60 – Clear, pH 11.3

Foam Shampoo 1	F9 (EU)	F10 (non-EU)
Ingredients	10% Berol® ENV226 Plus	10% Berol® 226
	1% Ampholak® YCE	1% Aromox® 14D-W970
	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S
	2% Na-Metasilicate pentahydrate	2% Na-Metasilicate pentahydrate
	81% Demin	81% Demin
Appearance	Clear	Clear
Cloud point	> 70°C	> 70°C
pH	12.8	12.9
Dilution & pH	1/40 – Clear, pH 11.4	1/40 – Clear, pH 11.4

Fig. 2 White metallic tile (car lacquer finish)

Fig. 3 Soiled metallic tile (train engine soil)

Fig. 4 Cleaning process

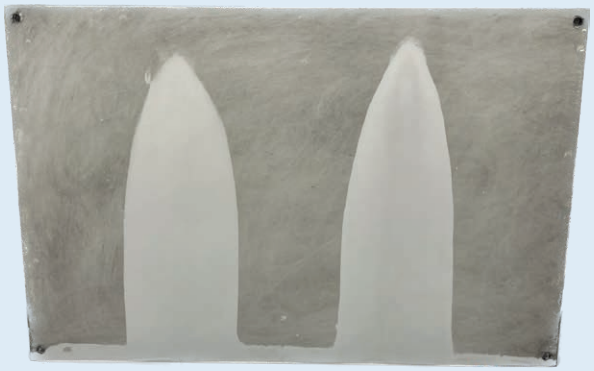

Fig. 5 Cleaning test, F9 and F10 (1-40 dilutions)

Foam Shampoo 2	F11 (EU)	F12 (EU)	F13 (Global)	F14 (Global)
Ingredients	10% Berol® EZ-1	10% Berol® DGR 81	10% Berol® EZ-1	10% Berol® DGR 81
	1% Ampholak® YCE	1% Ampholak® YCE	1% Aromox® 14D-W970	1% Aromox® 14D-W970
	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S	6% Dissolvine® GL-47-S
	2% Na-Metasilicate penta-hydrate	2% Na-Metasilicate pentahydrate	2% Na-Metasilicate pentahydrate	2% Na-Metasilicate pentahydrate
	81% Demin	81% Demin	81% Demin	81% Demin
Appearance	Clear	Clear	Clear	Clear
Cloud point	70°C	> 70°C	57°C	59°C
pH	12.7	12.7	12.8	12.8
Dilution & pH	1/20 – Clear, pH 11.6	1/20, Clear/slightly hazy, pH 11.6	1/20 – Clear/slightly hazy, pH 11.7	1/20 – Turbid, pH 11.6

Truck Cleaner 1	F15 (EU)	F16 (non-EU)
Ingredients	4% Ethylan® 1008	4% Ethylan® 1008
	2% Berol® R648 NG	2% Berol® 556
	2% Ampholak® YCE	2% Aromox® 14D-W970
	1% NaOH	1% NaOH
	20% Dissolvine® GL-47-S	20% Dissolvine® GL-47-S
	71% Demin	71% Demin
Appearance	Clear	Clear
Cloud point	38°C	38°C
pH	13.4	13.4
Dilution & pH	1/40 – Clear, pH 11.8	1/40 – Clear, pH 11.8

Truck Cleaner 2	F17 (EU)	F18 (non-EU)
Ingredients	12% Berol® ENV226 Plus	12% Berol® 226
	3% AG™ 6206	3% AG™ 6206
	1% NaOH	1% NaOH
	20% Dissolvine® GL-47-S	20% Dissolvine® GL-47-S
	64% Demin	64% Demin
Appearance	Clear	Clear
Cloud point	43°C	45°C
pH	13.4	13.4
Dilution & pH	1/40 – Clear, pH 11.8	1/40 – Clear, pH 11.8

* All formulations have been stable for 10 days.

The future

The dynamics of car and vehicle cleaning will be focused on sustainable, recyclable, reduced water usage, environmental impact, and just as importantly, efficiency for quicker and easier cleaning cycles. Formulating the right solution will be key.

About Nouryon

Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, agriculture and food, pharmaceuticals, and building products. Furthermore, the dedication of more than 8,400 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands. Visit our website and follow us @Nouryon and on LinkedIn.

Reference:

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Sustainable Beauty: Recycled Plastic Packaging for Cosmetics

A. Grabitz

In the past the beauty industry has been criticized for its extensive use of single-use plastics, contributing to global plastic pollution.

However, as environmental awareness grows, beauty brands are nowadays tending to more sustainable packaging options. Furthermore, brands have to deal with specific regulations and adapt to local requirements (eg: AGEC law ...). Cosmetic companies are now embracing recycled materials like high-density polyethylene (HDPE) and polypropylene (PP) emerging as eco-friendly packaging solutions.

Post consumer recycled plastics may be beneficial in terms of:

1. **Reduced Carbon Footprint:** HDPE and PP can be recycled multiple times without losing integrity. Using recycled materials generates fewer greenhouse gas emissions than virgin plastics and contributes to the reduction of carbon footprint of cosmetics packaging.
2. **Resource Conservation:** Recycled HDPE and PP conserve resources by decreasing the demand for virgin plastics, derived from fossil fuels. This helps save energy resources and promoting sustainability.
3. **Waste Reduction:** Recycling HDPE and PP diverts plastic waste from landfills and oceans, reducing plastic pollution and preserving ecosystems.

Nevertheless suppliers and brand owners are still facing several challenges in using recycled plastics for their applications:

1. **Quality Consistency:** Maintaining consistent quality can be challenging due to variations in feedstock sources. Close collaboration with suppliers is absolutely mandatory to ensure that recycled plastics meet standards for appearance, durability, and safety.
2. **Consumer Perception:** Some consumers associate recycled materials with lower quality or aesthetics.
3. **Design Limitations:** Recycled plastics may have design limitations compared to virgin plastics. However, creative packaging design can turn these limitations into unique selling points.
4. **Supply Chain Considerations:** Ensuring a reliable supply of recycled HDPE and PP can be challenging, but diversifying sources and collaborating with recycling facilities mitigates supply chain risks.

Furthermore the risk of chemical contaminants in recycled plastics, including HDPE and PP, needs careful consideration. Plastic materials can come into contact with harmful chemicals during their lifecycle but also ingredient from goods packed in the plastic during their first life as aromas, stabilizers or pigments can still be present in the recyclate. Furthermore also chemicals which were used in the manufacturing of the packaging like printing inks, antioxidants or masterbatches remain in the recycled material and may leach into the product. Cosmetic companies should partner with reputable suppliers and testing partners who adhere to strict quality control measures and ensure their recycled HDPE and PP meet safety and purity standards. Thorough testing, safety assessment and analysis of packaging materials further mitigate risk of hazardous chemicals contaminating cosmetic products.
The Cross-Industry Consortium CosPaTox (https://cospatox.com/) was founded in 2021 aiming to accomplish so far missing specific safety standards for high-quality Post-Consumer Plastic Recyclates (PCRs) for cosmetics and other household packaging as well as the implementation of on-site measurement methods for recyclers. By the end of 2023 the publication of an industry guideline how to assess safety of recycled plastic for cosmetic application is announced by the Consortium.

Conclusion

The use of recycled HDPE and PP for cosmetics packaging represents a significant step towards a sustainable beauty industry. Overcoming challenges through innovation, communication, and responsible sourcing, cosmetic brands can contribute to a greener planet while meeting the demands of environmentally-conscious consumers. By prioritizing sustainability and addressing concerns about chemical contaminants, the cosmetics industry can play a vital role in reducing its environmental footprint and promoting eco-friendly practices.

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mibelle GROUP biochemistry

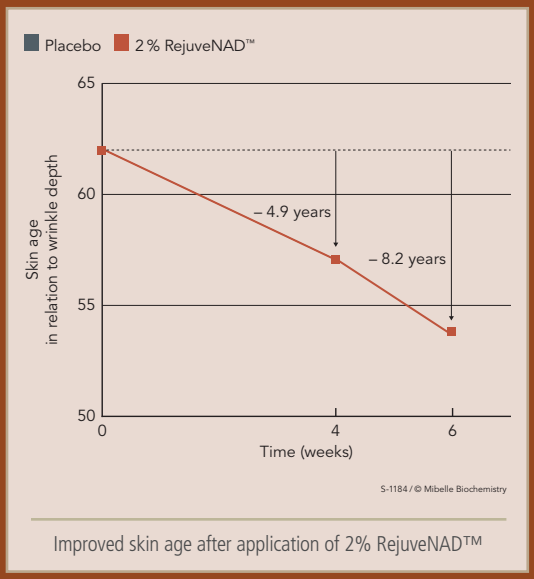
Boosting Endogenous NAD⁺ for Skin Longevity

The cosmetics industry is increasingly prioritizing the trending concept of longevity to fulfil the everlasting demand for vital, youthful-looking skin as well as skin rejuvenation. This focus on skin longevity is in line with the historical pursuit of a longer lifespan, which has driven advances in aging research. In 2013, researchers have introduced the classic "hallmarks of aging" to outline the fundamental biological processes underlying aging. Growing evidence underlines that the metabolite nicotinamide adenine dinucleotide (NAD^+) plays a significant role in all hallmarks of aging. In recent years NAD^+ has gained substantial recognition, especially in the food supplement sector, as studies have shown a strong correlation between declining NAD+ levels and accelerated aging. NAD^+ is a vital coenzyme in energy metabolism, particularly because it is essential to produce ATP. Moreover, NAD^+ serves as a cofactor for hundreds of NAD^+-dependent enzymes involved in diverse cellular processes which hold substantial relevance for all cell types, including skin cells.

Incorporating the metabolite NAD^+ into cosmetics has been challenging due to its instability in formulations and limited penetration into skin cells. An innovative solution to this issue is RejuveNAD™, an active ingredient derived from organic sunflower sprouts that are cultivated sustainably by indoor farming. RejuveNAD™ naturally boosts endogenous NAD^+ levels by enhancing the expression of the rate-limiting NAD^+ synthesis enzyme nicotinamide phosphoribosyltransferase (NAMPT). Further studies have demonstrated that RejuveNAD™ tackles at least five out of the nine classic aging hallmarks, namely genomic instability, epigenetic alterations, mitochondrial dysfunction, loss of proteostasis and cellular senescence.

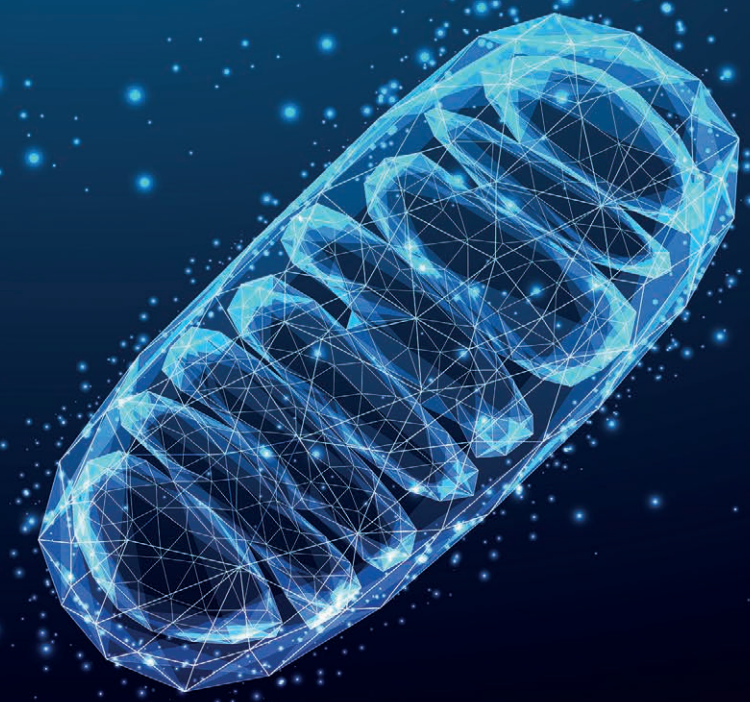
The skin is exposed to external and internal stress that can cause DNA damage, a driver of skin aging. The efficiency of the skin to repair its DNA reduces with age. To simulate skin aging, DNA damage was induced in keratinocytes. Treatment with sunflower sprout extract reduced the aging stress-induced elevation of the DNA damage and epigenetic markers that lead to the development of senescent cells. Moreover, the rejuvenation potential of RejuveNAD™ was assessed in skin explants that were exposed to UV and subsequently treated. RejuveNAD™ enhanced mitochondrial function and proteostasis by the reduction of mitochondrial protein carbonylation, a marker of protein damage. The levels of the longevity marker sirtuin 1 as well as collagen XVII were significantly increased in the UV-treated explants, representing a reverse aging effect of RejuveNAD™. Furthermore, RejuveNAD™ counteracts the impacts of photoaging by increasing the collagen density.

In a placebo-controlled clinical study, the use of a cream containing 2% RejuveNAD™ appliedtwice daily for 42 days by 22 women aged 52 to 65 resulted in improvement in facial skin aging signs. RejuveNAD™ increased skin smoothness and had a significant lifting effect in the jowl line region. Before-and-after pictures of a volunteer demonstrated effective rejuvenation, visible by a reduction in wrinkles and folds, leading to facial reshaping. The application of RejuveNAD™ reduced crow's feet wrinkle depth by 9.2% and 15.3% after 28 and 42 days, respectively. Moreover, a comparison with a reference dataset comprising over 300 women aged 30 to 65 years showed that RejuveNAD™ made the skin appear 8.2 years younger after 42 days. Overall, the findings demonstrate that RejuveNAD™ promotes skin longevity, resulting in visible rejuvenation of the skin.



Improved skin age after application of 2% RejuveNAD™

info@mibellebiochemistry.com | www.mibellebiochemistry.com



Focus on Cell Respiration – Have you Heard of Hypoxiageing™

The oxygen we breathe with our lungs is used by all our body's cells including skin cells. This cell respiration process is essential to their survival. Specifically, oxygen is used by mitochondria, the cell's powerhouse, to produce energy and water, to ensure optimal functioning of vital metabolisms such as hydration, regeneration, protection, and cell proliferation.

Hypoxiageing™ is tissue ageing induced by cell hypoxia. It is a rising skin concern because of pollution. Although the skin is very poorly permeable thanks to its multi-lamellar structure, a certain number of entry routes exist, particularly via the pores and the capillary infundibulum. Once deposited on the skin, the microparticles found in polluted atmosphere deliver the molecules adsorbed on their surface which can thus penetrate even through healthy skin thanks to their small size, their lipophilic nature and the drop in quality of the barrier function of the epidermis. The absorption of these microparticles causes toxic effects on cellular components and in particular, a deficit in the supply of oxygen.

Lack of oxygen or hypoxia causes the cell to return to its old mode of energy production without mitochondria, called fermentation. This is 18 times less effective. This alteration in cell respiration induces premature skin ageing together with dull, dry, and devitalised skin.

More and more beauty salon offers oxygen therapy to counteract hypoxiageing™ but a cosmetic solution should be able to answer this increasing needs.

To address hypoxiageing™, the first step consists of improving cell respiration and energy production, necessary for optimal cell functions. The second one is detoxifying the cells from micropollutants to protect mitochondria and reduce cell oxidative damage. And the third one is about cell regeneration especially to ensure skin barrier reinforcement as pollution induces barrier function disruption and dysbiosis.

SEDERMA has developed an active ingredient of marine origin allowing, like an exercise, to stimulate the production of energy by skin cells, to strengthen the barrier function of the epidermis, to stimulate the depollution mechanisms and allows to restore all its radiance to the skin in particular by promoting hydration of the skin and its smoothing.

Stay connected to be among the first to benefit from this innovative and sustainable ingredient which protects the skin from pollution and combats hypoxiageing™.

More to come in a few weeks!

www.sederma.com

sederma

Unlocking Sustainable Innovation: Croda Consumer Care's Brand Portfolio and Environmental Commitment

CRODA

Interview with **Angelina Gossen,** Technical Marketing Manager Consumer Care, **Croda**

To start, could you provide us an overview of Croda's commitment to sustainability in general and within the Consumer Care division?

Sustainability is at the heart of our corporate philosophy, and it is deeply integrated into our values and operations across all divisions, including Consumer Care. We aim to be the most sustainable supplier of innovative ingredients by 2030 and we intent to achieve this through three key aspects in our approach: by becoming Climate, Land and People Positive. So, how can this be transferred to our everyday lives?

We are dedicated to responsibly sourcing our raw materials. This means ensuring they are ethically and sustainably procured, while actively reducing our carbon footprint during the process. We invest significantly in research and development to create sustainable ingredients and solutions. Our innovations focus on enhancing product performance while minimising environmental. Already 57% of our organic raw materials are bio-based, with our target at 75% by 2030.

Angelina Gossen

We collaborate closely with our customers to help them achieve their sustainability goals. This involves providing education and technical support to facilitate the integration of sustainable practices into their formulations, with a location-based approach to be able to respond to the locally individual needs of our customers.

A specific example of our People Positive commitment is, that in 2022, through the use of our solar-protection ingredients, Croda contributed to protecting more than 61 million people from potentially developing skin cancer. Here, we have already exceeded our target for 2030 of protecting at least 60 million people.

Croda has a diverse range of brands within Consumer Care. Could you elaborate on how these brands contribute to Croda's sustainability targets?

Croda Consumer Care includes several well-recognised brands, each pursuing with distinct sustainability goals. Beginning with the **Croda** brand:

In **Home Care**, we have published the first Life Cycle Analysis (LCA) for a biopolymer in 2022. This is the start of one of our biggest sustainability projects, as we head to have LCAs for our top 100 ingredients throughout all Croda by 2030. This will help suppliers, formulators, retailers, and customers understand the impact of our products beyond our factory gate, delivering greater transparency throughout the supply chain.

Through our **Personal Care** campaign Purposeful Beauty™, we have made it our mission to ensure an ethical and traceable supply chain in the sourcing of our materials, sharing transparent data around the manufacture of our ingredients, and transform our portfolio by producing sustainable, innovative technologies that promote healthy lives and wellbeing.

Sederma focuses on developing sustainable bioactive ingredients for the personal care sector with substantiated efficacy. Their know-how and the mastery of biotechnology, vegetal extraction and plant cell culture allows environmentally conscious sourcing, waste reduction as well as water- and energy savings.

Crodarom and **Alban Muller** form the Botanical Alliance and they are specialised in botanical extracts with an emphasis on biodiversity conservation. Crodarom has more than

20 years of experience in microwave-assisted extraction, and Alban Muller contributes with methods like Zeodration, a unique energy-saving and pollutant-free drying technique to transform botanical extracts from liquids into a powder form, to direct their research in the valorisation of plants via green technologies.

Our fragrance division includes the brands **Iberchem** and **Parfex**. Both contribute by developing eco-friendly fragrances with resource efficiency and responsible sourcing. Overall, these brands align with Croda's comprehensive sustainability goals, offering unique contributions to create environmentally responsible solutions.

Could you share some insights into the emerging trends in sustainable formulations and ingredients, and how Croda is addressing them?

Consumers are increasingly seeking products that contain natural and organic ingredients. This trend has driven the demand for plant-based and sustainably sourced products. As an example, at Croda we offer the ECO range. We have our production site in Atlas Point, USA, where we produce ethylene oxide from biomass instead of crude oil. So, alongside many other ingredients that are already 100% bio-based, we have now the opportunity to offer our customers an even wider range of 100% bio-based products.

Another emerging trend we are experiencing is, that consumers are more aware of ingredients than ever before. Transparency and traceability are big topics that our industry is trying to cope with. Especially in B2B companies this is not always easy. At Croda, we therefore actively seek certifications, labels, and standards to offer our customers more traceable parameters: Cosmos, Ecocert, NaTrue, ISO certifications, as well as vegan-suitable, halal, and kosher certificates, just to name some.

Are there any collaborations or partnerships on the horizon that will help Croda accelerate its sustainability efforts in the Consumer Care sector?

Just recently, we have announced the acquisition of Solus BioTech, a global leader in premium, biotechnology-derived materials. With over 30 years of expertise in the development of naturally derived ceramides and phospholipids, the acquisition broadens our offering of high performance, natural ingredients for the beauty industry. Produced via biotechnology at a GMP compliant plant, these ingredients are ideal to cater for the growing trend in fermented ingredient claims and interest in holistic wellness claims seen post-pandemic. Solus BioTech has a deep commitment to a greener and more sustainable future, aligning their scientific advancements with environmental stewardship and is therefore a valuable enrichment towards our sustainability goals.

In conclusion, what message would you like to convey regarding Croda's vision for a sustainable future in Consumer Care?

We are strongly committed to creating a sustainable future in ingredients manufacturing for the Home Care and Personal Care industry. We invite customers to look at our products as a symbol of quality and sustainability. To all industry professionals, I would like to say: Let us collaborate to lead the way towards a greener and more eco-conscious future together!

www.croda.com

SEPICLEAR G7™ - The Eco-friendly and Non-foaming Solubilizer & Preservative Booster

In recent years, consumers' interest in the ingredients contained in their cosmetic products has grown strongly. Various criteria such as INCI lists, ingredients, effects on the environment, naturalness, etc. play an important role.

Solubilizers are a difficult category to work with, as it is often still tricky to incorporate oily substances into the water phase. Therefore, natural solutions are of great interest in this regard.

Thanks to its expertise in green chemistry, Seppic offers SEPICLEAR G7™ (INCI: Heptyl Glucoside), a powerful non-ionic solubilizer derived from sugar/glucose and castor oil. SEPICLEAR G7™ is 100% natural [1], readily biodegradable [2] and COSMOS & Natrue certified. Being a concentrated liquid and cold processable, it is an energy-efficient solution. It is also odorless, colorless in formulations and resistant to extreme pH values.

Unlike other natural solubilizers, SEPICLEAR G7™ does not produce foam, which is an essential point when formulating cosmetic products such as toners, facial waters, perfumes or aqueous gels.

But not only due to its non-foaming properties it is a smart solution for e.g. micellar water: SEPICLEAR G7™ also increases the make-up removal performance of make-up remover formulations (tested on a W/O foundation compared to ethoxylated solubilizers) and thus improves the efficiency of cleansing.

It can also be used in dental care products due to good toxicological data.

Additionally, Seppic has recently re-explored the potential of SEPICLEAR G7™ and discovered its reinforcing preservative properties.

[1] Natural Origin Content according to ISO 16 128
[2] According to OECD Guideline 301F, 82.25 % of degradation in 28 days, within the 10-day window.

	Dose of preservatives used in natural formulas to reach Criterion A	
	PRESERVATIVE SYSTEM 1 *Beznyl Alcohol – Benzoic Acid – Dehydroacetic Acid – Tocopherol pH ≈ 5.5*	**PRESERVATIVE SYSTEM 2** *Aqua/Water – Sodium Benzoate – Potassium Sorbate pH ≈ 5.5*
Control Gel **without** SEPICLEAR G7™	**1.00%**	**1.00%**
Gel with 1% of SEPICLEAR G7™ (commercial product)	**0.50%**	**0.25%**
	÷2 the preservative dose	**÷2** the preservative dose

Table 1 Results of the challenge test depending on two preservation systems and the percentage of SEPICLEAR G7™ used.

Thanks to challenge tests conducted in accordance with ISO 11930, it has been proven that SEPICLEAR G7™ can reduce the dosage of preservatives to achieve criterion A, whereas this would not be possible with the preservative alone at a low dosage. Therefore, formulators can use less preservative while maintaining the same protection.

Its preservative-enhancing properties can be explained by its hydrotropic property, which increases the solubility of preservatives in formulations and reduces water activity increasing the performance of preservatives.

www.seppic.com/en/sepiclear-g7

With SEPICLEAR G7™, Seppic offers a natural solubilizer that not only allows the development of transparent products, but can also add value to various formulations thanks to its multifunctional properties and especially its new preservative booster properties.

SEPPIC

Seppic Germany | germany.seppic@airliquide.com | www.seppic.com


Matthias Maase

Interview with **Matthias Maase,** Director Global Sustainability Care Chemicals, **BASF**

Hello Matthias, you recently took over the lead of the newly established global sustainability team for BASF's Care Chemicals division at a very turbulent time. How did you get started?

Indeed, the economic situation in the Home and Personal Care Industry in Europe is not easy at the moment. High inflation levels make consumers think twice where they spend their money. This has an impact on how frequently people clean, which products they choose and if they spend the little extra for more sustainable alternatives. Nevertheless, the long-term mission in our industry is clear: we need affordable products, without compromising on performance while providing an improved sustainability profile.

For BASF's Care Chemicals division, sustainability has long been a driving force. How does the current situation in the European Chemical Industry affect the commitment you're making?

The transition of the chemical industry towards climate neutrality comes at a cost which cannot be ignored. In this context it is important that legislation and regulation provide a level playing field across industries. Players who are driving the change should be recognized. Moreover, cleaning and personal care products need ingredients, and these are built from carbon. This feedstock base cannot be "decarbonized". Other industries, like transportation, can switch easier from carbon-based fuels to other energy carriers like hydrogen or electricity. This should also be reflected by regulation.

The current geopolitical developments represent a huge challenge for the chemical industry as well as for our downstream industries. However, BASF has not changed its commitments to a more sustainable future and the same is true for Care Chemicals.

Where does your sustainability path lead to?

We have a lot on our agenda. The big topics are greenhouse gas emissions and climate neutrality, biodegradation, responsible sourcing of feedstocks and protection of biodiversity, water stewardship and circularity – just to name a few.

Our customers for example have published very ambitious targets to reduce their overall greenhouse gas emissions and they look toward us to support them in achieving their goals. Step one is to have a meaningful baseline, for which our customers need solid and comparable data on the product carbon footprints of the ingredients that we supply to them. BASF is pioneering the ability to provide such data for each of our individual sales products, and we are engaged in industry consortia that are currently developing harmonized methodologies and standards like Together for Sustainability (TfS) and the World Business Council for Sustainable Development (WBCSD) Partnership for Carbon Transparency (PACT).

Data and baselines are the starting point. As a next step, we need tangible measures and approaches to reduce product carbon footprints. BASF has initiated major projects for the reduction of our scopes 1 and 2 emissions as part of our "Net Zero 2050" Roadmap. In addition, we offer approaches like Biomass Balance that allow the use of sustainably sourced renewable carbon feedstocks from biomass, preferably residues. Replacing fossil carbon by renewable alternatives is an important approach to generate sizeable product carbon footprint reductions at scale, in a short period of time and in an affordable way. We recently converted the majority of our European ingredient portfolio with our partner Henkel to renewable feedstocks using the Biomass Balance approach. This will avoid more than 200,000 tons of CO_2 emissions in total in the next four years.

In personal care, we focus a lot on biodegradable alternatives for our high performing polymers. The Verdessence family represents high-quality biopolymers that enable our customers to gradually replace conventional ingredients in their products. We recognize that this is challenging and not possible on a one-to-one basis. But we have developed solutions that take a holistic view and support our customers in the development of new or adjusted formulations. Digitalization plays an important role in this journey. Whether it is the Emollient Maestro, the Surfactant Navigator or the SFA Formulator in personal care, our digital tools are giving our customers the ability to develop sustainable formulations faster and reduce ingredients with sustainability challenges.

Our offerings are accessible through our well-established digital platforms, like D'lite in the personal care space. Customers can find product information, formulation support, access to smart AI based tools and Product Carbon Footprint (PCF) data. This gives our customers the confidence they need to move forward.

Where do you see the greatest challenges to come?
Coming back to climate neutrality. The first and fastest step is avoidance. We have for example developed high performing ingredients that either boost the cleaning performance of a formulation or enable a net reduction of ingredients at the same performance level. Cleaning polymers and enzymes are great examples for such innovations. In a next step we increase the share of renewable carbon, e.g. from biomass or waste, to substitute fossil carbon, either in dedicated products or by means of the mass balance approach. This allows very significant reductions of the product carbon footprint of an ingredient. However, biomass will also not be an unlimited resource if you consider the growing world population, the need to stop deforestation and the decreasing area of arable land. The Home and Personal Care industry will continue to need chemicals, and chemicals will continue to be based on carbon chemistry. Cleaning products are converted to CO_2 at the end of their life, e.g. through biodegradation in a sewage plant. We need to explore new ways to recycle the carbon in this CO_2 as a feedstock for ingredients. In other words: in the long run we need to close the CO_2 re-cycling loop.

What is the innovation to come in the next couple of years?
As we move towards more renewable raw materials, we need to ensure that we source sustainably by protecting biodiversity and human rights. Through responsible sourcing, we can increase transparency and traceability in our supply chain. We continue to expand this. Starting with palm, we already have several certified sustainable raw materials in our portfolio. For coconut, castor, shea, argan, rambutan and others, we can provide dedicated information, creating transparency.

I have mentioned already our biomass balance approach to substitute fossil feedstocks by renewable alternatives, such as biomethane or biobased cracker feeds. In addition, we are transitioning production sites to green electricity. BASF has a 49.5% share in the world's largest offshore wind farm Hollandse Kust Zuid with an installed capacity of 1.5 GW. It will enable BASF to implement innovative, low-emission technologies at several of its production sites in Europe. BASF's Antwerp Verbund site will benefit from the renewable power to a significant extent.

Last, but not least circularity will be a key priority for the next years. Some approaches like shifting toward more biobased ingredients and enabling more sustainable feedstocks with Biomass Balance are already happening. In the future, we expect carbon capture and use to become an important additional pillar to also bring CO_2 back into the re-cycle loop.

The transition to more sustainable home and personal care is a journey. There will be no one master solution that solves all problems. It will be a mix of innovations and approaches that add up to create impact for a more sustainable future.

www.basf.com

From Waste to Value: Driving Skin Care Sustainability Claims with Upcycled Ingredients

Interview with **Erin Dunn**, **CP Kelco** Global Technical Lead, Consumer Care Research & Development


Erin Dunn

When we speak of upcycled ingredients in skin care and personal care, what does that encompass?

There is a variety of food waste that potentially can be utilized, if it can be shown to be of some benefit as an active or functional ingredient. For example, our KELCOSENS™ Citrus Fiber is upcycled from citrus peels, an abundant byproduct of the juice industry. It really is a workhorse ingredient that can help skin care formulators develop a range of SENSational textures while providing excellent stability. It can also take the place of synthetic or natural emulsifiers, while enabling the inclusion of a high level of oils.

What is the consumer perception of skin care products that claim to be sustainable or upcycled?

We know that consumers across the globe have a great interest in buying products that are "good for you" and "good for the planet." However, it is easy to be confused and overwhelmed by all the different "green," "natural" and other sustainability claims. For example, the European Union states that half of all such product labels offer weak verification, so it has issued a greenwashing directive to help ensure claims are clarified. Upcycling is a simpler concept to grasp; waste is diverted. Materials are given new purpose and, together, we can help lessen food waste. Now that is a great sustainability story!

Speaking of great sustainability stories, can you tell us more about KELCOSENS™ Citrus Fiber?

We are proud to be recognized as the first Upcycled Certified® citrus fiber ingredient in the industry. It was important to us to verify our commitment to upcycling and a near-wasteless lifecycle for KELCOSENS™ Citrus Fiber. We actively pursued third-party certification with the Upcycled Food Association, an independent nonprofit, to ensure transparency and credibility. To receive this certification, upcycled ingredients must meet a rigorous threshold of at least 95% upcycled input by weight. In addition, verifiable documentation is required that food waste is being diverted from a waste stream.

We believe in a circular economy that challenges the linear, take-make-waste model. KELCOSENS™ Citrus Fiber utilizes a closed loop approach. Leftover materials from the production process are repurposed into animal feed for over 30,000 animals per year and fertilizer to grow crops and orchards near our facilities in Brazil.

How can you influence more transparent label and sensory properties when replacing synthetics in general?

We understand that manufacturers are looking to reduce their environmental footprint and want transparency, especially since suppliers affect much of their product's impact. We provide our customers with a life cycle assessment as a method for identifying the environmental impact of our product and process so they can see for themselves. As far as replacing synthetics, we believe we can help you achieve your product goals and develop a specific sensory profile – everything from silky thin serums to gels to luxe creams. We also have options to support vegan, ECOCERT® and COSMOS® certification claims.

There are some concerns in the industry about emulsifiers, but how can KELCOSENS™ Citrus Fiber provide a stable emulsion if it is not an emulsifier?

Yes, some common concerns about emulsifiers include disrupting skin's natural pH levels, causing dryness and diminishing the protective barrier. KELCOSENS™ Citrus Fiber contributes to a stable emulsion by providing viscosity to the water phase. Some emulsifiers are more efficient thickeners than others, some work in limited pH range or require heat, and each contributes a unique feel or texture. These factors all play a role in deciding which alternative ingredient to incorporate into your formulation.

Can synthetic emulsifiers be replaced 1:1 with KELCOSENS™ Citrus Fiber?

This really depends on your specific system and the rest of your formulation. For instance, if you are trying to replace waxy emulsifiers (such as PEG-100 Stearate), you may need to include a waxy component in your oil phase to maintain the same feel. Each stabilization mechanism is completely different and should be assessed individually.

How can a formulator achieve different textures with KELCOSENS™ Citrus Fiber?

It plays well with other ingredients, so it is easy to create anything from a silky serum to a body lotion with a perceivable fresh feel on the skin to a light face cream with good pick up – or perhaps even powder applications.

We are exploring the use of citrus fiber in dry shampoo and color cosmetics to provide formulas with enhanced consumer desirability. With our citrus fiber, use level is tunable.

It can be adjusted to match your needs, pH level and oil content.

CP Kelco is a nature-based ingredient solutions company with approximately 90 years of experience working with manufacturers worldwide. We apply ingredient innovation and problem-solving to develop customized solutions that leverage our regional insights and meet manufacturers' goals to address consumer needs and preferences. Key product lines include gellan gum, pectin, xanthan gum, carrageenan, diutan gum, fermentation-derived cellulose and our new Upcycled Certified® KELCOSENS™ Citrus Fiber. Learn more at **www.cpkelco.com.**

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Home & Personal Care Ingredients & Formulations
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Award

11 | 2023
english

1 | IFF Health & Biosciences

Advances in Enzyme Engineering: Delivering on the Need for Sustainable Laundry Detergents

2 | GloryActives GmbH

Protective Beauty – Holistic Skin Protection through Enzymes

3 | COLIPI GmbH

Sustainable Yeast Oil – What the Fat?

Download SOFW award edition:

SOFW JOURNAL
BEST PAPER AWARD 2023

BERLIN, GERMANY, OCTOBER 25, 2023

For the 4th year in a row, the SOFW award was presented to the authors of the three best articles of the year published in SOFW Journal. Congratulations to the winners!

At the SEPAWA® CONGRESS 2023 in Berlin, Robert Fischer presented a certificate and the SOFW award to the authors. The three contributing authors had the opportunity to give a brief overview of their award-winning article to the congress attendees.

A total of 51 articles published in SOFW Journal – issues November 2022 to July/August 2023 from the Home & Personal Care and Fragrance Industries – were submitted and reviewed by a 9-member jury.

Feel free to apply to be considered by submitting an article to SOFW Journal as well. For questions, contact editorial@sofw.com. **We look forward to receiving your applications.**

The winners of this year's SOFW award together with the editor in chief of SOFW Journal: Enda Carey (IFF Health & Bioscience), Robert Fischer (SOFW journal), Maximilian Webers (COLIPI) and Dr. Volker Krug (GloryActives) at the award ceremony.

Picture Credits © Katrin Heyer / katrinheyer.de

The winner of the first prize is the article:

1 Advances in Enzyme Engineering: Delivering on the Need for Sustainable Laundry Detergents

Authors: A.J. Hoekstra, E. Carey, T.P. Graycar
Company: IFF Health & Biosciences

Abstract: There is a market need for more sustainable laundry detergents. Consumers are looking for cleaning products that are biobased and biodegradable, but do not comprise on stain removal performance. Enzymes play a key role in today's liquid laundry detergents. This article reports on recent advances in biotechnology to improve the stability and low temperature performance of enzymes for laundry. It also demonstrates how protein engineering can enable detergent formulators to remove chemical stabilizers.

Picture Credits © Katrin Heyer

The winner of the second prize is the paper:

2 Protective Beauty – Holistic Skin Protection through Enzymes

Authors: S. Christian, V. Krug
Company: GloryActives GmbH

Abstract: Every day, our skin is exposed to many factors that promote premature skin ageing. Two key factors are also closely related to each other: UV radiation and free radicals. It is known that UV radiation alone is responsible for 80% of the visible signs of facial skin ageing [1]. Therefore, our skin needs a reliable repair and protection system. Following nature's example, enzymes are ideal components for such a system, as they offer a highly efficient and long-lasting effect. The active ingredient Gloryderma®GUARD contains a synergistically acting complex consisting mainly of two enzymes: the repair enzyme photolyase, which is derived from microalgae, and an antioxidant enzyme in the form of an iron peptide. A liposomal encapsulation of the enzymes additionally improves their penetration into the skin.

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

The winning article of the third prize is:

3 Sustainable Yeast Oil – What the Fat?

Authors: J. Heuer, P. Arbter
Company: COLIPI GmbH

Abstract: After almost three years of an ongoing pandemic, climate change sent its regards this summer to remind humankind of what the future will look like. With political uncertainties arising worldwide, a sustainable oil source becomes increasingly important in both terms: ecological and economical. Yeast oil, triacylglycerides produced by oleaginous yeasts, is a promising alternative or even replacement to plant oils like cocoa butter, palm oil and similar. It has a small ecological footprint, can be produced locally in a reliable manner and has unique characteristics making it functional in multiple applications. The following article aims to give an exciting glimpse into a trending topic and COLIPI, a startup located in Hamburg dedicated to leading the fat revolution.

SOFW eVENTS

WeCONNECTING industries

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Do you already know our SOFW eVENTS?

At SOFW, we've been thinking about how we can better inform you with knowledge and the latest developments from our industry. The answer: our SOFW eVENT series.

What is it?

These are digital, topic-oriented lecture series and interviews that give you a current insight and update on products, processes and scientific developments. The duration of the event is 4-6 hours. The presentations themselves are about 30 min.

Which topics are addressed?

We focus on home care, skin care, sun care, hair care and sustainable packaging in relation to cosmetics and household products.

When are the next events?

December 07, 2023

Skin & Sun Care

Skinnovation 23

What does the whole thing cost you?

Nothing. There are no costs for visitors of our online eVENTS. However, you must register for the event.

Are you interested in a presentation or sponsorship?

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HPCI CEE 2023

Home and Personal Care Ingredients Central and Eastern Europe

WARSAW, POLAND / HANNOVER, GERMANY, OCTOBER 2023

The Central and Eastern European home and personal care community gathered at the **EXPO XXI Centre in Warsaw** from **September 27-28, 2023**, for the highly anticipated **12th Edition of HPCI CEE** (Home and Personal Care Ingredients Exhibition and Conference Central and Eastern Europe).

Building on the remarkable success of the previous year's event, HPCI CEE 2023 proved to be a dynamic showcase of the latest innovations in the industry.

Picture Credits: Marcin R. Szulżycki / Studio Kambutam

Exhibitors from the home and personal care industry presented their cutting-edge products and recent innovations. In conjunction with the technical seminars, this not only enhanced the overall experience for exhibitors and visitors but also contributed to the event's popularity.

> *"HPCI CEE 2023 exceeded our expectations, and we were thrilled to announce that* ***over 90% of the exhibition area had already been re-booked for HPCI CEE 2024****. This demonstrated the high level of satisfaction among our exhibitors and their strong commitment to the event."* said **Matthias Janz**, Director Trade Shows at Vincentz Network.

Educational Programme Highlights:

In addition to the exhibition, HPCI CEE 2023 featured an extensive educational program that included technical seminars providing insights into the latest developments in raw materials for cosmetics and home and personal care products. Renowned industry and academic speakers shared their expertise during a scientific conference, shedding light on the latest discoveries. The event also included a poster session, fostering collaboration between the scientific community, industry entrepreneurs, and fair participants.

Safety Assessor Seminar:

The **DGK/IKW** Safety Assessor Seminar, held for the 9th time on the first day of HPCI CEE, offered safety assessors the opportunity to stay updated and exchange ideas with colleagues in the field.

Poster Session:

The HPCI Poster Session, a collaborative effort with **The Warsaw College of Health and Engineering**, was another highlight of the event. It facilitated meaningful connections between representatives of the scientific community, industry entrepreneurs, and fair participants, further promoting innovation and knowledge sharing.

Save the Date:

The **13th edition of HPCI CEE** is scheduled to take place from **September 25 to 26, 2024**, at the **EXPO XXI Exhibition Centre in Warsaw, Poland**.

Stay tuned for more updates and exciting developments as we continue to support and celebrate the home and personal care ingredients industry in Central and Eastern Europe.

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NOTE THE DATE

HPCI INDIA

MUMBAI | 18-19 JANUARY 2024

HPCI CENTRAL & EASTERN EUROPE

WARSAW | POLAND

25-26 SEPTEMBER 2024

HPCI MIDDLE EAST AND EURASIA

ISTANBUL | TURKEY (DATES TBA)

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Hydrating Facial Mask with MossCellTec™ Aloe

Harmonizes the skin's moisture flow

mibelle GROUP biochemistry

Phase	Application / Trade Name	INCI	% w/w
A	Aqua / Water	Aqua / Water	Add 100%
	Xanthan Gum FNCSP-PC (Jungbunzlauer International AG)	Xanthan Gum	1.00
	Actigum™ CS 11 QD (Cargill)	Sclerotium Gum	1.00
	Hydrolite® 6 (Symrise)	1,2-Hexanediol	1.00
	SymSave® H	Hydroxyacetophenone	0.50
	Glycerin	Glycerin	10.00
	Panthenol	Panthenol	5.00
	MossCellTec™ Aloe	**Xylitol (and) Caprylyl Glycol (and) Ketoglutaric Acid (and) Aqua / Water**	**2.00**
B	Symbio®solv clear plus MB (Evonik Operations GmbH)	Caprylyl / Capryl Glucoside (and) Aqua (and) Sodium Cocoyl Glutamate (and) Glyceryl Caprylate (and) Citric Acid (and) Polyglyceryl-6 Oleate (and) Sodium Surfactin	5.00
	True Lighthouse CO (Essencia AG)	Perfume	0.20
C	Symcolor Chlorophyll	C. I. 75810	0.01

MANUFACTURING PROCEDURE:

1. Mix phase A , one after the other, under agitation.
2. Add MossCellTec™ Aloe and stir until completely homogenous.
3. Premix phase B and add to phase A under agitation, do not homogenize.
4. Add phase C and mix until the color is evenly dispersed in the product.
5. If necessary, adjust pH to 4.5 – 5.5 using Citric Acid / NaOH sol.

DESCRIPTION:

- **Improves hydration evenness**
- **Activates cell-to-cell communication**
- **Fades away signs of aging**
- **Comforts dry skin**

DISCLAIMER:

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FORMULATIONS

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Natural Instant Care Balm to Powder

SC-FR-22-011-A015

BASF
We create chemistry

Phase	Ingredients	INCI	% by weight	Function
A	Cutina® HR Flakes	Hydrogenated Castor Oil	2.00	Consistency agent
	Lanette® 22	Behenyl Alcohol	7.00	Consistency agent
	Cetiol® SB 45	Butyrospermum Parkii Butter	4.00	Emollient
	Eutanol® G	Octyldodecanol	13.30	Emollient
	Myritol® 331	Cocoglycerides	12.00	Emollient
	Cetiol® C 5C	Coco-Caprylate/Caprate	13.00	Emollient
	Cosmedia® Gel CC	Dicaprylyl Carbonate, Stearalkonium Hectorite, Propylene Carbonate	15.00	Rheology modifier
B	Verdessence® RiceTouch	Oryza Sativa (Rice) Starch	10.00	Skin feel modifier
	Vivapur CS 9 FM *(JRS)*	Microcrystalline Cellulose	10.00	Skin feel modifier
C	Cetiol® Ultimate	Undecane, Tridecane	10.00	Emollient
	Ultra Filling Spheres™ C00487	Ethylhexyl Palmitate, Trihydroxystearin, Sodium Hyaluronate, Glucomannan	3.00	Active ingredient
	Covi-ox® T 90 C	Tocopherol	0.20	Antioxidant
	Perfume	Parfum	0.50	Fragrance

SPECIFICATIONS:

Dropping point (DP70 Dropping point system): 57.9°C

PERFORMANCE:

Additional performance has not been evaluated

MANUFACTURING PROCESS:

Hot process

1. Mix under medium stirring and heat to 85°C ingredients of phase **A** until it becomes homogeneous.
2. Introduce phase **B** and have a medium stir for 5 minutes. Check the good dispersion of the powders.
3. Cool down to 60°C and introduce ingredients of phase **C**, one after the other.
4. Poor hot directly in chosen packagings (the formulation is at 50-60°C.).

STABILITY TEST:

Conform 1 month at -10°C, 50°C and 3 months at 4°C, 40°C and Room Temperature

EXTERNAL SUPPLIERS:

Vivapur CS 9 FM: AMI Ingredients
Perfume: Expressions Parfumées (*Plaisir 0322387 also includes Alpha-Isomethyl Ionone, Benzyl Benzoate, Benzyl Salicylate, Citronellol, Coumarin, Geraniol, Hexyl Cinnamal, Hydroxycitronellal, Limonene, Linalool)*

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