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The Science behind Effective Skincare

Three Generations of Advanced Active Ingredient Release

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abstract

As increasing emphasis is placed on the efficacy of skincare products, science is taking on an even more important role in the beauty industry, helping to provide consumers with solutions that help them not only look good, but feel great, too. One of the leading innovations in science-driven cosmetic ingredients trends is BASF's MicroPatch® technology, which offers the opportunity to harness the power and boost the efficacy of active ingredients by controlling the time they are released on the skin, for longer-lasting positive effects. Throughout the years, the research team has continued to refine this technology further and expand its mode of action by integrating different actives that enable ever-evolving claims for skin care products. By now, BASF's portfolio includes four highly effective MicroPatch products – and further innovations are in the works. The technology has the potential to meet an even wider range of consumer needs and applications, making it a leading light in the future of personalized skincare solutions.

Science-based beauty products with strong, proven efficacy are on the rise, as more consumers put their trust in sophisticated technologies to find reliable, personalized solutions for healthy, glowing skin [1]. While the beneficial effects of active ingredients – or “actives” – on the skin are well known, the focus of science-based skincare has now shifted to finding ways to boost the efficacy of these substances through new delivery systems. Leading the way in this field is BASF's MicroPatch® technology. By combining their dual expertise in natural macromolecules and the controlled release of active ingredients, the skincare specialists at BASF have created a unique delivery system to entrap actives in a reservoir above the skin and control their release over a longer period, for far greater efficacy.

The benefit of active delivery systems

Whilst freely applying skincare products ensures a high concentration of actives on the skin at the moment of application, this rapidly diminishes, reducing their effectiveness over a longer period of time. Delivery systems like MicroPatch technology can harness the full power of active ingredients by releasing them over a longer period, prolonging their action on the skin for longer-lasting effects. MicroPatch technology also increases the potential for more personalized skincare solutions by acting as a vessel for different actives to suit various applications and endpoints, from advanced moisturizing to soothing sensitive skin. And it's all thanks to a molecular-level network of natural bio-macromolecules.

Bio-macromolecules: harnessing the power of active ingredients

At the heart of MicroPatch technology are bio-macromolecules – natural polysaccharides produced by the cells of living organisms. To create the MicroPatch, two or more bio-macromolecules are combined to form a molecular-level, layered, mesh-like structure, which entraps the chosen actives above the skin. This 3D molecular mesh forms an invisible film-like layer – a “second skin” – that serves as a reservoir of actives, delivering them when needed. This improves efficacy by ensuring the slow and prolonged release of the relevant actives, extending their action. When applied, the patch protects the skin from drying out by limiting transepidermal water loss. There are also sensory benefits, as the smooth, film-forming surface provides a pleasant feel on the skin.

An evolving science

To date, researchers at BASF have created three generations of MicroPatch products, tailoring the science to serve a range of different needs, from moisturizing and anti-pollution, to soothing sensitive skin and boosting well-being. **The first generation** involved a combination of two bio-macromolecules – alginate and acacia gum – combined with the active ingredients caffeine or serine to provide anti-cellulite or moisturizing effects.

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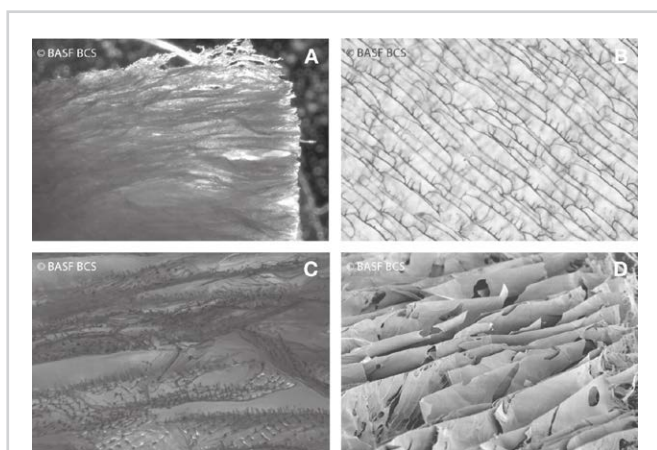


Fig. 1 Microscopic observations of a freeze-dried patch. A, B and C: Optical microscopy. D: Transmission electron microscopy.

The second generation of MicroPatch – known as PatchH2O® – is a more sophisticated combination of three bio-macromolecules – pullulan, alginate and hyaluronic acid – which are loaded with four hydrating actives (trehalose, urea, glycerine and serine) to provide enhanced skin moisturization [2]. Taking this to an even more advanced level, **the third generation** – known as the Sacred Patch® – combines the MicroPatch technology with Sacran, an ingredient found in a rare Japanese alga that is well known for its soothing properties. Sacred Patch is used to soothe sensitive skin and enhance well-being.

An in-depth look at each generation of MicroPatch technology provides useful insights into the evolving nature of this technology and its potential to shape the future of efficient and personalized skincare.

First generation: establishing the molecular network

Composition

The foundation of MicroPatch technology was laid with the formation of a molecular meshwork of alginate and acacia gum macromolecules, within which small molecules of active ingredients could be introduced, which slowly diffuse into the skin. In this first generation of patch, the 3D molecular mesh is loaded with two different active ingredients: caffeine, well known for its lipolytic effects [3], or serine [4], the principal amino acid in the skin's natural moisturizing factor and the synthesis precursor of ceramides responsible for maintaining hydration of the epidermis.

MicroPatch® Serine is a serine-filled 3D micro-fleece composed of acacia polysaccharides and alginate (INCI: Aqua (and) Butylene Glycol (and) Pentylene Glycol (and) Algin (and) Acacia Senegal (and) Serine).

MicroPatch® Caffeine is a caffeine-filled 3D micro-fleece composed of acacia polysaccharides and alginate (INCI: Aqua (and) Salicylic Acid (and) Caffeine (and) Butylene Glycol (and) Propylene Glycol Alginate (and) Acacia Senegal).

Efficacy

In a clinical trial, 20 female volunteers with normal to dry skin applied 2% MicroPatch Serine on the forearm. Hydration levels were measured by Corneometer after one, three and six hours. Immediately after application, the hydration level by impregnation of the upper layers of the epidermis increased progressively with time, reaching a maximum at three hours. At this measurement point, there was a +25% increase in hydration compared to the control site. This showed that 2% MicroPatch Serine has an immediate hydration capacity, as well as persistence for at least six hours after a single application (data not shown).

The absorption of caffeine when freely applied and when applied via MicroPatch Caffeine was tested on Franz cells with human skin explants. The diffusion kinetics (0-24 hrs), the release (48 hrs) and the storage (72 hrs) were measured by HPLC.

Results showed that MicroPatch Caffeine increases the action time of caffeine and has a reservoir effect (**Figure 2**). At 48 and 72 hours, the release and the storage of caffeine is higher for the MicroPatch application than for the freely applied form (+68% and +114% respectively, data not shown). The MicroPatch technology allows for a slow release of caffeine to exert an intense and long-lasting action.

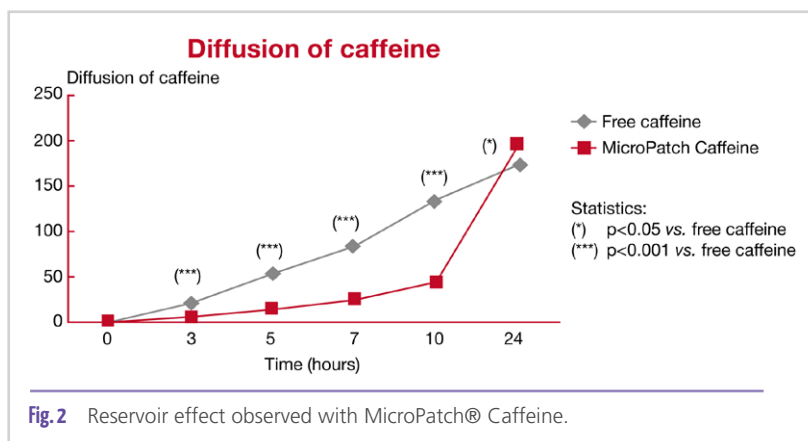


Fig. 2 Reservoir effect observed with MicroPatch® Caffeine.

Second generation: advanced moisturization

Composition

Second-generation MicroPatch technology, named PatchH2O, focused on finding advanced, longer-lasting moisturization by entrapping a humectant complex with glycerin, L-serine, trehalose and urea in the biopolysaccharide mesh. Here, the 3D molecular mesh was formed from three bio-macromolecules, selected for their filmogenic properties. Hyaluronic acid is a hygroscopic molecule that can hold up to 1,200 times its volume in water [5]. Pullulan is produced by bio-fermentation, and its polymeric structure gives it unique gelling, adhesive and film-forming properties.

Alginate is obtained by basic hydrolysis of brown algae (Phaeophyceae) and has the ideal porosity to trap small molecules, while retaining their free diffusion inside and outside the gel.

PatchH2O is a 3D micro-fleece composed of three bio-polysaccharides entrapping a hydration complex (INCI: Aqua (and) Glycerin (and) Glyceryl Polyacrylate (and) Trehalose (and) Urea (and) Serine (and) Pentylene Glycol (and) Algin (and) Caprylyl Glycol (and) Sodium Hyaluronate (and) Pullulan (and) Disodium Phosphate (and) Potassium Phosphate). An alternative version free of Glyceryl Polyacrylate and Phosphate is available.

Efficacy

In a double-blind, placebo-controlled clinical study, 23 female volunteers with dry skin applied either a placebo formula or a formula containing PatchH2O on each hemi-face, twice daily, for 15 days. A novel measuring device linked to the smartphone enabled the participants to determine their skin mois-

turization level in real time during the application period and seven days after the treatment (regression period). Results showed that the day-long moisturizing effect increases the longer the product is used (Figure 3). This moisturization efficacy even lasted into the regression period, after participants stopped using the products. Further performance tests on the anti-pollution effect of PatchH2O, its microbiome-friendliness as well as its suitability for use in hair care products are available (data not shown).

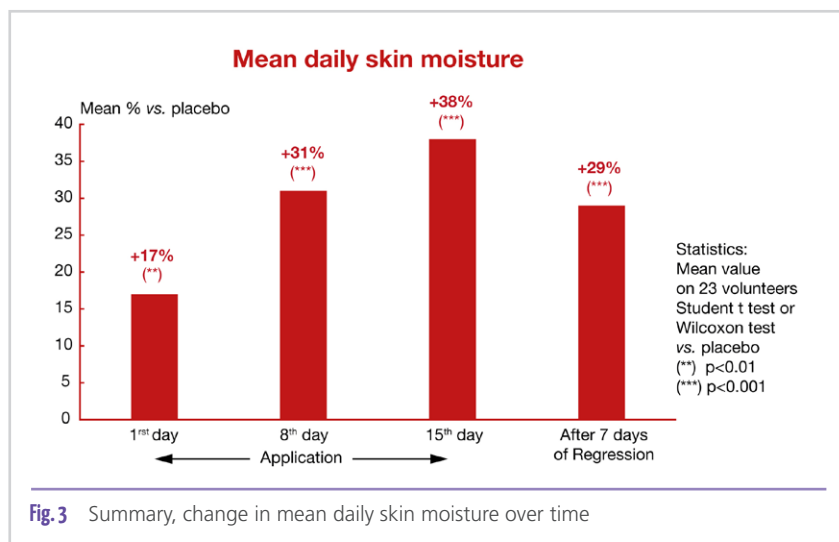
Third generation: soothing sensitive skin and boosting well-being

Composition

Sacred Patch – the most recent generation of MicroPatch technology – enhances the link between emotional well-being and healthy skin, and how our state of mind can impact our skin’s appearance [6].

It aims to help those suffering from sensitive skin by soothing irritation, providing advanced moisturization and offering a unique and pleasurable sensorial experience. It combines patch technology with Sacran, a large polysaccharide found in an extremely rare type of blue-green alga found only in Japan [7]. Sacran can offer superior hydration, improve skin barrier function and act on skin irritation, making it an effective way of treating sensitive skin when delivered through a molecular mesh of pullulan, alginate and hyaluronic acid.

Sacred Patch uses molecular patch technology to entrap the precious Sacran biopolysaccharide (INCI: Aqua (and) Glycerin (and) Pentylene Glycol (and) Algin (and) Caprylyl Glycol (and) Glyceryl Polyacrylate (and) Sodium Hyaluronate (and) Pullulan (and) Aphanothece Sacrum Polysaccharides). An alternative version free of Glyceryl Polyacrylate is available.



Efficacy

The emotional benefits of Sacred Patch were assessed during an *in vivo* test involving 87 Asian women aged 30 to 50, who suffered from sensitive skin. A placebo emulsion and an emulsion containing 2% Sacred Patch were applied twice daily for two weeks on each side of the face. An emotional test was performed immediately after the first application, where participants were asked to correlate their perceived emotions while applying the product to visual stimuli. This non-verbal method is based on nine picture boards, each consisting of several images expressing a specific emotion: surprise, ten-

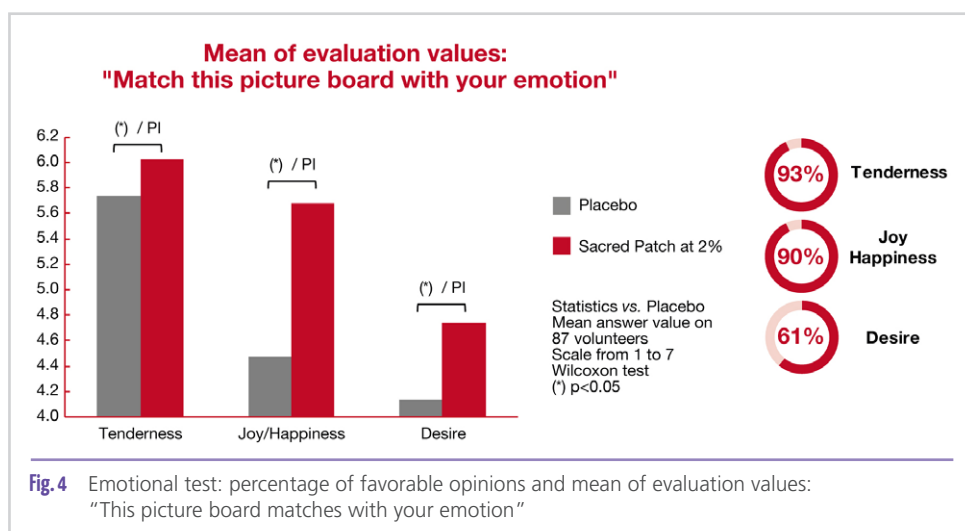
derness, curiosity, disgust, desire, anger, ill at ease, happiness, and sadness. The name of the emotion is never mentioned, allowing the volunteers to state how they felt.

The emotional content of the boards had been previously validated with more than 1,200 naïve consumers from eight countries in Europe, the US and Asia. Correlation was indicated on a scale from one (does not match the board at all) to seven (completely matches the board), with positive answers falling within the five to seven range. The results confirmed the positive emotional effect of Sacred Patch immediately after application, with 93% of participants matching the use of the patch with tenderness, 90% associating it with joy and happiness, and 61% linking it to desire. In all three cases, the active ingredient outperformed the placebo. Other emotions were not selected in a significant quantity.

Conclusion

A new future for skincare

The proven efficacy of all three generations of MicroPatch technology shows positive signs for the future of personalized skincare, by offering a customizable active delivery system to suit a range of applications and consumer needs. Alongside proven benefits such as moisturization and soothing sensitive skin, the sensory and emotional benefits of Sacred Patch also helps to meet consumers' growing appetite for cosmetic solutions that not only have beauty benefits, but have positive emotional and well-being benefits, too. With its host of opportunities for continual evolution, BASF's MicroPatch technology clearly has the potential to be a leading light in the future of tailored, personalized skincare solutions – and there is more to come before long.



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