Jungbunzlauer

From nature to ingredients®

facts

ERYLITE® Erythritol boosts natural hair conditioners

Introduction

Many people like to round off their hair cleansing routine with a conditioner. Conditioning leaves hair more manageable, glossier and fragrant, and may supply nourishing and repairing substances. Conditioners come with a wide range of properties, but they all have one thing in common: they help to improve hair manageability by modifying the surface layer of the hair – the cuticle. Shampoo cleanses hair and scalp by removing sebum, residual styling products, dead cells and dirt, but this can have adverse effects on the cuticle. The cells of the cuticle are arranged somewhat like shingles on a roof. The stress of shampooing causes these shingles to shift slightly, leaving the cuticle itself and also the internal hair structure more vulnerable to damage. Conditioners smooth the cuticle and realign it, restoring the hair's natural shield. The hair is once more protected, more manageable and ready for styling.

This conditioning effect can be achieved through a mix of natural substances including surfactants, moisturisers, acidifiers, oils and antistatic substances. As previously shown, ERYLITE® erythritol demonstrated very beneficial effects when incorporated into a shampoo formula.[1] These effects ranged from improved combability and reduced frizz to scalp hydration and enhanced shampoo performance with better foamability.[2] This article discusses the advantages of incorporating ERYLITE® into hair conditioners to complement the benefits of ERYLITE® shampoo formulations.

ERYLITE® – a fermentation-based polyol for personal care applications
ERYLITE® is the first sugar alcohol, also called polyol, to be manufactured using a fermentation-based process. The fermentation and minimum processing make ERYLITE® a very interesting ingredient for end products destined for the "natural" shelf. It is furthermore COSMOS-approved and vegan. ERYLITE® can already be found in different personal care formulations. It is increasingly used in skin care products, where it acts as a powerful skin moisturising agent.[2] It can be incorporated into face masks, as well as body lotions, skin and hand creams. In this article the benefits of ERYLITE®'s outstanding features for conditioner formulas will be described.

ERYLITE® – for more sustainable solutions
The main raw material for ERYLITE® production is glucose derived from corn. If the customer wishes the glucose can be supplied by farmers committed to sustainable agriculture as verified by the FSA (farm sustainability assessment by SAI platform).[3]

- Jungbunzlauer is committed to the SBTi (Science Based Targets initiative) and sets targets to reduce the emission of greenhouse gases in line with climate science, for example by further improving its energy management system.
- Jungbunzlauer performs regular calculation of the product carbon footprints (PCFs) in cooperation with a certified and independent external partner (myclimate).
- The production plant for ERYLITE® achieved ISO 50001 certification and implemented an energy management system focused on continuous improvement.

Benefits of ERYLITE® in hair care formulations

Combability is an important factor when assessing hair for manageability. Good combability means smooth healthy hair that is free from knots. It enables quick and easy styling. Combability is a direct indicator of the physical status of the hair cuticle, revealing whether it is damaged and rough or intact and smooth. Repetitive styling, combing, drying, straightening and curling as well as UV radiation damage the hair. This increases the force needed to comb through the hair. Hair which is young and healthy or has been effectively treated with repairing and conditioning agents can usually be combed effortlessly.

A positive effect on combability is one of the most popular claims for hair care products, and was the most important benefit demonstrated when ERYLITE® was integrated into shampoos. With ERYLITE®, a reduction of the combing force by up to 40% could be demonstrated. This was in contrast to the blank surfactant shampoo, which increased the combing force by 140%. Comprehensive information on ERYLITE® in shampoo applications has been published previously.[1]

Like shampoos, hair care products such as conditioners or masks can help to improve combability. Conditioners can be divided into two groups: leave-in and rinse-off. While a rinse-off conditioner is washed out of the hair after a defined period of time, a leave-in conditioner (often sprayed on) remains in the hair.

In order to satisfy cosmetics regulations, all product claims on conditioners must be substantiated. Companies therefore devote a great deal of effort to the research and development of formulas and substantiation of the defined claims. Jungbunzlauer has already substantiated a number of claims for ERYLITE®, like moisturising and foam formation.[1]

To support the performance claims advertised on a hair care product, substantiating tests need to be performed on the finished product as well as on individual ingredients. This is because the functionality leading to a claimable effect is typically attributed to single ingredients, in this case to ERYLITE®. However, any finished formulation also has to be evaluated in respect of intended claims, and it too has to show the desired functionalities in order to qualify for a claim on the final packaging. Individual ingredients may interfere with each other, diminishing or even erasing verified positive claims due to incompatibilities among individual ingredients. To validate the claims and performance proven for ERYLITE® as a single ingredient, full formulations need to demonstrate the same favourable results.

To substantiate the claim of combability, this parameter is commonly tested with a tensile test. It determines the force needed to pull a comb through hair tresses. It is a straightforward method for evaluating the extent to which a hair care product improves combability.

Goals of the study

The study was designed to evaluate the ability of Jungbunzlauer's ERYLITE® to act as a natural and label-friendly conditioning agent. In order to exclude any influence from other ingredients, ERYLITE® was initially tested as a single ingredient in an aqueous solution. In a second step, two natural leave-in and rinse-off conditioner formulations were developed to check for compatibility in a final formulation. This meant that the claim of improved combability could be substantiated for both the single ingredient and the full conditioner formulation.

Experimental part

Treatment compositions

In order to substantiate claims for ERYLITE® as a single ingredient, its performance in a conditioner application was first analysed in an aqueous matrix. The matrix consisted of an aqueous 3% or 5% ERYLITE® solution with a pH of 5.0.

Suitable full formulations were then developed to assess the conditioning effects of ERYLITE® in a hair conditioner formulation. These comprised one leave-in and one rinse-off conditioner.

The natural leave-in conditioner formulation was a slightly opaque, low viscosity spray. Its composition is shown in table 1. The formulation contained 5% ERYLITE® as a conditioning ingredient for hair. The pH value of the final formulation was set to 4.5–5.0. The conditioner was aqueous-based and had a spray-on format. In addition to ERYLITE® the formulation contained small amounts of emollient to form a smooth, even film on the hair. An analogous blank formulation was prepared in which ERYLITE® was omitted and compensated for by water.

Table 1: Formulation of leave-in conditioner

Phase	Ingredients	INCI	Function	Supplier	Quantity
A	Water, demin.	Aqua	Solubiliser		Qs to100
	ERYLITE® Personal Care Grade	**Erythritol**	**Conditioning agent**	**Jungbunzlauer**	**5.00**
	Xanthan Gum FNCS-PC	**Xanthan Gum**	**Thickener**	**Jungbunzlauer**	**0.08**
	Plantacare® 2000 UP	Decyl Glucoside	Surfactant	BASF	0.10
B	Neossance® Squalane	Squalane	Emollient	Saficalcan	2.00
	Argan Oil	Argan Oil	Emollient	OLVEA	1.00
	CITROFOL® AI Extra	**Triethyl Citrate**	**Emollient**	**Jungbunzlauer**	**0.10**
C	Preservation		Preservative		Qs
D	**L(+) Lactic Acid 90% Heat stable Personal Care Grade**	**Lactic Acid**	**pH regulation**	**Jungbunzlauer**	**Qs**

The natural rinse-off conditioner with 5% ERYITE® as conditioning ingredient is shown in table 2. It was a conventional emulsion and was therefore produced using a hot emulsification process. It contained large amounts of emulsifier and co-emulsifier, had a high viscosity and provided an even, sticky film on the hair. Hence it needed to be rinsed carefully after the exposure time. The final pH was set to 4.5–5.0. In this case, too, a blank formulation was prepared, in which ERYLITE® was omitted and compensated for by water.

Table 2: Formulation of rinse-off conditioner

Phase	Ingredients	INCI	Function	Supplier	Quantity
A	Water, demin.	Aqua	Solubiliser		Qs to100
	ERYLITE® Personal Care Grade	**Erythritol**	**Conditioning agent**	**Jungbunzlauer**	**5.00**
	Xanthan Gum FNCS-PC	**Xanthan Gum**	**Thickener**	**Jungbunzlauer**	**0.30**
B	Axol® C62 Pellets	Glyceryl Stearate Citrate	Emulsifier	Evonik	2.50
	Lanette® O	Cetearyl Alcohol	Co-Emulsifier	BASF	4.00
	Coconut Oil	Coconut Oil	Emollient		1.00
	Dermofeel® sensolv	Isoamyl Laurate	Emollient	Evonik	1.00
C	Preservation		Preservative		Qs
D	**L(+) Lactic Acid 90% Heat stable Personal Care Grade**	**Lactic Acid**	**pH adjustment**	**Jungbunzlauer**	**Qs**

When the two different conditioner formulations were compared it could be seen that the rinse-off formulation contained larger amounts of emollients such as hydrophobic oils, which form a film on hair surface. This was a “richer” formulation than the leave-in conditioner and therefore expected to be more effective.

Combing force measurement

Prior to each test, commercially available hair tresses of European bleached hair (Haarhaus Kerling, Germany) were pre-treated (washed) with a solution of 10% sodium laureth sulfate (SLES, surfactant solution) for three times over a period of one minute to remove all remaining chemicals from the hair. The tresses had a length of 25 cm and a width of 2 cm. After three wash cycles, the hair tresses were detangled with a coarse comb (Herkules Sägemann 480/1637, Germany). The wet and detangled hair tresses were then analysed with a tensile tester equipped with a special measuring comb (Herkules Sägemann 372, Germany).[4] The combing force of each tress was determined by five individual combing cycles. The average of these five measurements was defined as baseline value. This baseline was specific for each hair tress and allowed for a “before and after treatment” comparison.

Afterwards, each pre-treated tress was rinsed under lukewarm water for 30 s. After rinsing, the hair tresses were treated with the test product (ERYLITE® aqueous solution or full conditioner formulation) at a residence time of one minute. In the case of ERYLITE® solutions and leave-in conditioner, the first measurement of the hair tress was done without rinsing, followed by measurements of the tresses rinsed for 15 s, 30 s or 45 s. This was done to study the persistence of the conditioning effect. In the case of the rinse-off conditioner, the first measurement was taken after rinsing for 15 s, followed by 30 s and 45 s rinsing time.

All measurements were performed in duplicate. The method is visualised in figure 1.

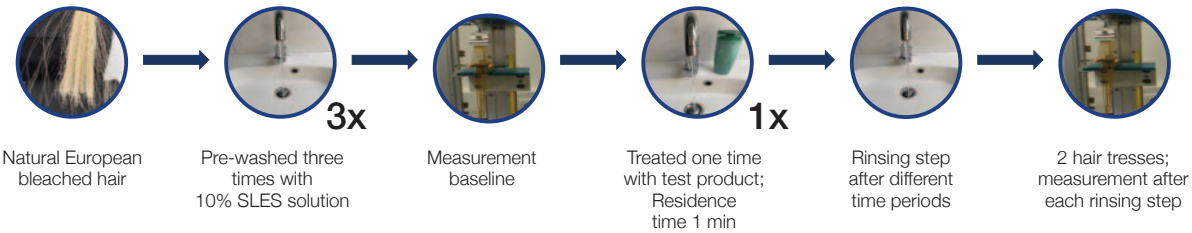

Figure 1: Schematic description of combing force method

Microscopy

To visualise the effect of ERYLITE® on hair, microscopic images of the same individual hair were taken after different treatments. The hair was treated for 1 min with an aqueous surfactant solution of 10% sodium laureth sulfate (SLES). The pH of the solution was adjusted to pH 5.0. After a drying time of 10 min, microscopic images were taken. Then the hair was treated with an aqueous 5% ERYLITE® solution, pH 5.0, for 1 min. After 10 min drying time a second microscopic image was taken. All images were taken with a Keyence VHX 5000 microscope at 1000 x magnification.

Results and discussion

Claim substantiation with ERYLITE® in aqueous solution

For claim substantiation of ERYLITE® as a single ingredient, the performance of ERYLITE® was analysed in an aqueous matrix first. The results are shown in figure 2.

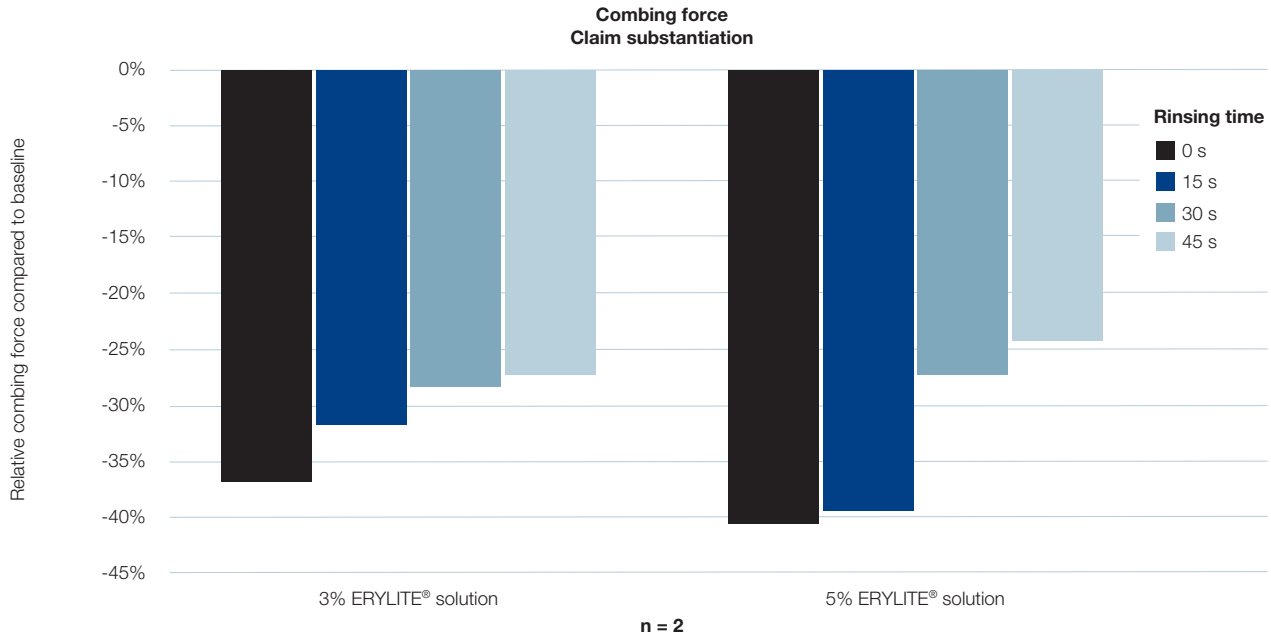

Figure 2: Influence of 3% and 5% aqueous solution of ERYLITE® on combing force

It is obvious that both the 3% ERYLITE® solution and the 5% ERYLITE® solution had a strong effect on hair pre-treated with a surfactant solution. These tresses, which had initially required a higher combing force, were now easier to comb. In the first instance, after no rinsing and 15 s of rinsing time, the effect of the 5% ERYLITE® solution was stronger compared to 3% ERYLITE®. After longer rinsing times, 30 s and 45 s, the performance of the two concentrations approached a comparable level. Overall, the positive effect of ERYLITE® on combability was noticeable even after several rinsing steps.

When evaluating the best performance, especially for leave-in application and short rinsing times, the solution containing 5% ERYLITE® showed superior performance.

The positive effect is visible under the microscope, as shown in figure 3.

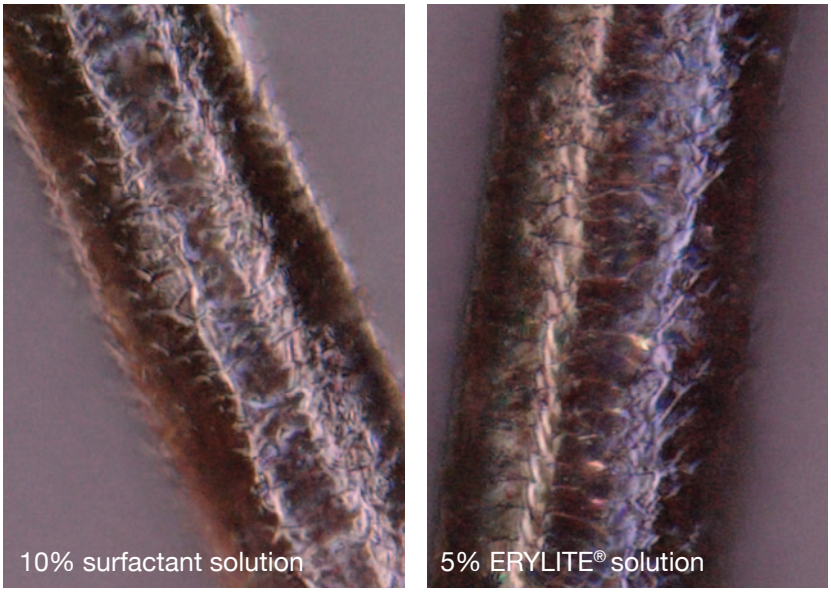

Figure 3: Microscopic images of the same individual hair after different treatments, 1000 x magnification

After treatment with 10% surfactant solution (SLES), the hair showed an uneven surface, the shingle cells had become visible due to shifting. This effect of anionic surfactants is well known, which is why treatment with a conditioning agent is necessary after washing hair with surfactants. The leave-in application of 5% ERYLITE® solution improved the hair surface structure, the shingle cells were back in position and the hair surface appeared very smooth.

In summary, it can be stated that ERYLITE® as a single ingredient solution has a conditioning effect on hair. This conclusion opens the way to conditioning claims for ERYLITE® and holds the promise of being transferable to full formulations.

Claim substantiation with full conditioner formulation

For claim substantiation of ERYLITE® in natural conditioner formulations, the performance of ERYLITE® was analysed in a leave-in and rinse-off formulation.

Leave-in conditioner

For claim substantiation in a full formulation, hair tresses were treated with the leave-in hair conditioner formulas containing either 5% ERYLITE® or none. The first combing force measurement was taken immediately after spraying on the conditioner. Afterwards the tresses were rinsed for 15 s, 30 s or 45 s and the combing force determined after each rinsing step using the tensile measuring system. The results are shown in figure 4.

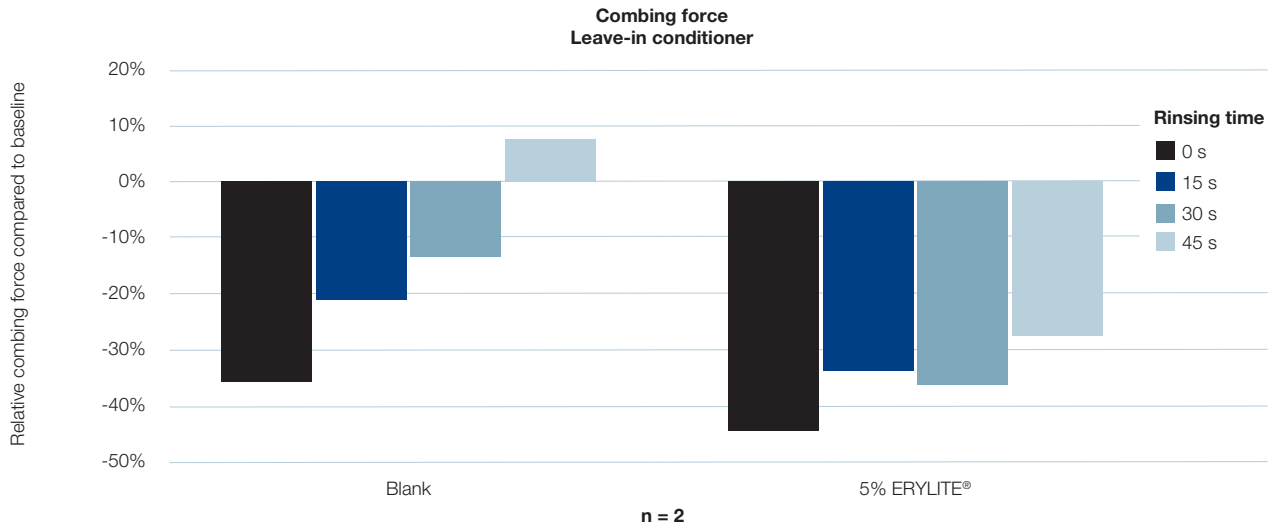

Figure 4: Combing forces measured after leave-in hair conditioner treatment

The results of the tensile measurement show that both conditioners – with and without ERYLITE® – have a conditioning effect on the tresses. However, if the long-term effect is compared, the ERYLITE®-based conditioner is clearly superior, as its effect is sustained even after prolonged rinsing periods. It thus has greater rinsing stability.

If we refer back to the results for claim substantiation, shown in figure 3, when ERYLITE® was tested as single ingredient, the results for combing force reduction directly after the treatment with the leave-in formulation containing ERYLITE® can be related to the results of the 5% aqueous ERYLITE® solution. It follows that the conditioning effect of the leave-in formulation can be linked to the effect of ERYLITE®.

Rinse-off conditioner

Hair tresses were treated with hair conditioner formulas containing 5% ERYLITE® or no ERYLITE® for comparison.

The conditioner was of high viscosity and was applied directly onto the tresses. The tresses were rinsed for 15 s, 30 s or 45 s and the combing force determined after each rinsing step using the tensile measuring system. The results are shown in figure 5.

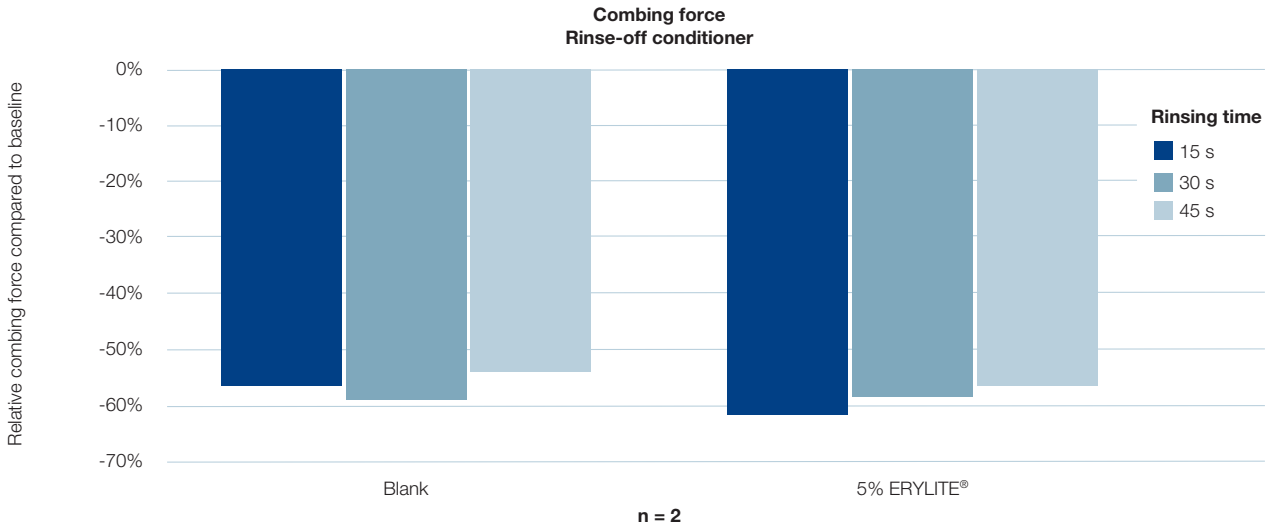

Figure 5: Combing forces measured after rinse-off hair conditioner treatment

The tresses showed a very good combing force reduction after treatment with rinse-off conditioners, but there were no significant differences in the formulations with or without ERYLITE®. A possible reason for this is the limited sensitivity of this method. It may therefore be assumed that any conditioning product will reduce the combing forces needed when the baseline is high. The results clearly indicate that the combing force reduction of rinse-off conditioners is generally much higher compared to leave-in applications. One explanation for this is the larger amount of emulsifiers and emollients in the rinse-off formulation. In direct comparison, the conditioning performance of a leave-in conditioner is not as effective as that of a rinse-off conditioner. Nevertheless, considering the limited amounts of active ingredients in the leave-in conditioner, the combing force reduction is still impressive. Overall, both conditioners show combing force reduction and demonstrate the excellent compatibility of ERYLITE® in leave-in and rinse-off formulations.

Summary

ERYLITE® was tested for its effects on combability of hair when used as a natural conditioning agent. A clearly detectable reduction in combing force could be observed, providing substantiation of a claim for combability improvement. Ready-to-use formulations for leave-in and rinse-off conditioners were developed to demonstrate the effect of ERYLITE® in a representative formulation.

Additionally, ERYLITE® provided prolonged rinsing stability, especially when used in leave-in conditioners. For rinse-off conditioners the differences appeared relatively small.

Overall, Jungbunzlauer's personal care grade ERYLITE®, which is COSMOS and NATRUE approved, demonstrates excellent performance in hair care, enabling the formulation of natural conditioner formulations with a cleaner label and shorter ingredient list to fit perfectly with the sustainable trend.

Approved by ECOCERT RAW MATERIAL
COSMOS APPROVED

NATRUE Approved

References

[1] L. Meyer, T. Bernsmeier, T. Berninger, F. Weiher, ERYLITE® Erythritol in hair shampoo, *Jungbunzlauer Facts* 2023.

[2] M. Neubauer, Natural moisturising solutions - gentle and effective, *Jungbunzlauer Facts* 2021.

[3] Jungbunzlauer, Sustainability, https://www.jungbunzlauer.com/en/sustainability.html, accessed on 30th January 2023.

[4] Combability tests were performed at Dr. Straetmans, 2016.

About Jungbunzlauer

Jungbunzlauer is one of the world's leading producers of biodegradable ingredients of natural origin. We enable our customers to manufacture healthier, safer, tastier and more sustainable products. Due to continuous investments, state-of-the-art manufacturing processes and comprehensive quality management, we are able to assure outstanding product quality.

Our mission "From nature to ingredients®" commits us to the protection of people and their environment.

The Author

Laura Meyer – Application Technology, Jungbunzlauer Ladenburg GmbH
laura.meyer@jungbunzlauer.com

Thomas Bernsmeier – Product Management Sweeteners, Jungbunzlauer International AG
Thomas.bernsmeier@jungbunzlauer.com

Dr. Felix Weiher – Application Technology, Jungbunzlauer Ladenburg GmbH
felix.weiher@jungbunzlauer.com

Discover more on
www.jungbunzlauer.com

Headquarters **Jungbunzlauer Suisse AG**
4002 Basel · Switzerland · Phone +41 61 295 51 00 · headquarters@jungbunzlauer.com · www.jungbunzlauer.com