

facts



ERYLITE® Erythritol
– adding functionality
to hair shampoo

Jungbunzlauer

*From nature
to ingredients®*

Introduction

The use of hair care products such as shampoo or conditioners is an integral part of our personal care routine. Using hair care products is driven by our desire for clean and great-looking hair which also leaves the impression of regular care. There are clearly differences between women and men in the value perception and usage pattern of hair care products, but overall it can be agreed that hair care products are today considered to be the main cosmetic products that determine the external appearance of a person.

The main purposes of shampoo and conditioners are also the main subjects in the advertising messages and in the product claims used, for example: “brightening/illuminating” to emphasise the ameliorative effect on our appearance, or “moisturising/hydrating” to indicate their nourishing properties. But, in reality, the main functions of hair shampoo go far beyond this.

Most importantly, a shampoo cleans and degreases the scalp and hair through the use of surfactants. Shampoos also improve the combability and shine of hair, some help tame frizz and some reduce dandruff. Another beneficial function of certain shampoos is their moisturising effect on the scalp. One of the last trends are so-called natural shampoos with ingredients that are organic and biodegradable, these have become very popular in recent years.^[1]

Shampoos consist primarily of a mixture of water and surfactants. Surfactants are responsible for cleansing and foaming; they increase viscosity and largely determine the hair's condition after shampooing. There are also a number of other ingredients with a variety of functions: these include modifying agents and additives such as emulsifiers (e.g. glycol distearate), colouring additives, foam boosters (e.g. cocamide monoethanolamine), humectants, thickeners (e.g. xanthan gum) and preservatives (e.g. parabens). pH control is very important – citric acid is typically added for this purpose and makes the hair feel smoother. Finally, fragrance oils are added to produce a pleasant scent.

The purpose of this paper is to highlight how the fermentation-based polyol ERYLITE® erythritol, known to have moisturising properties in personal care applications, influences the performance of shampoo.



ERYLITE®: a fermentation based polyol for personal care applications

ERYLITE® is the first polyol to be manufactured using a fermentation-based process. It is used in many personal care formulations for different applications. Erythritol, a sweetening ingredient with non-cariogenic properties can be found in many kinds of oral care products as a cariostatic agent. In these applications, it reduces the adhesion of oral bacteria and the quantity of plaque. Due to its flavour-enhancing properties, erythritol is used to mask unpleasant flavours and rounds off the overall taste profile of toothpastes and mouth rinse products. Upon dissolution it provides an intense cooling effect in the mouth, a clean, sweet taste as well as mouth-feel and bulk.

ERYLITE® can be found in an increasing number of skin care products, as it works as a powerful moisturising agent and increases the humidity of the skin. It is used in body lotions, skin and hand creams as well as face masks. Apart from ERYLITE®'s high level of performance, cost-effective synergies with glycerol can also be observed. The combination of both can lead to a significant increase in skin humidity and thus to a great improvement in the way the skin feels.

Contemporary personal care science is working on ways to incorporate these outstanding features into hair shampoo and conditioner formulas. But recent product launches of shampoos and conditioners are not only based on humectant properties.

ERYLITE® test program on product claims

As part of their adherence to cosmetics regulations, the product claims on a shampoo must be substantiated. Therefore, companies devote a great deal of effort to the research and development of formulas and the substantiation of the defined claims. There is quite a number of substantial claims that can be advertised on the product label. Jungbunzlauer focused on four of them:

Combability

This is one of the most basic shampoo claims. Many hair care products promise better, smoother hair, and aim for combability. The comb should slide easily through the hair after application of the product.

Better manageability and anti-frizz

The surfactants in the shampoo dry the hair out, which can lead to serious damage. As a result, it becomes frizzy and difficult to comb. Anti-frizz additives form a layer of film to form on the surface of the hair and produce curls in naturally wavy hair.

Foaming

Greater foam stability and smoother foam formation are important sensory requirements for the consumer. Foam is usually the first visual indication of performance and consumers rely on foam as evidence for cleaning. If the foam consists of very fine, small bubbles, the consumer is given the impression of mild cleaning and assumes that their hair is being gently conditioned.

Moisturisation

This is also important in hair care. As the surfactants have a pronounced drying effect on the skin, regular hair washing with shampoos that do not contain moisturising agents continuously dries the scalp. As a result, the scalp starts to itch and dandruff can occur.

Formulations

In order to see the effects of ERYLITE®, three very basic shampoo formulations containing different amounts of ERYLITE® were prepared. Firstly, we tested the plain surfactant, which uses one of the most common surfactant systems: sodium laureth sulfate and cocoamidopropyl betaine, stabilised by methylisothiazolinone, yet without further additives and without erythritol.

The second test formulation consisted of the same concentration of surfactants as the surfactant-only system as well as 3% ERYLITE®. The third formulation contained 5% ERYLITE®. A detailed overview of the formulations is given in table 1.

Table 1: Formulations analysed in the tensile test. Where needed, the viscosity and pH have been adjusted using NaCl and lactic acid 90% cosmetic grade, respectively

Ingredient	INCI	Supplier	Plain surfactant	3 % ERYLITE®	5 % ERYLITE®
Water	Aqua		q.s.	q.s.	q.s.
Texapon N 70	Sodium laureth sulfate, aqua	BASF	14.00 %	14.00 %	14.00 %
Tego Betain F 50	Aqua, cocamidopropyl betaine	Evonik Industries	8.50 %	8.50 %	8.50 %
ERYLITE®	Erythritol	Jungbunzlauer	0.00 %	3.00 %	5.00 %
Neolone 950	Methylisothiazolinone	Rohm and Haas	0.10 %	0.10 %	0.10 %

Combing force measurement

The most fundamental method for the evaluation of a shampoo's combability improvement is the tensile test. It determines the force needed to pull a comb through a sample of hair. This is of interest for several reasons. Our hair is damaged every day by repetitive styling, combing and drying as well as straightening or curling. Furthermore, UV exposure damages the keratin fibres of the hair cuticles. All of this influences the amount of force needed to comb through the hair. Young, healthy hair can be combed effortlessly. The results of tensile testing can be related to the surface of and damage to the cuticles.

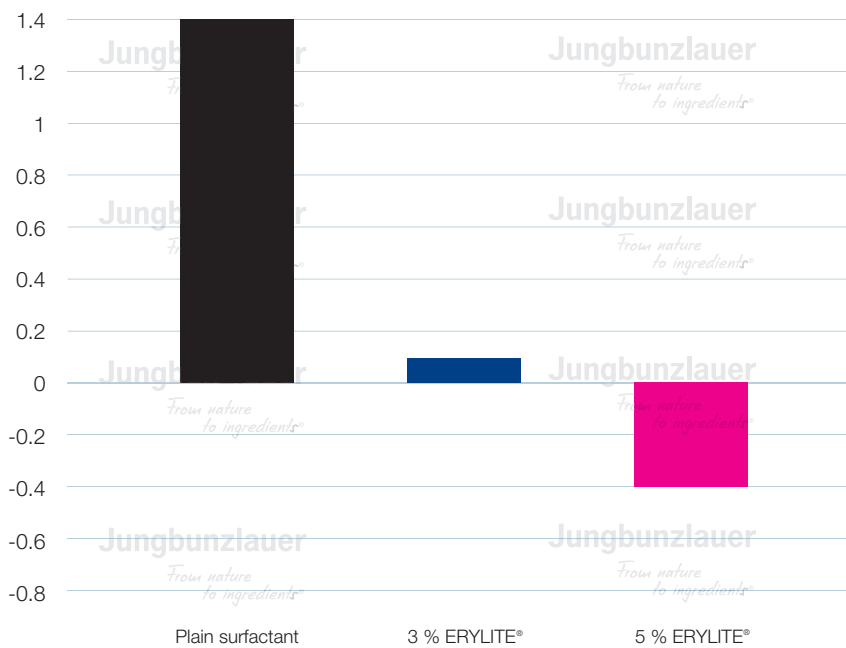
Method

Commercially available hair tresses were washed three times with a solution of 10% sodium laureth sulfate and tap water, and measured with a tensile strength test setup. These results were treated as initial conditions and zero line.

Afterwards, each tress was rinsed, washed with the respective test product (plain surfactant, +3% and +5% ERYLITE®), detangled, and the combing force was measured twice for each tress, in a total of five runs. The average result of these five duplicate tests was then compared with the initial value. The exact test method is available on request.



Figure 1: Average change of force needed to comb through the hair tress upon usage of the different shampoos given in table 1



As expected, an increase in the combing force was observed for the plain surfactant system due to the drying effect of the surfactants and the resulting damage to the cuticles. The surfactant system all by itself increases the combing force by 140% compared to the zero line. Forces of up to 200g are not uncommon if the hair is not protected by other ingredients in the shampoo. Yet a reliable surfactant system is needed in order to ensure proper cleaning of the hair, as this is the primary function of a shampoo.

In order to protect the hair and maintain a low combing force, other ingredients that act as conditioners are added to a shampoo formulation. In our study, the second formulation contained 3% ERYLITE®. This had a tremendous impact on the combing force. The increase in the force needed to comb through the hair compared to the zero line was 12% – a significantly better combability that was produced only by the addition of erythritol, since the overall concentration and ratio of the other ingredients were not changed.

In figure 1 it is evident that a greater amount of ERYLITE® – a total concentration of 5% – reduced the combing force needed by 39% compared to the zero line. This shows that the addition of erythritol can reduce the combing force needed by a total of 179% compared with the pure surfactant system consisting of sodium laureth sulfate and cocoamidopropyl betaine – the most common combination of wash-active substances in shampoos.

Foam comparison

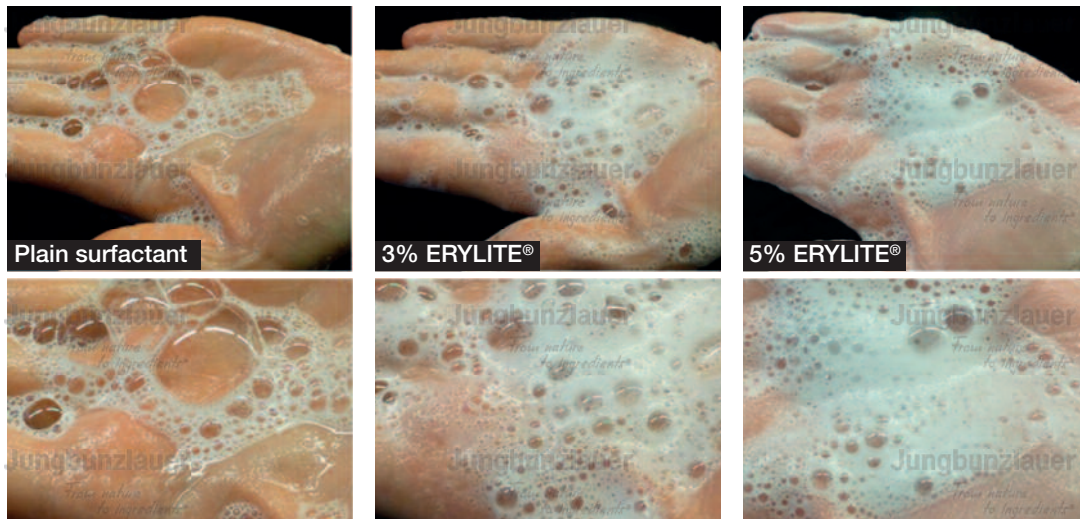
Consumers rely on the foaming behaviour of different formulations for several reasons. Firstly, foam is an easy control for the thorough distribution of shampoo in the hair due to its recognisable bubbles. Secondly, the breakdown of foam is often associated with the loss of cleaning performance, not only in the field of personal care, but also in other aspects of daily life such as cleaning. Thirdly, the stability and texture of the bubbles and the resulting foam is important for the consumers' tactile experience. A fine foam with small, stable bubbles during application is gentle and soft to the touch, and therefore more desirable. Imaginary the haptic feedback is often transported to the touch of the hair afterwards.

Method

In order to provide reproducible results for foam behaviour, a test has been set up describing the cleaning of the hands with water and surfactant solution and the creation of the foam with defined amounts of water and shampoo. The exact method is available on request.

The three formulations shown in table 1 were used as test shampoos. The foam resulting from the plain surfactant shampoo consists of rather large bubbles and does not remain on the hand easily. It is of a water-like perception. The addition of ERYLITE® has a direct impact on the foaming behaviour of the base formulation.

Figure 2: Pictures of the foam behaviour of all three basic formulations



ERYLITE® influences the foam density and the size of individual bubbles. In figure 2 it is evident that the individual bubbles are smaller compared to the surfactant-only system. Further, the volume as well as the stability of the foam is increased. A higher content of erythritol in the formulation amplifies the effects, as the foam produced by the shampoo containing 5% ERYLITE® is even denser than that of the formulation containing 3% only. The obvious whitish appearance of the foam makes it easier for the consumer to ensure thorough shampoo distribution. The texture of the foam is gentler and softer in both shampoos containing erythritol. The removal of the foam was simple and unproblematic for all three formulations.

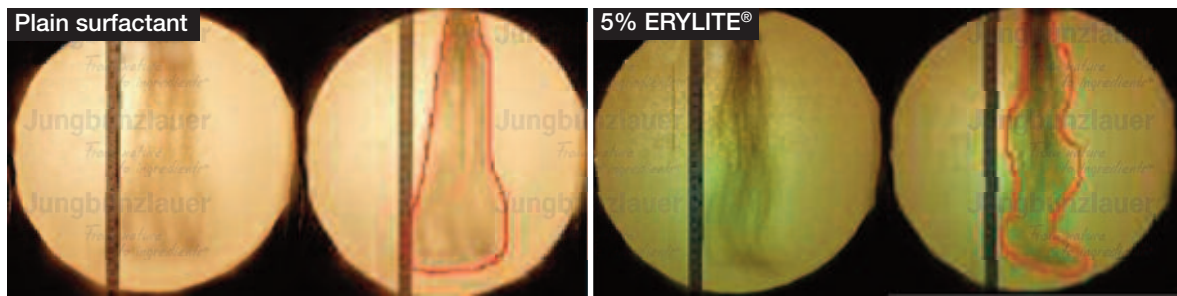
Shadow mapping

Another core trend in hair care is manageability.^[7] Manageability is nicely displayed in the “shadow mapping” test that shows curl definition. Hair tresses with a length of 25 cm were prewashed with a neutral 10% sodium laureth sulfate solution, then with the test shampoo (“plain surfactant” and “5% ERYLITE®”). The hair was then detangled using a standard comb ten times. The tresses were dried for 24 hours. A source of light was used to create a shadow of each tress on parchment paper. The shadows were recorded for comparison. The exact test method is available on request.

Two values are important when evaluating the curl definition. The first is the length of the tress after the treatment. If the tress is shorter in direct comparison, the curl definition is more distinct. The tress treated with the plain surfactant formulation had a final length of 23.5 cm. After addition of 5% erythritol to the shampoo formulation, the curl of the tress is more evident and results in a shorter (22.5 cm) length.

The shadow images simplify the evaluation of the width of the curl. In figure 3, the curl treated with the plain surfactant formulation is visibly broader. The addition of ERYLITE® leads to more defined curls and supports the manageability of wavy hair.

Figure 3: Shadow images of both tresses before and after treatment with the plain surfactant (left) and 5% ERYLITE® (right) formulation



Moisturisation

Moisturisation is becoming an area of dual focus in the hair care segment: not only due to its importance for the hair and the smoothness it produces, but also for the scalp. The latter is relevant for both genders, since nowadays, shampoos increasingly serve as convenient, all-in-one solutions for daily hair and scalp care.

A pleasant-feeling scalp is the basis for convincing consumers of any shampoo product. The surfactants present in shampoos dry the skin. If the water content in the stratum corneum is below 20%, the skin is classified as dry and rough.^[2] On the scalp this can lead to itching and dandruff if the water content drops further. Moisturisers are defined in a variety of ways, e.g. as a “substance or product that overcomes the signs and symptoms of dry skin” or similarly, as a substance to “increase the water content of the epidermis”.^[3,4]

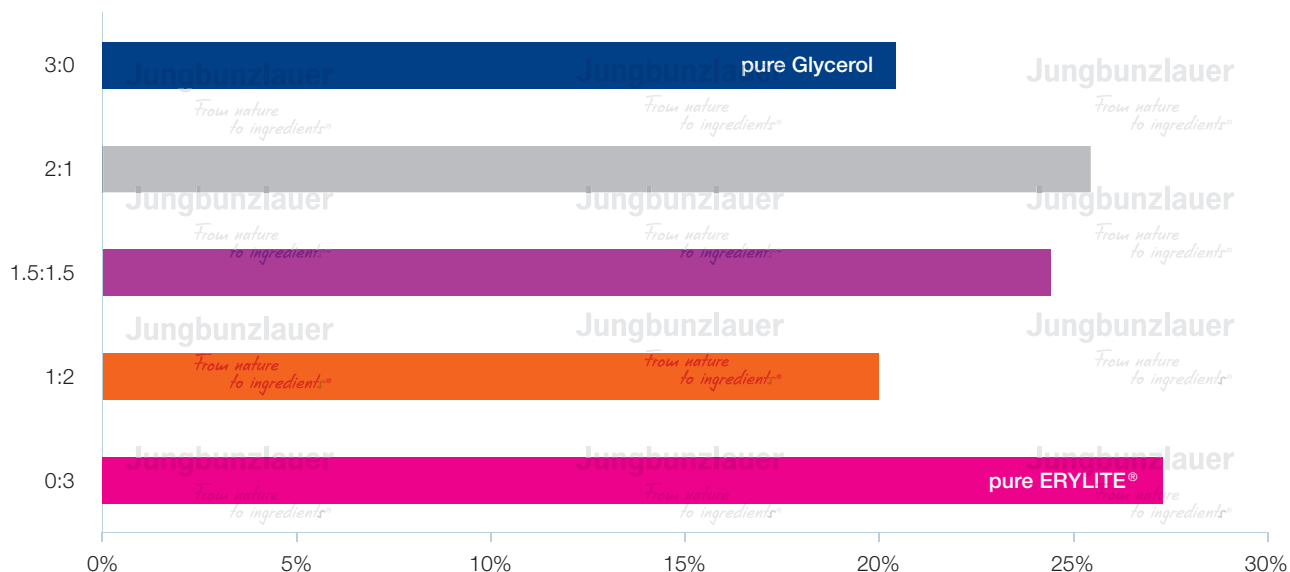
Method^[5]

The test method to determine moisturising effects is a Corneometer®. This device identifies the moisture retention in the superficial layers of the stratum corneum (10–20µm) and is based on the dielectric constant of water. The skin was tested initially and after the defined time of treatment (14 days). The emulsions used in these tests each had different ratios of glycerol to ERYLITE® (3:0, 2:1, 1.5:1.5, 1:2, 3:0) and were each tested on ten people.

The panel had to apply the emulsions daily on their right forearm for 14 days. Afterwards, the skin moisture was analysed again on the same spot as before. For statistical reasons, four measure points per person were determined (one untreated and three treated with the emulsion). The exact method is available on request.

In contrast to the untreated areas, all emulsions increased skin moisture. Emulsions of ERYLITE® alone increased skin moisture in ten people by an average of 27%. This is significantly higher than for the glycerol treatment, which yielded an average improvement of 21%. Also the different mixtures of ERYLITE® and glycerol show moisturising effects, with one exception they exceed the performance of glycerol. It is common sense that moisturising effects proven on human skin e.g. on the forearm can be transferred to the skin of other body parts as well, in this case on the scalp. Thus, it can be concluded that also on the scalp ERYLITE® will reveal a strong moisturising effect.

Figure 4: Relative improvement of skin moisture content after two weeks of application with an emulsion containing 3% (w/w) moisturiser



In a second study, the panel consisted of ten healthy females with different skin types.^[6] Otherwise, the same method was applied. Emulsions of a shower gel and different moisturisers at a concentration of 5% (w/w) were used. A blank emulsion without active substances was used as the negative control. Again, glycerol was used as the positive control.

The results were the same as in the previous study: all shower gels with active substances improved skin hydration. While glycerol improved relative skin moisture by 4%, other moisturisers performed better. ERYLITE®, at a concentration of 5%, increased skin moisture content by 9.2%.

Summary

ERYLITE®, already known to be a potent moisturising agent in skincare applications, where it shows strong synergies with glycerol, has proven to have beneficial effects in hair care as well. Apart from having a smoothing effect, the use of hair care products containing ERYLITE® leads to improved combability displayed through a significantly decreased combing force needed. In addition frizz is reduced visibly. The treated hair is more manageable and, as a consequence, styling becomes much easier. These positive effects can be obtained through shampoos and/or conditioners. In addition, a moisturising effect on the scalp can be observed. ERYLITE® thus delivers greatly on the basic requirements of a modern hair care system. ERYLITE® by Jungbunzlauer is listed as INCI and is approved for use according to the Cosmetic Organic Standard (COSMOS).

References

- [1] Thiemann, A., Scholze, J., Estarita, S. & Dieker, K. Conditioning, naturally going back to earth! *Househ. Pers. Care Today* 9, 24–27 (2014).
- [2] Rawlings, a V, Canestrari, D. a & Dobkowski, B. Moisturizer technology versus clinical performance. *Dermatol.Ther.* 17 Suppl 1, 49–56 (2004).
- [3] Kligman, A. M. *Safety and Efficacy of Topical Drugs and Cosmetics.* (Grune & Stratton, 1982).
- [4] Kraft, J. N. & Lynde, C. W. Moisturizers: What They Are and a Practical Approach to Product Selection. *Skin Therapy Lett.* 10, (2005).
- [5] Haji, F., Kljaic, S. & Jungbunzlauer. Moisturise naturally with ERYLITE® Erythritol. *Cosmet. Des.* (2011).
- [6] Lenz, D., Raab, F., Seelig, O., Wiemer, S. & Jungbunzlauer. Natural moisturizing solutions for leave-on and rinse-off products. *COSSMA 18* (2013).
- [7] Jeffries, N. Hair Shine , Hydration and Health. *SpecialChem* 1–18 (2015).

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. Jungbunzlauer offers ERYLITE® Erythritol as pure bulk sweetener as well as ERYLITE® Stevia, blends of ERYLITE® with steviol glycosides at different sweetness levels.

The Authors

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

Thomas Bernsmeier – Technical Service Manager, Jungbunzlauer International AG
thomas.bernsmeier@jungbunzlauer.com

Ferid Haji – Product Group Manager, Jungbunzlauer International AG
ferid.haji@jungbunzlauer.com

Discover more on
www.jungbunzlauer.com

The information contained herein has been compiled carefully to the best of our knowledge. We do not accept any responsibility or liability for the information given in respect to the described product. Our product has to be applied under full own responsibility of the user, especially in respect to any patent rights of others and any law or government regulation.

Headquarters **Jungbunzlauer Suisse AG** · CH-4002 Basel · Switzerland · Phone +41-61-2955 100 · headquarters@jungbunzlauer.com

www.jungbunzlauer.com

Jungbunzlauer
*From nature
to ingredients®*