Sensitive skin solutions from head to toe

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Skin is the largest organ of the body and covers an area of up to two square meters. As the interface between the environment and the body, it is often exposed to environmental stressors, pathogens and xenobiotics. Depending on the severity and duration of exposure along with the genetic predisposition, the skin can react or be damaged to varying degrees. Among the well known visible effects to external influences, such as sunburn as a result of exposure to UV irradiation, one of the great enigmas remains the phenomenon of sensitive skin – a very prevalent skin condition. Various studies (Willis et al., 2001; Farage, 2010) indicate that over 50% of the Western population consider themselves to have sensitive skin - but what exactly is sensitive skin? A satisfactory definition of sensitive skin is still not available due to its many causes and the subjective nature associated with its complaints. The term “sensitive skin” is commonly used by individuals to describe a number of unpleasant sensations of varying intensity and usually transient in nature, e.g. tingling, burning, redness, dryness or skin tightness. Skin discomfort is often experienced after exposure to environmental insults (e.g. sun, cold, and wind), irritants or following the application of topical products. In this context, other terminology has also been proposed, e.g. subjective irritation, non-immunologic adverse skin reactions or self-estimated enhanced skin sensitivity (Farage, 2010; Farage & Maibach 2006).

Although the prevalence of sensitive skin was once thought to be largely due to psychosocial elements, it being fashionable und socially acceptable to have sensitive skin, recent studies confirm physiological origins. The lack of visible clinical findings, the reliance on self-diagnosis and the varying types of reactions, their intensities and causal agents have hampered the search for objective diagnostic methods. Based on

recent scientific literature, a number of different factors seem to play a role in sensitive skin, e.g: 1) subclinical irritation thresholds can be involved and sensitive skin is sometimes found to react more intensely to irritants; 2) increased cutaneous neurosensory responses can be of relevence; 3) decreased lipid content and/or hydration has been reported; and 4) a weakened skin barrier function and/or increased skin permeability, most likely constitute one of the main causes as sensitive skin is often associated with a high baseline transepidermal water loss (TEWL; Frage et al., 2010; Pinto et al., 2010). **Table 1** gives a short overview of subjective and objective signs associated with sensitive skin and examples of test methods that can be used to assess them (Fluhr et al., 2011; Primavera & Beradesca, 2004).

Table 1: Brief overview of signs of sensitive skin and methods (non-exhaustive) to assess it

Subjective signs	Objective signs	Examples of methods
Burning	Increased reactivity to irritants	Patch tests, soap chamber tests
Itching Stinging	Hypersensitivity to topically applied substances (increased neurosensory activation)	Use tests, lactic acid stinging tests, thermal tolerance tests, measurement of neuromediator levels
Tightness	Lower skin hydration status	Corneometry, visual assessments
Tingling	Susceptibility to skin redness	Visual assessments, chromametry
Methods: sensory perception tests; questionnaires	Impaired barrier function; decreased barrier thickness	TEWL measurements, ultrasonic measurements of skin thickness

Although predominantly reported for the face, sensitive skin is not limited to the facial region. It can occur all over the body, e.g. torso, neck, hands and scalp (Saint-Martory et al., 2008; Misery et al., 2008). A two-center French study was conducted with approximately 400 volunteers being enrolled in the study. Subjects were asked to complete questionnaires asking for demographic data, such as age, occupation, phototype and geographical origin, as well as for severity, localization and symptoms of sensitive skin and allergies. The most reported symptoms of skin sensitivity were

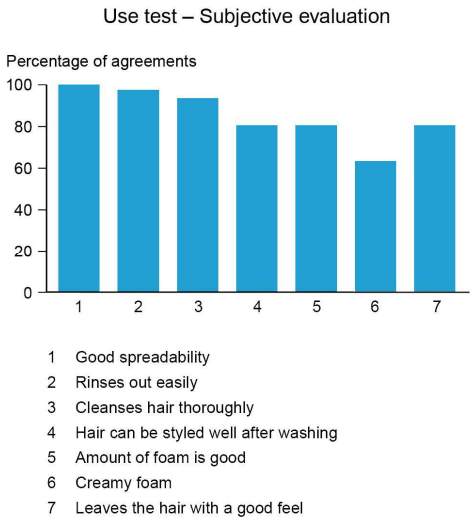
erythema (74%) and itch (61%). Although most respondents reported to have sensitive skin in the face (85.4%), hands (57.7%), scalp (36.2%), feet (34.2%), torso (23%) and neck (20.9%) were also affected body parts. Complaints were predominantly exacerbated by various factors such as sun, wind, stress and cold (Saint-Martory et al., 2008).

Formulating for sensitive skin

Not unexpectedly, one of the steadily growing demands of the cosmetic market is cosmetics targeted and developed for sensitive skin. Yet, developing solutions for sensitive skin presents considerable challenges for the formulator. One major problem is the subjective nature of sensitive skin which makes predicting the sensorial responses difficult. Another factor is effectively meeting the specific needs of sensitive skin. Wide-ranging expertise is therefore needed to develop new products that meet this growing market demand. Not only mild state-of-the art ingredients are important but also a high degree of know-how in formulation technology. Additionally, the latest industry developments and scientific discoveries need to be closely monitored as these also feed into product development processes.

The first step when developing sensitive care formulations is to select and source appropriate ingredients. Once a formulation has been created, it then needs to be evaluated. The tests and methods used will depend on the type of skin sensitivity that is investigated and on the specific application. Sensations can be the result of hypersensitivity to a topically applied substance. Typical methods to test these reactions in human volunteers are use tests, lactic acid stinging tests, etc. Due to the subjective nature of the sensations, these tests need to include questionnaires. On the other hand, e.g. a feeling of tightness could also be caused by deficient levels of hydration the best ways to quantify this are through visual assessment and corneometry. Burning sensations and transient redness can sometimes be the result of increased reactivity to irritants. The irritation potential can be tested using patch testing and/or the soap chamber method. A disturbed skin barrier function is most likely one of the major factors involved, and this can be assessed by measuring transepidermal water loss (TEWL) (reviewed in Fluhr et al., 2011).

The formulations discussed below are good examples of sensitive care formulations developed for different needs. Examples of which tests can be used to evaluate suitability for sensitive skin are shown. To assess the skin irritation potential, all formulations were subjected to a tape-strip patch test. The compositions were also tested for their eye irritation potentials by conducting tests with a reconstructed tissue model. Performance-related tests were chosen to substantiate claims such as moisturizing or UV-protection via objective measurements. Due to the sensory responses involved in sensitive skin, evaluations via the consumer's subjective opinion are important for the final acceptance of cosmetics. Therefore, in some cases, subjective evaluations based on questionnaires specifically developed for the product or use tests were incorporated into the test procedures.

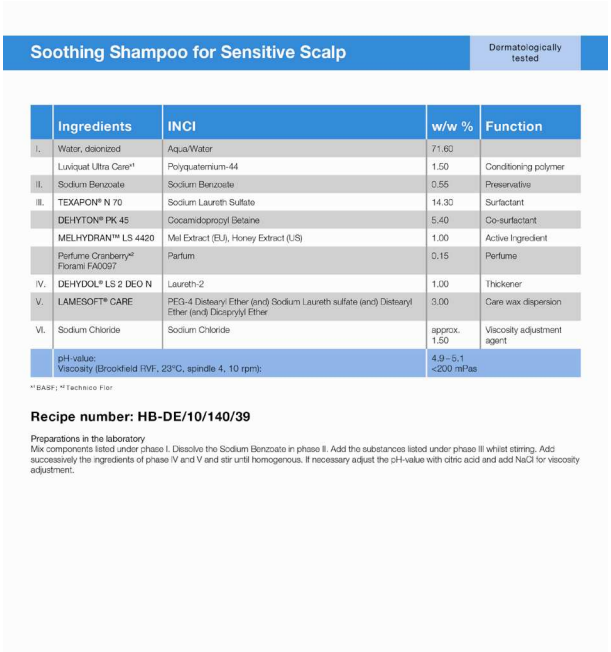


Soothing hair cleansing for sensitive scalps

Sensitivity of the scalp is a common, but somewhat neglected problem as it is often insufficiently perceived as a manifestation of sensitive skin. In a recent study of over 1,000 respondents in France, 44% declared that they had a sensitive scalp (Misery et al., 2008). Factors such as frequent washing, hair drying and exposure to irritants can increase the unpleasant sensations of redness involved and can leave the skin of the scalp feeling tight and itchy. Therefore, it is important to use products that can help to reduce sensitive scalp symptoms.

"Soothing Shampoo for Sensitive Scalps" (**Fig. 1**) is based on mild surfactant systems and makes use of a micronized lipid system. According to the results of a tape strip patch test, this shampoo has a low irritation potential indicating its suitability for sensitive skin. An in-use test was then carried out on a specific panel of 30 individuals suffering from sensitive scalps. This four week study confirmed that the gentle formulation helps to reduce both the intensity and the frequency of scalp itch,

redness and tightness. The subjects also evaluated the performance of this shampoo. The majority found that it is easily distributed throughout the hair and lathers into a rich and creamy foam. After a thorough but mild hair wash, the shampoo is easy to rinse out and leaves hair feeling pleasant and ready to style **(Fig. 1).**



Soothing Shampoo for Sensitive Scalp — Dermatologically tested

	Ingredients	INCI	w/w %	Function
I.	Water, deionized	Aqua/Water	71.60	
	Luviquat Ultra Care*1	Polyquaternium-44	1.50	Conditioning polymer
II.	Sodium Benzoate	Sodium Benzoate	0.55	Preservative
III.	TEXAPON® N 70	Sodium Laureth Sulfate	14.30	Surfactant
	DEHYTON® PK 45	Cocamidopropyl Betaine	5.40	Co-surfactant
	MELHYDRAN™ LS 4420	Mel Extract (EU), Honey Extract (US)	1.00	Active Ingredient
	Perfume Cranberry*2 Fiorami FA0097	Parfum	0.15	Perfume
IV.	DEHYDOL® LS 2 DEO N	Laureth-2	1.00	Thickener
V.	LAMESOFT® CARE	PEG-4 Distearyl Ether (and) Sodium Laureth sulfate (and) Distearyl Ether (and) Dicaprylyl Ether	3.00	Care wax dispersion
VI.	Sodium Chloride	Sodium Chloride	approx. 1.50	Viscosity adjustment agent
	pH-value: Viscosity (Brookfield RVF, 23°C, spindle 4, 10 rpm):		4.9 – 5.1 <200 mPas	

*1 BASF; *2 Technico Fior

Recipe number: HB-DE/10/140/39

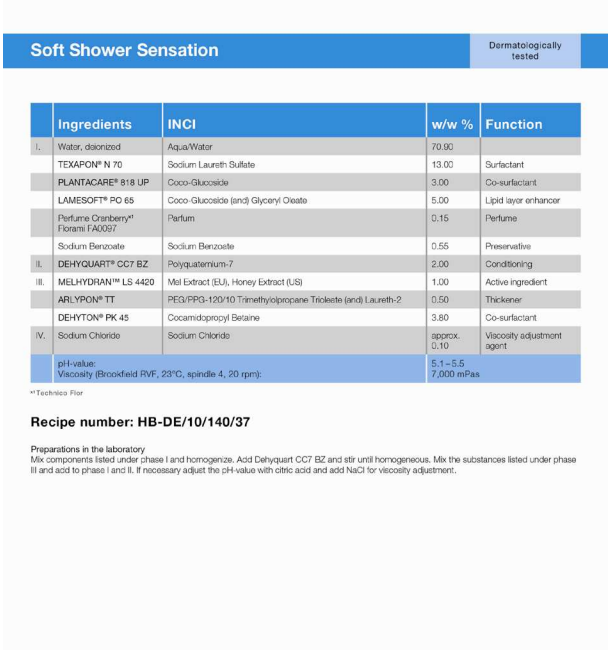
Preparations in the laboratory
Mix components listed under phase I. Dissolve the Sodium Benzoate in phase II. Add the substances listed under phase III whilst stirring. Add successively the ingredients of phase IV and V and stir until homogenous. If necessary adjust the pH-value with citric acid and add NaCl for viscosity adjustment.

Fig. 1: “Soothing Shampoo for Sensitive Scalp” provides hair cleansing while contributing to keeping the scalp in good condition.

A soft shower experience

Body washes often contain surfactants that can interact with the skin and then cause irritation and dryness particularly when individuals have a predisposition to sensitive skin. While it is essential to effectively wash off impurities, undesired lipids and other surface particles, this must be achieved without overly disturbing the skin barrier function. Thus, body cleansing preparations for sensitive skin should be specifically formulated to offer mild and gentle cleansing while maintaining the skin’s natural hydration balance and barrier function. To meet these requirements “Soft Shower Sensation” is composed of mild surfactants and well selected personal care ingredients including a lipid layer enhancer (**Fig. 2**). The mildness of the formulation was confirmed by the outcome of a soap chamber test in which it was compared to a

commonly known market benchmark for sensitive skin. The results were comparable with respect to irritation potential and influence on skin barrier function, and demonstrated the formulation to be mild and gentle to the skin and skin barrier **(Fig. 2)**.



Soft Shower Sensation — Dermatologically tested

	Ingredients	INCI	w/w %	Function
I.	Water, deionized	Aqua/Water	70.90	
	TEXAPON® N 70	Sodium Laureth Sulfate	13.00	Surfactant
	PLANTACARE® 818 UP	Coco-Glucoside	3.00	Co-surfactant
	LAMESOFT® PO 65	Coco-Glucoside (and) Glyceryl Oleate	5.00	Lipid layer enhancer
	Perfume Cranberry*! Florami FA0097	Parfum	0.15	Perfume
	Sodium Benzoate	Sodium Benzoate	0.55	Preservative
II.	DEHYQUART® CC7 BZ	Polyquaternium-7	2.00	Conditioning
III.	MELHYDRAN™ LS 4420	Mel Extract (EU), Honey Extract (US)	1.00	Active ingredient
	ARLYPON® TT	PEG/PPG-120/10 Trimethylolpropane Trioleate (and) Laureth-2	0.50	Thickener
	DEHYTON® PK 45	Cocamidopropyl Betaine	3.80	Co-surfactant
IV.	Sodium Chloride	Sodium Chloride	approx. 0.10	Viscosity adjustment agent
	pH-value: Viscosity (Brookfield RVF, 23°C, spindle 4, 20 rpm):		5.1–5.5 7,000 mPas	

*! Technico Flor

Recipe number: HB-DE/10/140/37

Preparations in the laboratory
Mix components listed under phase I and homogenize. Add Dehyquart CC7 BZ and stir until homogeneous. Mix the substances listed under phase III and add to phase I and II. If necessary adjust the pH-value with citric acid and add NaCl for viscosity adjustment.

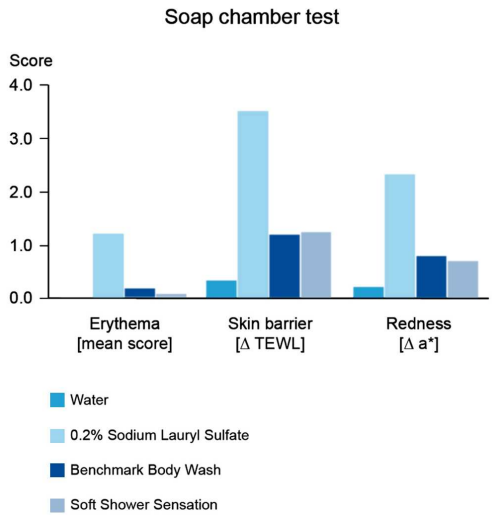


Fig. 2: “Soft Shower Sensation” is a mild body wash which helps to keep the skin´s natural moisture balance and the barrier intact.

Body lotion with a hydrobalancing effect

Sensitive skin can occur on many different parts of the body including hands, feet, torso and back. Very often, sensitive skin is linked to a decrease in cutaneous skin barrier integrity and stratum corneum hydration. Skin roughness can occur and often even skin friction from clothing can increase itchiness and discomfort. Therefore, it is important to keep skin smooth and in good condition. “Hydrobalancing Body Lotion” was formulated using a mild emulsifier and selected emollients **(Fig. 3)**. Apart from a tape strip patch test, the formulation was evaluated for its 24 hour moisturizing properties and in a use test. The tape strip patch test confirmed a low irritation potential and the 24 h moisturizing effects were also verified. The use test was conducted with 20 individuals with high baseline TEWL levels, 16 of which had self-

assessed sensitive skin. The lotion was applied twice daily for four weeks. The results confirmed that this body lotion significantly improves skin barrier function (TEWL) and skin hydration (corneometry) after four weeks of use. The subjective assessments revealed that this was also perceivable by the majority of the subjects. They reported that the lotion left their skin feeling softer, firmer, and smoother and also had a soothing effect **(Fig. 3).**

Hydro-Balancing Body Lotion — Dermatologically tested

	Ingredients	INCI	w/w %	Function
I.	EUMULGIN® SG	Sodium Stearoyl Glutamate	0.40	O/W Emulsifier
	CUTINA® GMS-V	Glyceryl Stearate	1.50	Consistency factor
	CETIOL® SB 45	Butyrospermum Parkii (Shea) Butter	3.00	Emollient
	CETIOL® C 5	Coco-Caprylate	2.00	Emollient
	IRWINOL™ LS 9890	Octyldodecanol (and) Irvingia Gabonensis (and) Hydrogenated Coco-Glycerides (EU); Octyldodecanol (and) Irvingia Gabonensis Kernel Butter (and) Hydrogenated Coco-Glycerides (US)	1.00	Moisturizing active
II.	Water, deionized	Aqua/Water	86.77	
	Glycerin	Glycerin	3.00	Humectant
	EDETA B Powder[a1]	Tetrasodium EDTA	0.05	Complexing agent
III.	RHEOCARE™ C PLUS	Carbomer	0.35	Thickener
IV.	NaOH (Aq sol. 25%)	Sodium Hydroxide	0.10	Neutralizing agent
V.	COVI-OX® T 70 C	Tocopherol	0.05	Antioxidant
	Perfume Rose Dorée[a2] Florami FA0094	Parfum	0.10	Perfume
VI.	Euxyl PE 9010[a3]	Phenoxyethanol (and) Ethylhexylglycerin	1.00	Preservative
	Sensiva SC50[a3]	Ethylhexylglycerin	0.50	Preservative
VII.	NaOH (Aq sol. 25%)	Sodium Hydroxide	approx. 0.18	Neutralizing agent
	pH-value: Viscosity (Brookfield RVT, 23°C, spindle 5, 10 rpm):		6.5 – 7.0 15,000 mPas	

[a1] BASF; [a2] Technico Flor; [a3] Schülke;

Recipe number: FR 00918.105

Preparations in the laboratory
Heat phases I and II to 75°C. Disperse phase III in phase II and neutralize with phase IV. When the mix is homogeneous, add phase I in phases II+III+IV. Cool down while stirring. At approx. 55°C homogenize with suitable homogenizer e.g. UltraTurrax. Then, cool down. Below 40°C add phases V and VI. Finally adjust pH-value to 6.5 – 7.0 with phase VII.

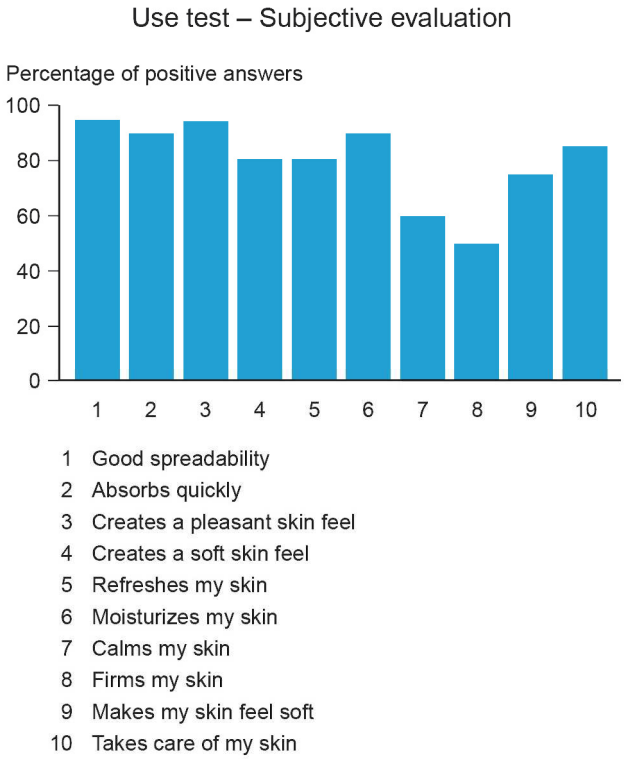
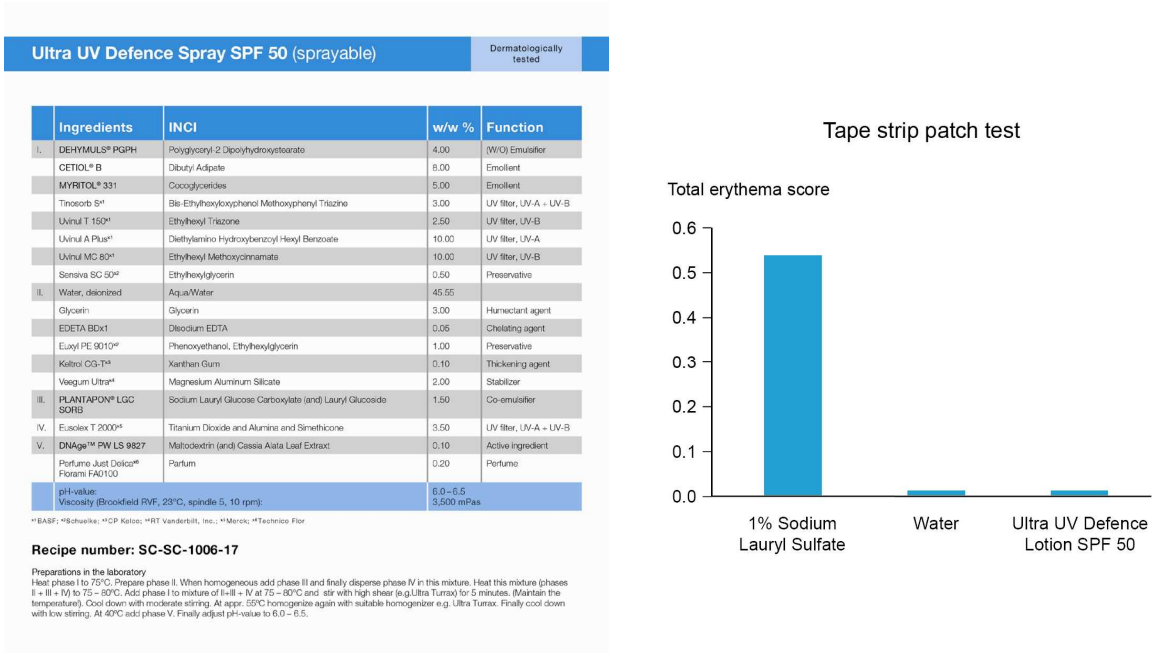


Fig. 3: “Hydrobalancing Body Lotion” makes the skin feel pleasantly refreshed and well cared for.

“All inclusive” UV protection

Studies have revealed that 77% of the general population and 82% of the respondents with sensitive skin report exposure to the sun to cause irritation (Farage 2008). Although sun is essential for life, too much solar irradiation can result in deleterious effects to the skin and its cells regardless of the skin type. Fair skin, especially types I – III, is more susceptible to sun damage and therefore needs even better protection. Ideally, sunscreens should be water resistant so that protection is

maintained even during swimming or sweating. “Ultra UV Defence Lotion SPF 50” was developed based on the new “switch oil phase” technology **(Fig. 4)**. The lotion is an O/W emulsion that transforms into W/O emulsion when applied to the skin. One advantage is that the emulsion feels light and is easy to distribute. A further favorable characteristic makes this emulsion type ideal for sun care: The formulation itself is able to provide immediate water resistance without additional water repellent agents. Both the SPF 50 and water resistance were confirmed in tests performed in accordance with COLIPA guidelines (2009) and the protection criteria for UV-A/UV-B balance were achieved. The formulation was also tested in a tape strip patch test. The low irritation potential indicates suitability for use on sensitive skin **(Fig. 4).**



Ultra UV Defence Spray SPF 50 (sprayable) — Dermatologically tested

	Ingredients	INCI	w/w %	Function
I.	DEHYMULS® PGPH	Polyglyceryl-2 Dipolyhydroxystearate	4.00	(W/O) Emulsifier
	CETIOL® B	Dibutyl Adipate	8.00	Emollient
	MYRITOL® 331	Cocoglycerides	5.00	Emollient
	Tinosorb S*1	Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine	3.00	UV filter, UV-A + UV-B
	Uvinul T 150*1	Ethylhexyl Triazone	2.50	UV filter, UV-B
	Uvinul A Plus*1	Diethylamino Hydroxybenzoyl Hexyl Benzoate	10.00	UV filter, UV-A
	Uvinul MC 80*1	Ethylhexyl Methoxycinnamate	10.00	UV filter, UV-B
	Sensiva SC 50*2	Ethylhexylglycerin	0.50	Preservative
II.	Water, deionized	Aqua/Water	45.55	
	Glycerin	Glycerin	3.00	Humectant agent
	EDETA BDx1	Disodium EDTA	0.05	Chelating agent
	Euxyl PE 9010*2	Phenoxyethanol, Ethylhexylglycerin	1.00	Preservative
	Keltrol CG-T*3	Xanthen Gum	0.10	Thickening agent
	Veegum Ultra*4	Magnesium Aluminum Silicate	2.00	Stabilizer
III.	PLANTAPON® LGC SORB	Sodium Lauryl Glucose Carboxylate (and) Lauryl Glucoside	1.50	Co-emulsifier
IV.	Eusolex T 2000*5	Titanium Dioxide and Alumina and Simethicone	3.50	UV filter, UV-A + UV-B
V.	DNAge™ PW LS 9827	Maltodextrin (and) Cassia Alata Leaf Extract	0.10	Active ingredient
	Perfume Just Delice*6 Florami FA0100	Parfum	0.20	Perfume
	pH-value: Viscosity (Brookfield RVF, 23°C, spindle 5, 10 rpm):		6.0 – 6.5 3,500 mPas	

*1 BASF; *2 Schuelke; *3 CP Kelco; *4 RT Vanderbilt, Inc.; *5 Merck; *6 Technico Flor

Recipe number: SC-SC-1006-17

Preparations in the laboratory
Heat phase I to 75°C. Prepare phase II. When homogeneous add phase III and finaly disperse phase IV in this mixture. Heat this mixture (phases I + III + IV) to 75 – 80°C. Add phase I to mixture of II+III + IV at 75 – 80°C and stir with high shear (e.g.Ultra Turrax) for 5 minutes. (Maintain the temperature!). Cool down with moderate stirring. At appr. 55°C homogenize again with suitable homogenizer e.g. Ultra Turrax. Finally cool down with low stirring. At 40°C add phase V. Finally adjust pH-value to 6.0 – 6.5.

Fig. 4: “Ultra UV Defence Lotion SPF 50” provides an overall protection without causing irritation.

Well cared for sensitive skin

Sensitive skin is a common condition, and one that is now accepted as a genuine dermatological problem of physiological origin. It has a significant impact on personal well-being. As a result, consumers are increasingly looking for products that help them to care for and soothe sensitive skin. Products designed in particular for

sensitive skin need appropriate ingredients and to be formulated accordingly. Their suitability for sensitive skin should be assessed using dermatological tests which allow the evaluation of endpoints associated with sensitive skin, e.g. skin barrier function, hydration and adverse sensorial effects. Dermatologically tested cosmetic products provide added value for both, the manufacturer and consumers, who now benefit from mild solutions that help to counter the stressors which cause reactions of sensitive skin to deliver soothing and effective skin care.

References

Farage M (2008) Perceptions of sensitive skin: changes in perceived severity and associations with environmental causes. Contact Dermatitis. 59:226-32.

Farage MA, Maibach HI (2008) Sensitive skin syndrome: sensory response and classification. Cosmetics & Toiletries, 123: 26 - 30.

Farage MA, Maibach HI (2010) Sensitive Skin: Closing on a physiological cause. Contact Dermatitis 62:137-149.

Fluhr J, Darlenski R (2011) Development of Skin Models: Sensitive Skin. SÖFW, 136:16-22.

Misery L, Sibaud V, Ambronati M, Macy G, Boussetta S, Taieb C (2008) Sensitive scalp: does this condition exist? An epidemiological study. Contact Dermatitis. 58:234-8.

Pinto P, Rosado C, Parreirão C, Rodrigues LM (2011) Is there any barrier impairment in sensitive skin? a quantitative analysis of sensitive skin by mathematical modeling of transepidermal water loss desorption curves. Skin Res Technol.17:181-5.

Saint-Martory C, Roguedas-Contios AM, Sibaud V, Degouy A, Schmitt AM, Misery L. (2008) Sensitive skin is not limited to the face. Br J Dermatol. 158:130-3.

Willis CM, et al. (2001) Sensitive skin: an epidermiological study. Br J Dermatol, 145:258-263.