Protecting the Skin from Environmental Stresses with an Exopolysaccharide Formulation

Alain Thibodeau,
Atrium Biotechnologies, Quebec, PQ Canada

KEY WORDS: *polysaccharide, exopolysaccharides, hydrothermal, epidermis, ICAM-1, leucocytes, keratinocytes, interferon, fibroblasts*

ABSTRACT: *A polysaccharide with a repetitive unit of 11 glycosidic residues and a relative molecular mass of 1.8. 10³ kDa has been found to exert properties such as skin repair, restructuring and protection against inflammatory processes, in a described formulation.*

An increasing number of hyperthermophilic and mesophilic bacteria have been isolated from deep-sea hydrothermal vents throughout the past 20 years and found to be an extraordinary source of innovative molecules with unusual biological properties. These properties have developed as defense mechanisms enabling the marine organisms to adapt themselves to extreme conditions of temperature, pressure and darkness that prevail in the world's seas.

Among these, bacteria belonging to the genus *Alteromonas*, and precisely to the species *A. macleodii*, were identified as being able to produce large amounts of biologically active exopolysaccharides (EPS).[1] A close investigation of some of these biopolymers revealed that they could be of powerful value in the cosmetic industry by providing a new way to protect the skin from environmental injuries. The best example is a polysaccharide produced by *A. macleodii*, strain HYD657[a] (EPS657) that is the sole bioactive polymer in a described *Alteromonas* ferment extract formulation[b] (SEPS657). The present review will focus on this ferment extract with particular emphasis on its properties as exemplified by a number of laboratory and clinical studies. A separate article on page 26 discusses the scheme of events that led to its discovery.

Bacteria belonging to the species *A. macleodii* were identified as being able to produce large amounts of biologically active exopolysaccharides.

Innovative EPS of Biotechnological Interest in Cosmetics

Recently, a new EPS produced by a strain of *A. macleodii* (HYD657), a bacterium collected on the dorsal integument of the polychaete annelid *Alvinella pompejana* in an active hydrothermal vent of the East Pacific Rise, was characterized using monosaccharide analysis, methylation analysis, β-elimination studies and NMR spectroscopy.[2] The HYD657 strain was selected on the basis of its ability to exhibit a swarming mucoid phenotype when grown on Okutani medium.[3] According to cytological, physiological, biochemical and molecular investigations, strain HYD657 of *A. macleodii* was described as a motile (single polar flagellum), encapsulated gram-negative bacterium that appeared nonpigmented, nonluminescent and nonfermentative. Optimal growth temperatures on artificial medium were estimated to be 30°C to 35°C and optimal pH between 6.5 and 7.5. The bacterium was found to produce catalase and cytochrome oxidase, and to secrete a complex EPS, or EPS657.

Chemical characterization of EPS657 revealed that neutral sugars (glucose, galactose, fucose, rhamnose and mannose) in the polymer accounted for 58%, and uronic acids (glucuronic and galacturonic acids) for 30% of the molecule. Interestingly, this exopolymer differed from all other EPS extracted from *Alteromonas* sp. by the presence of an unusual sugar identified as a 3-0-(1 carboxyethyl)-D-glucuronic acid. This originality of EPS657 relied also in the replacement of a glucuronic acid residue by a lactate group in position 3 (see Figure 1). EPS657 has a repetitive unit of 11 glycosidic residues and a relative molecular mass of 1.8. 10³ kDa (see Figure 2).

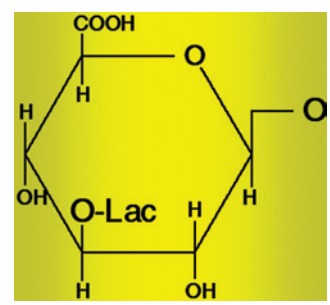

Figure 1. This EPS' originality: A glucuronic acid residue replaced in position 3 by a lactate group.

[a] *Deepsan is a trade name of Atrium Biotechnologies.*
[b] *Abyssine 657 (INCI: Water (aqua) (and) Alteromonas ferment extract (and) butylene glycol) is a product of Atrium Biotechnologies.*

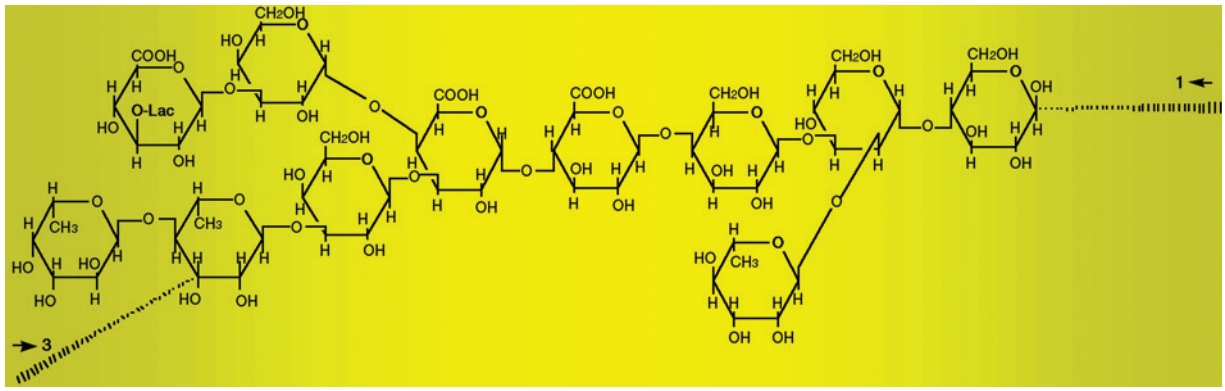

Figure 2. Hypothetical structure of the repeating unit of the EPS (n = 900 to 100)

Even though the biological function of EPS657 is not fully elucidated yet, one may suggest that, in nature, it contributes to the formation of the filamentous mats found in the microenvironment of the annelid *Alvinella pompejana*. Such bacterium-produced mats are thought to help the annelids to fix on the hydrothermal sulfide-chimney and to protect them against the high concentration of toxic compounds such as heavy metals. It is this latter property that incited further investigation into the potential value of this polymer in skin protection against injuries and inflammatory reactions.

Skin as primary target of the inflammation process

In the epidermis, the principal cell types found are the keratinocytes, the melanocytes and the Langerhans cells. In response to injury, keratinocytes produce cytokines and expressing molecules from the Major Histocompatibility Complex and adhesion molecules called ICAM-1 (Intercellular Adhesion Molecule). In most inflammatory skin reactions, the expression of ICAM-1 in the epidermis initiates a series of events leading to interactions between leukocytes and keratinocytes.[4] Under normal conditions, the level of expression of ICAM-1 by leucocytes is quite low. However, this level can be amplified markedly upon exposure to pro-inflammatory agents, contact allergens, histamine, enterotoxins, pollutants and other chemical or physical irritants.

ICAM-1 is a transmembrane glycoprotein molecule of the immunoglobulin superfamily. Each molecule is characterized by five distinct immunoglobulin-like domains, a transmembrane domain and a cytoplasmic tail.[4] While the final protein is 505 amino acids long, the molecule weighs between 80 and 114 kDa, depending on the level of glycosylation that varies among cell types and environments. ICAM-1 expression is regulated through four primary pathways: proteine kinase (PKC), AP-1 and MAP kinase, JAK/STAT and interferon-γ (IFN-γ), and NFkB.[5] IFN-γ has a signaling effect on the transcriptional control of ICAM-1. The pathway appears to be prompted by pro-inflammatory cytokines which, in turn, activate a signaling cascade leading ultimately to the transcription of ICAM-1.[5]

> Any molecule able to reduce the expression of ICAM-1 by keratinocytes represents a promising tool for cosmeceutical formulations.

Histamine is another compound known for its capacity at regulating the expression of inflammatory molecules. While histamine is produced mainly by different leukocyte populations, it also is produced by keratinocytes upon UV irradiation.[6] Thus, ICAM-1 is produced abundantly by skin keratinocytes in cutaneous inflammatory reactions[7] and is up-regulated on the surface of many cell types by pro-inflammatory mediators such as IFN-γ and interleukin-1α (IL-1α). Expression of ICAM-1 by keratinocytes has been correlated with accumulation of lymphocytes in the skin epidermis. Lymphocyte-keratinocyte interactions are thought to play an important role in immunological defense reactions and also in the pathogenesis of several mucocutaneous disorders such as *Candida albicans*-incited dermatitis.

In view of the predominant role played by ICAM-1 in cutaneous inflammatory reactions, one can argue that any molecule able to reduce the expression of ICAM-1 by keratinocytes represents a promising tool for cosmeceutical formulations that may have the potential to protect irritable, hyperreactive or simply sensitive skin from inflammation.

Effect of SEPS657 on the expression of ICAM-1 by keratinocytes

As mentioned in the preceding section, ICAM-1 is a fundamental component in many immune-related processes including skin inflammatory processes.[8] For example, the topical application of molecules causing allergic contact dermatitis has the ability to initiate cutaneous inflammation by directly influencing the transduction signal that leads to the expression of ICAM-1 in the keratinocytes. This expression takes place during the pre-erythematous phase preceding the appearance of T lymphocytes and the clinical symptoms of allergic dermatitis, and is very intense during the amplification phase that coincides with dermal and epidermal infiltration of T cells. Lymphokine INFγ then is released and this amplifies the original stimulus.

In an attempt to demonstrate that SEPS657 could reduce ICAM-1 production by human keratinocytes, experiments were performed by using cultured human

keratinocytes exposed to IFN-γ, a natural inducer of ICAM-1. In these experiments, human keratinocytes were cultured at 37°C in a serum-free medium. Culture suspensions were seeded in 96-well plates and incubated at 37°C for 72 hours (h) before being exposed to the test product (5% SEPS657). After incubation of the cultured keratinocytes at 37°C for 24 h, stimulation of ICAM-1 was performed by using interferon γ (INFγ). Twenty-four hours later, ICAM-1 was measured by immunocytochemistry at the surface of keratinocytes. Controls consisted of human keratinocytes treated with INFγ only. The results clearly demonstrated that pre-treatment of keratinocytes with SEPS657 drastically reduced the level of ICAM-1 produced upon stimulation by INFγ (see Table 1).

Table 1. Effect of EPS657 and SEPS657 on the production of ICAM-1 by keratinocytes

	Control		SEPS657—5 %	
INF-γ (U/ml)	0	100	0	100
ICAM-1 (DO/well)	0.17	1.20	0.14	0.29
Proteins (µg/well)	7.53	7.30	7.34	7.29
ICAM (ua/µg prot.)	23.12	164.71	18.72	39.68
Production ICAM-1		**141.59**		**20.96**

Table 2. Effect of SEPS657 (1.7 %) on the percentage of tritiated thymidine incorporation in the keratinocytes

Treatment	n=number of replicates	% incorporation	p=significance
Control	6	100	/
EGF Reference	6	147	< 0.01
1.7% SEPS657	6	**163**	**< 0.01**

Effect of SEPS657 in stimulating keratinocytes proliferation

Skin cell renewal is strongly dependent on the presence of active keratinocytes in the epidermis. In order to determine whether SEPS657 could have a beneficial effect on skin cell renewal, human epidermal keratinocytes were cultured in single layers at 37°C in a calcium-poor SFM medium and in the absence of any complement. The keratinocytes were labeled by incorporating tritiated thymidine in the DNA. SEPS657 (1.7 %) was added to the culture medium and the culture suspension was seeded in 96-well plates before being incubated at 37°C for 24 h. Labeled keratinocytes were detected by liquid scintillation count. The experiment was replicated six times

and included epidermal growth-factor in addition to pituitary extract (EGF) as a positive reference.

EPS657 at a concentration of 50 µg/ml (equivalent to 1.7% SEPS657) strongly stimulated the incorporation of tritiated thymidine (163%) into cultured keratinocytes (see Table 2), thus suggesting that it could exert a positive effect on skin cell renewal.

Effect of SEPS657on the biological function of fibroblasts

Fibroblasts are the most important cell components of the dermis. They synthesize an extracellular matrix (ECM) made of various proteins among which collagen and elastin play a key role by allowing the skin to maintain its elasticity and firmness. Type I collagen is the most important protein in the dermis that also contains other types of collagen (types III, IV, VII and so on). Type I pro-collagen is secreted into the dermal extracellular space where it undergoes an enzymatic process, arranging itself in a triple helix configuration. This helix binds to other extracellular matrix proteins to form regularly arranged fibrillar structures, resulting in the elaboration of collagen bundles that are responsible for the strength and resiliency of the skin.

The contraction of collagen fibrils by the fibroblasts represents an important pre-ordained step in skin appearance as well as in the process of tissue remodelling and healing. Prolonged exposure to irritants may alter dermal matrix contraction that, in turn, compromises the integrity and regeneration of the skin tissue, which leads to the formation of wrinkles and other disorders.

The ability of dermal fibroblasts to form a gel in the presence of collagen has been explored as a means to monitor the speed of matrix contraction. Recent in vitro studies, designed to assess the beneficial action of SEPS657 in stimulating the speed of matrix contraction by human dermal fibroblasts in suspension, revealed that, at concentrations as low as 0.03%, the product was able to improve the rate of collagen fibril contraction by 20% to 29% as compared to untreated suspensions (see Figure 3). Other controls included demecolcine, a known inhibitor of matrix contraction, and retinoic acid, a strong inducer of matrix contraction.

The results obtained from in vitro experiments support the concept that SEPS657 is capable of making a positive contribution to remodelling tissues in the event of skin lesions.

Effect of SEPS657 on sensitive and highly reactive skins

The main objective of this clinical trial was to determine the calming effect of a cream containing 0.5 % SEPS657as the sole active ingredient by quantifying the degree of skin reactivity on a panel of 20 volunteers with sensitive, reactive skin, after 28 days of twice daily use. The test product was an emulsion containing 0.5 % SEPS657.

The Stinging Test, developed by Frosch and Kligman (1977), was used to evaluate the degree of cutaneous reactivity of the volunteers. The test was performed by applying on the nasogenial groove a solution of 10% lactic acid on one side and physiological saline, a placebo, on the other side. Ten seconds, 2.5 minutes (min) and 5 min after application, volunteers' sensations were evaluated according to the following scale:

- 0: No stinging
- 1: Slight sensation
- 2: Moderate sensation
- 3: Severe sensation

A global score of reactivity was calculated according to the following formula:

Global score = Σ scores on the lactic acid side - Σ scores on the physiological saline side, or

$$\text{Global score} = \Sigma S_{la} - \Sigma S_{ps}$$

A minimum score of 3 was required to select the individuals reacting positively (sensitive skin) to the stinging test ("stingers").

A total of 20 female volunteers with a minimum score of 3 received the emulsion containing 0.5 % SEPS657 and used it morning and evening instead of their usual moisturizing cream during 28 days. D0 = distribution of the product to

the volunteers who used it morning and evening for 28 days, instead of their usual moisturizing cream. The values obtained during the pre-inclusion examination were used as basic values (D0). D28 = Stinging Test in the same areas as on D0. Statistical analyses were performed by using Wilcoxon's test (see Table 3).

These results indicate that after 28 days of twice daily use, the formulated cream containing 0.5% of SEPS657 contributes to a 25.4% reduction of cutaneous reactivity. These observations confirm those obtained through the in vitro study and highlight the remarkable potential of SEPS657 at protecting sensitive and reactive skins from inflammation or environmental insults. The incorporation of SEPS657 in skin care products should therefore be of value to improving the comfort of sensitive skins that are considered to "react to everything," or skins that have become sensitized by an accumulation of small daily attacks.

Table 3. Effect of the cream containing 0.5 % SEPS657 on the reduction of skin reactivity to irritants

Score Average D0	Score Average D28	Difference	% variation	p unilateral test
4.0 ± 0.3	3.2 ± 0.5	- 0.8 ± 0.4	Θ **25.4 %**	0.043

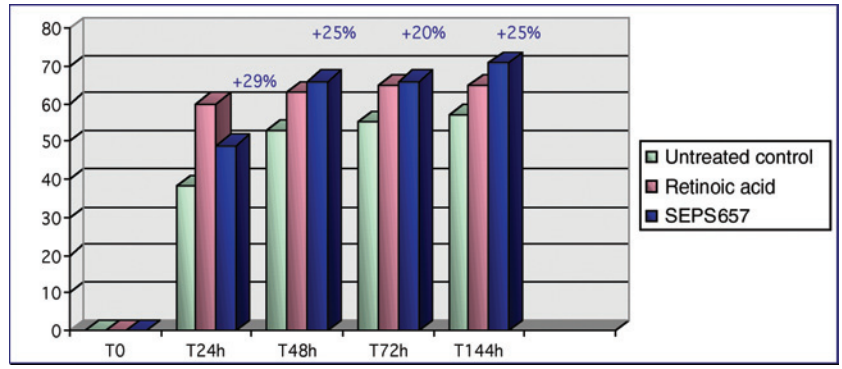

Figure 3. Effect of 0.03% SEPS657 (equivalent 1µg/ml EPS657) in stimulating the rate of collagen fibril contraction

Effect of SEPS657 on the secondary effects of an oral isotretinoin

Acne occurs due to an excessive production of sebum from over-active sebaceous glands in the skin matrix. A keratinaceous plug blocks the sebaceous glands, a process that prevents the oil from flowing out freely, and causes an accumulation of sebum under the skin. The bacteria associated with acne develop abundantly in these conditions. They feed on the sebum, and produce waste products and fatty acids that irritate and inflame the glands, causing spots.

Isotretinoin is a powerful drug used in the treatment of acne. By decreasing the size and activity of the sebaceous glands, it reduces the amount of sebum under the skin and consequently the number of bacteria that use sebum as a nutrient source. When the treatment is ended, the beneficial effects persist for several months. Unfortunately, such an effective drug against acne also can have serious side effects such as general dryness of the skin, dryness of the mucous membranes, skin darkening, abnormal reaction of skin to light, hair loss and inflammation of the surface of the eye. This unique mode of action, leading to major changes in skin protection phenomena, explains why dermatologists frequently recommend a complementary soothing cream when they prescribe treatment with oral isotretinoin for the treatment of severe acne.

The undesirable cutaneous side effects, expressed by patients subjected to isotretinoin treatment, represent the ideal model for studying the efficacy and tolerance of a cosmetic product with prolonged protective action. The main objective of this trial was to determine the efficacy of a cream containing 3% SEPS657 at protecting the skin of 40 patients taking oral isotretinoin from secondary cutaneous disorders. This efficacy was evaluated by investigator dermatologists during clinical examinations at the end of the study and by patients themselves via a self-evaluation questionnaire.

All volunteers suffered from inflammatory, mixed or retentional acne and exhibited an average number of 62.8 lesions. They suffered from this disease for an average of 7.1 years with a minimum of 7 months and a maximum of 16 years. Twelve volunteers out of 40 (30%) already had been treated with oral isotretinoin and 11 among them reported signs of discomfort during this previous treatment, which, in eight cases, led to the administration of skin care cosmetics.

In a preliminary survey, the incidence of discomfort after application of the

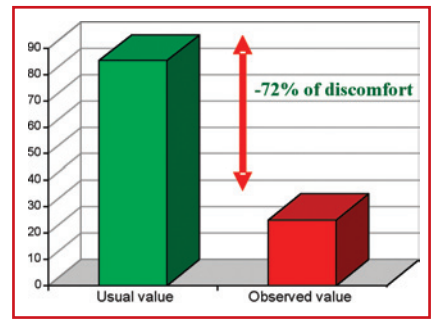

Figure 4. Application of the cream containing SEPS657 reduced the incidence of discomfort under oral isotretinoin by nearly 72%.

SEPS657-enriched cream was compared to the usual incidence of discomfort recorded upon isotretinoin treatment. The cream was applied on the whole face, morning and evening after washing, for 28 to 35 days, depending on the availability of volunteers for the final examination (see Figure 4).

The average value of incidence of discomfort under oral isotretinoin observed by investigators in their patients was 85.2%. The average time taken for observing signs of discomfort under oral isotretinoin was 10.9 days.

During the course of the test designed to evaluate the efficacy of the SEPS657-enriched cream at reducing discomfort, 25% (10 individuals) of the volunteers displayed discomfort of the facial skin.

Table 4. Scores given to the SEPS 657-containing aftershave by the volunteers

Product evaluation	Number	%	TOTALS
Very good	19	24.7 %	|
Good	34	44.1 %	|**Total good: 90.9%**
Fairly good	17	22.1%	|
Neither good nor poor	4	5.2%	|**Total average: 5.2%**
Rather poor	3	3.9%	|
Poor	0	0	|**Total poor: 3.9%**
Very poor	0	0	|
No reply	0	0	
Average score out of 100: 80.1 ± 1.00			

This value was maximized because it contained all data on discomfort, whether reported by the investigator or the volunteer alone, or by both.

This average value of 25% significantly contrasts with the generally expected value of 85.2% (a highly significant difference: $p < 0.0001$).

The efficacy of the cream was evaluated by investigating physicians. Most of them (85%) estimated that the cream containing SEPS657 markedly reduced the side effects caused by oral isotretinoin during the treatment of severe acne. On the basis of these results, it is clear that the SEPS657-containing cream offers the potential to become a complement to isotretinoin treatment in order to minimize the negative effects of this drug.

Effect of SEPS657 on skin irritation by manual shaving

The main objective of this trial was to evaluate user's satisfaction with a daily aftershave product containing 3% SEPS657. This involved analyzing spontaneous comments made by consumers as well as their replies to coded questions, with the aim of verifying the product's performance with respect to defined criteria.

A panel of 77 men who shaved manually was selected. The panel was split up according to skin type: very sensitive, 18.2%; sensitive, 48.1%; slightly sensitive, 24.6%; and not at all sensitive, 9.1%. The test was performed at home with a daily application of the aftershave after shaving, for two weeks.

The questionnaire was divided into two sections providing complementary information. The first one concerned spontaneous comments designed to describe the main product characteristics. The second one concerned the following aspects: softness of the skin, soothing effect, improved healing of micro-cuts due to shaving, improvement of the overall condition of the skin after application of the SEPS657 (see Table 4).

The tested aftershave obtained an average score of 80.1/100, which is excellent if one considers that the average score for aftershave products (more than 1,250 consumers) is 72.6/100.

Spontaneous comments on the product revealed that about 31% of the consumers estimated that the product was soothing or calming to razor burn, while nearly 25% noted that the product made the skin softer and 18% mentioned its moisturizing effect.

Answers to the second section of the questionnaire provided key information on the beneficial effects of the tested after-shave balm (see Figure 5).

Potential of SEPS657 for sun and after-sun skin care

Like all of the body's organs, the skin undergoes drastic changes not only during the normal aging process, but also as a result of prolonged exposure to external aggressors such as UV radiations.[9] The extrinsic aging, or photoaging, that

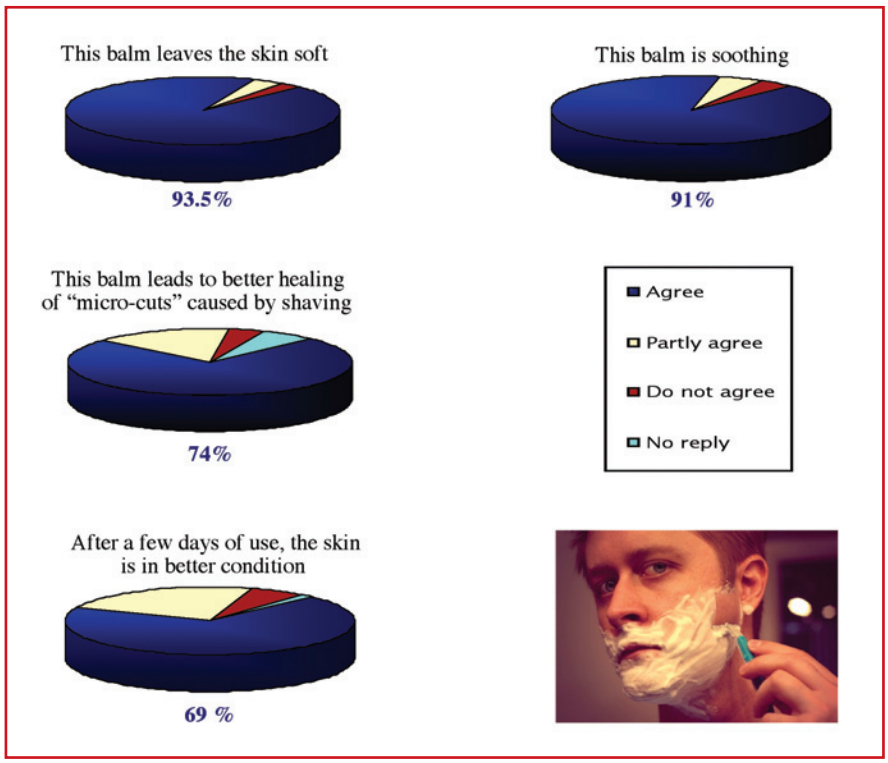

Figure 5. According to the replies, the performance of this aftershave balm based on SEPS657 was excellent. The key criteria for men shaving manually are the soothing effect of the product and the softness of the skin; both criteria received very high scores of 91% and 93% respectively.

results from long exposure to sun has been associated mainly with both oxidative stress and collagen degeneration[10,11] leading to skin alterations and, even worse, skin cancers.[12] Thus, UV rays speed up time and induce disorders that normally occur much later in a life.

The interplay between reactive oxygen species intensely produced upon sun exposure and premature skin aging has been the subject of several studies in the last decade. Clear evidence has been provided that oxygen radicals mainly were responsible for a series of disorders including membrane peroxidation and DNA alterations.[11] Endogenous antioxidants such as the enzymes, superoxide dismutase and catalase, and the reducing agents, vitamin E and glutathion, markedly decrease in photoaged skin while markers of oxidation damage such as lipid peroxidation product increase.[10]

In the epidermis, the Langerhans cells are a key target for UV irradiation, mainly because they are unprotected by melanin even in highly pigmented skins. During the process of photoaging, the Langerhans cells are less active, so immunity is reduced and sensitivity to infections consequently increased. This reduction in immune defense is observed locally and also on the global immune system.

> The concept of linking a "classic" protective system with "biological" protection is an option that is attracting increasing attention.

It therefore is particularly important to be protected from the harmful effects of UV radiations. The daily use of skin care containing sunscreens (UV-filters, UV-screening) has long been recommended for fighting against UV-induced aging. Although the advantages of these sunscreens are undeniable, a high concentration of chemical filtering is not necessarily well tolerated by the skin. In addition, mineral screens do not always provide the organoleptic characteristics required for a cosmetic product. In that context, the concept of linking a "classic" protective system with "biological" protection is an option that is attracting increasing attention.

A number of experiments recently were performed to delineate the potential effects of SEPS657 on skin protection against prolonged sun exposure.

Effect of SEPS657 and on skin protection against UVB irradiation: Human skin explants (8 mm in diameter) were cultured on 24-well plates, containing 300 µl of medium per well. The protective effect of SEPS657 was tested by applying twice the product on the surface of the epidermis at T24h and T48h. At T72h, the treated explants were UVB-irradiated (total irradiation of 1.5 J/cm^2) and at T96h, they were frozen before being cut into transverse sections. Thin sections then were treated with a specific marker of Langerhans cells: the anti-CD1a antibody. Sections were examined by epifluorescence, and the fluorescent Langerhans cells counted (6 fields per slide, giving 12 values per treatment). Results from this ex vivo experiment revealed that SEPS657 efficiently protected the Langerhans cells from the harmful effect of UVB irradiation as compared to irradiated control tissue sections.

In a second study, the same protocol was used to compare the effect of EPS657 (15 µg/ml = equivalent 0.5% SEPS657) to that of the marketed principle SEPS657 (2%) (see Figure 6).

Evidence was provided that the marketed solution SEPS657, at a concentration of 2%, provided full protection of the Langerhans cells in the skin explants. These results highlight the potential of SEPS657 that can be used to formulate any sun care product, in conjunction with a classic type of chemical or physical protection. In that context, SEPS657 can be recommended for use in daily skin care cosmetics, protecting Langerhans cells and hence the skin's defense system.

Effect of SEPS657 on actinic erythema caused by UV irradiation: In an attempt to confirm that SEPS657 had anti-inflammatory strengthening effects on skin exposed to UV irradiation, a clinical trial was carried out to evaluate the soothing action of this formulation as compared to a placebo. Seven volunteers who did not express any sign of skin pathology or known allergies to

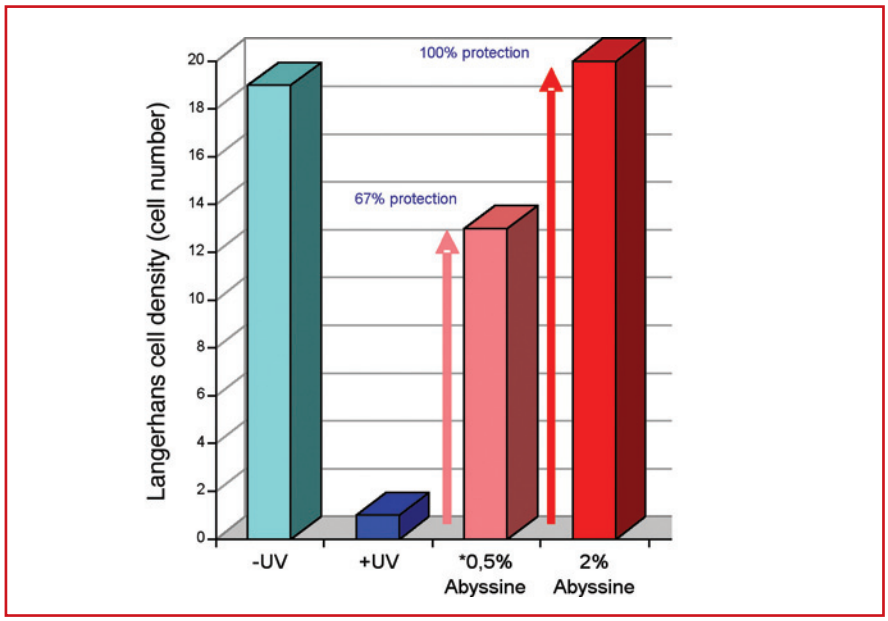

Figure 6. Effect of SEPS657 (0.5% and 2%) on the number of Langerhans cell viability following UVB radiation

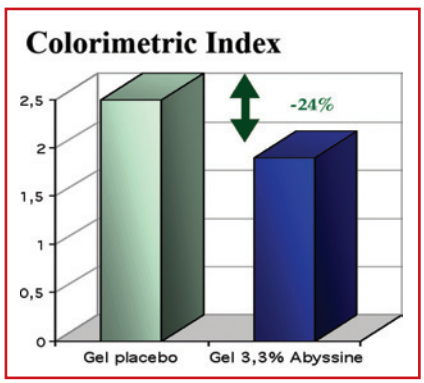

Figure 7. Colorimetric Index
Under the experimental conditions used, standard application of a gel activated with 3.3% SEPS657, as compared to a placebo gel, revealed a significant reduction in the intensity of erythema caused by UV irradiation.

the sun were invited to apply SEPS657 (3.3%) or a placebo on two irradiated skin zones on the back.

The effect of the applied products was evaluated through colorimetric measurements of the skin, before and after production of actinic erythema on the back. Each volunteer's phototype was determined by colorimetric measurement and calculation of the Individual Typological Angle. Determination of the Minimum Erythematous Dose (MED) of the volunteers was performed in the lumbar area of the back before the induction of actinic erythema by UV irradiation. Five hours later, the test products were applied at a rate of 2 µl/cm^2 on the defined skin zones (placebo on one zone, activated product on the other) and new colorimetric measurements were performed by seven hours. Comparison was made between the values obtained in the active product-treated area and those in the placebo-treated zone (see Figure 7).

The results of this clinical study therefore indicate that SEPS657 can be recommended in formulating any after-sun care to reduce signs of inflammation caused by prolonged sun exposure.

In vitro and clinical trials have proved the strong efficacy of SEPS657 at reinforcing the natural defense mechanisms of the skin, thus decreasing its vulnerability to a wide array of aggressions including oxidative damage, microbial infections and mechanical stresses.

Conclusion

Exploration of the tremendous biodiversity of the world's oceans and seas has led to the identification of major groups of organisms that developed the extraordinary ability to adapt themselves to the extremes of temperature, darkness and high pressure that are found in oceans. The demands of the marine environment have led these organisms to evolve unique structures, metabolic pathways, and defense mechanisms. Such

properties are increasingly explored in a number of industries and already have resulted in major innovative issues in the pharmaceutical and agri-food sectors. In the natural personal care industry, the introduction of new molecules originating from marine organisms is attracting much attention, mainly because these target molecules may not only have the ability to deliver nutrients necessary for healthy skin, but also display the potential to be key actors in the treatment of disorders such as actinic erythema, acne, psoriasis or physical injuries.

Intensive laboratory and clinical research studies have convincingly shown that EPS657, a polysaccharide produced by some marine bacterial species, has potential as an anti-inflammatory agent able to calm skin that has become sensitized by a combination of small daily attacks such as stress and pollution, micro-cuts and dermal infections, UV irradiation and photoaging. By promoting tissue restructuring and repair through a specific action on major skin cell types (keratinocytes, Langerhans cells and fibroblasts), SEPS657 helps improve skin appearance and reduce discomfort caused by daily attacks. SEPS657 can be incorporated easily in a wide range of cosmeceutical products including w/o and o/w creams and lotions, aqueous gels, emulsified gels and aftershave lotions.

Several hundred years ago, Confucius said, "True quality of life comes from a lasting harmony between the body and the mind." Much more than ever before, this philosophic concept appears realistic today. If one considers that the skin is the body's living envelope that expresses emotions, then taking care of the skin is a primordial need that allows individuals to protect and defend themselves, and to simply feel better. Thus, the time dedicated to skin care plays a major role in building harmony between the body and the mind.

References

Send e-mail to Alain Thibodeau c/o nlabonte@atrium-bio.com.

1. J Guezennec, Deep-sea hydrothermal vents: A new source of innovative bacterial exopolysaccharides of biotechnological interest, *J Indust Microbiol Biotechnol* 29 204–208 (2002)
2. MA Cambon-Bonavita, G Raguénès, J Jean, P Vincent and J Guezennec, A novel polymer produced by a bacterium isolated from a deep-sea hydrothermal vent polychaete annelid, *J Appl Microbiol* 93 310–315 (2002)
3. K Okutani, Structural investigation of the fructan from marine bacterium NAM-1, *Bull. Jap Soc Sci Fisheries* 8 1621–1625 (1982)
4. AV Stolpe and PT Saag, Intracellular adhesion molecule-1, *J Mol Med* 74 13–33 (1996)
5. KA Roebuck and A Finnegan, Regulation of intracellular adhesion molecule-1 (CD54) gene expression, *J Leuk Biol* 66 876–888 (1999)
6. R Malaviya, AR Morrisson and AP Pendland, Histamine in human epidermal cells is induced by ultraviolet light injury, *J Invest Dermatol* 106 785–789 (1996)
7. T Matsunaga, I Katayama, H Yokozeki and K Nishioka, ICAM-1 expression on keratinocytes in mechanically injured skin of a patient with atopic dermatitis, *J Dermatol Sci* 12 219–226 (1996)
8. JE Sligh, CM Ballantyne, SS Rich, HK Hawkins, CW Smith, A Bradley and AL Beaudet, Inflammatory and immune responses are impaired in mice deficient in intercellular adhesion molecule-1, *Proc Nat Acad Sci* 90 8529–8533 (1993)
9. F Trautinger, Mechanisms of photodamage of the skin and its functional consequences for skin aging, *Clin Exp Dermatol* 26 573–577 (2001)
10. TR Golden, DA Hinerfeld and S Melov, Oxidative stress and aging: beyond correlation, *Aging Cell*, 1 117–123 (2002)
11. K Hensley and R Floyd, Reactive oxygen species and protein oxidation in aging: a look back, a look ahead, *Arch Biochem Biophys* 397 377–383 (2002)
12. Y Yamamoto, 2001. Role of active oxygen species and antioxidants in photoaging, *J Dermatol Sci* 27 S1–S4 (2001) C&T