AvenaPLex

DATA PACK

ACTIVE LIPID COMPLEX WITH A POWERFUL ANTI-AGEING EFFECT

oatcosmetics.com

AvenaPLex

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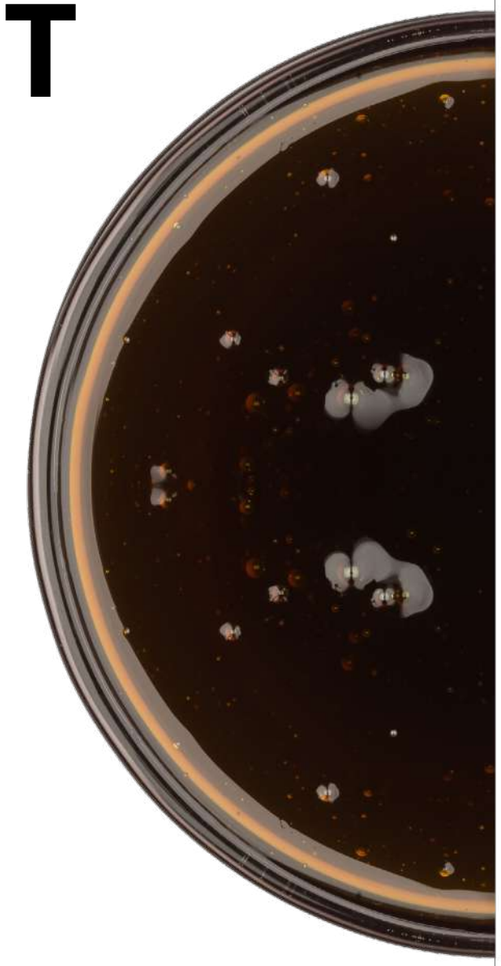
info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

INGREDIENT PROFILE



AvenaPLex is a unique active lipid complex that has a proven effect on skin physiology due to its impressive molecular profile. The key characteristics of this active ingredient include:

- Skin-identical phytoceramides
- Permeable phospholipids
- Beneficial neutral lipids and sterol profile
- Anti-inflammatory avenanthramides

PROFILING

AvenaPLex's unique lipid profile helps to replenish skin lipids lost through ageing and environmental factors. The lipid composition mimics that of the skin's natural make-up, containing a lipid-barrier-identical complex of ceramides, polyunsaturated fatty acids, sterols, tocopherols, tocotrienols, and more. AvenaPLex also contains phospholipids and essential triacylglycerols that provide short- and long-term protection for aged skin, and instant relief from dry, dull, flaky skin.

Polar Lipids*	Percentage
Ceramides	4.0
Phospholipids	15.0
Mono/Digalactosyldiacylglycerols	10.0
Other polar lipids	11.0
Total Polar Lipids	**40.0**

CERAMIDES

AvenaPLex contains a minimum of 4% naturally occuring phytoceramides. Many of which are skin identical and can replenish the ceramides that are lost through the ageing process.

Approximate Composition*	Percentage
Ceramides	1.36
Hydroxyceramides	
Glycosyl Inositol Phosphoryl Ceramides (Proceramide)	1.32
Glucosylceramide	1.32
Total Ceramides	**4.00**

AvenaPLex contains a significant proportion of the ceramide classes required by the skin.

Ceramide Class*	AvenaPLex Skin Identical (%)	AvenaPLex Total incl. Isomers (%)
Non-hydroxy-sphingosine [NS]	0.07	0.52
Non-hydroxy-phytosphingosine [NP]	0.13	0.13
Omegahydroxy-6-hydroxy-sphingosine [EOH]	0.47	0.47
Alphahydroxy-sphingosine [AS]	0.05	0.19
Alphahydroxy-phytosphingosine [AP]	0.05	0.05
Total	**0.78**	**1.36**

Skin ceramides are divided into 12 classes of which there are hundreds of sub-species. These account for 40%-50% of the lipids in the stratum corneum.

Independently tested by Stirling, Aug 2018

*Typical values may vary

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CERAMIDES (CONT.)

Human ceramide distribution varies according to body skin type and will change considerably in aged skin.

Age	Ceramide Level
Hands	
21-30 years	100%
31-40 years	78%
41-50 years	63%
Face	
21-30 years	100%
31-40 years	62%
41-50 years	37%

In addition to these changes in ceramide distribution, the chain length of the ceramides is markedly reduced during the ageing process, leading to a less tightly packed lipid arrangement between the corneocyte envelopes. In aged and dry skin conditions, phytosphingosine-containing ceramides and possibly phytosphingosine itself are deficient. In fact, as dryness levels of the skin increase, so too does the degree of phytosphingosine-containing ceramide deficiency.

AvenaPLex is immediately effective on skin with impaired barrier function as previous studies have shown the stabilising effect of a single application of a ceramide preparation was detectable.

PHOSPHOLIPIDS

Phospholipids, well known for their ability to maintain skin health and slow down skin ageing, make up 15% of the total lipid concentration in AvenaPLex. These phospholipids mainly fuse with the outer layer of the stratum corneum, potentially acting as permeability enhancers for skin actives. They have also been shown to enhance the skin barrier and display an anti-inflammatory effect by regulating the covalently bound hydroxy ceramides in the epidermis and decreasing the gene expression of both thymus activation-regulated chemokine and thymic stromal lymphopoietin. These are reported to affect the expression of ceramide-producing enzymes, resulting in reduced ceramide levels in the epidermis.

AvenaPLex contains phospholipids known to trigger gene pathways to physiologically increase the production of ceramides, thereby improving the integrity of the skin barrier.

Phospholipids*	Percentage
Phosphatidylcholine (PC)	6.0
Phosphatidylinositol (PI)	3.5
Phosphatidylethanolamine (PE)	3.0
Phosphatidic acid/ Phosphatidylglycerol/ cardiolipin (PG)	1.5
Lysophosphatidylcholine	1.0
Total Phospholipids	**15.0**

*Typical values may vary

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AvenaPLex Profile

PHOSPHOLIPIDS (CONT.)

Much of the barrier protection from the epidermis comes from stratum corneum lipids including ceramides, sterols and free fatty acids. These lipids are arranged in a highly organised, layered structure with controlled ratios; a tortuous pathway for substances attempting to permeate through the stratum corneum. A change in the ratio or structure of the stratum corneum lipids results in a compromised barrier function, which gives microbes and allergens unencumbered entrance to the deeper layers of the skin where inflammatory pathways are triggered. Notably, both ageing and exposure to environmental stresses elicit this type of distruption to the skin's barrier.

NEUTRAL LIPIDS

Studies have shown that topical application of a mixture of sterols, ceramides, and free fatty acids similar to AvenaPLex enable barrier recovery.

Neutral Lipids*	Percentage
Triacylglycerols	37.0
Free fatty acids	11.0
Cholesterol/sterols	10.0
Diacylglycerol	2.0
Total Neutral Lipids	**60.0**

STEROL PROFILE

AvenaPLex has a broad sterol profile which helps to contribute to overall skin wellbeing, particularly resilience and barrier functioning.

Sterols*	Percentage
ß-sitosterol	4.0
Avenasterol	4.0
Other (including cholesterol)	2.0
Total Sterols	**10.0**

EFFECT ON SKIN

AvenaPLex contains Avenasterol and Sitosterol, two major sterols with beneficial antioxidant and skin barrier support properties. It is reported that phytosterols not only stop the slow-down of collagen production that can be caused by exposure to the sun but also encourage new collagen production. Moreover, topical application of phytoceramides and phytosterols has been shown to inhibit the upregulation of MMP1 expression caused by UVA. The sterol profile of AvenaPLex also suggests that it could enhance the protection of collagen/elastin breakdown.

*Typical values may vary

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FREE FATTY ACIDS

AvenaPLex contains approximately 5%-6% natural free fatty acid. Although this percentage of free fatty acids is high in comparison to other similar oils, it is not a sign of degradation of the oil, but means that these free fatty acids are freely available to go into the skin and act as a precursor to long chain fatty acids. Fatty acid deficiency contributes to a disrupted skin barrier as it is a key component of the lipid lamella structure. In dry skin conditions, long chain fatty acids like palmitic (C16) and stearic acids (C18) are known to be deficient. In addition to natural free fatty acids, AvenaPLex also contains triacylglycerols with high concentrations of unsaturated and polyunsaturated fatty acids. These can act as precursors for skin identical fatty acids.

The roles of fatty acids in the skin are diverse and include maintenance of the stratum corneum permeability barrier, maturation and differentiation of the stratum corneum, inhibition of pro-inflammatory eicosanoids and cytokines, inhibition of lipoxygenase, and promotion of apoptosis in some malignant cells, including melanoma. They fulfil these functions independently and through the modulation of peroxisome proliferator-activated receptors (PPARs).

Fatty Acid Profile* (from Neutral and Polar Fraction)	Percentage
Myristic 14:0	0.07
Pentadecylic 15:0	0.08
Palmitic 16:0	4.66
Stearic 18:0	0.55
Arachidic 20:0	0.04
Behenic 22:0	0.04
Total Saturated	**5.45**
Palmitoleate 16:1n-9	0.02
Palmitoleic 16:1n-7	0.06
Oleic 18:1n-9	12.43
Vaccenic 18:1n-7	0.23
Eicosenoic 20:1n-9	0.24
Total Monounsaturated	**12.97**
Linoleic 18:2n-6	10.85
Eicosadienoic acid 20:2n-6	0.02
Total n-6 PUFA	**10.87**
Alpha-Linolenic 18:3n-3	0.35
Stearidonic acid 18:4n-3	0.03
Total n-3 PUFA	**0.37**
Total Fatty Acids	**29.61**

AVENANTHRAMIDES

The variety of oats used for the production of AvenaPLex are carefully selected to ensure high levels of avenanthramides (Avns). Solely found in oats, avenanthramide is a unique polyphenolic compound.

Typical Total Avenanthramides*	300.0 mg/kg

*Typical values may vary

The protective and anti-irritant role of avenanthramides has been proven in several dermatological imbalances such as atopic dermatitis, sunburn or allergies. In fact, Avns have anti- inflammatory and anti-pruritic effects on a disrupted skin barrier. An abnormal skin balance is characterised by higher levels of key molecules that promote inflammatory pathways such as IL-8, TNF-α, and arachidonic acid. When applied topically, Avns regulate the production of the IL-8 molecule, and decrease inflammation[1,2]. It has been proven that Avns, applied on the skin for 20 hours strongly reduce UV-induced erythema and that 200 mg/kg of Avns attenuate induced production of reactive oxygen species[1,2].

CONCLUSION

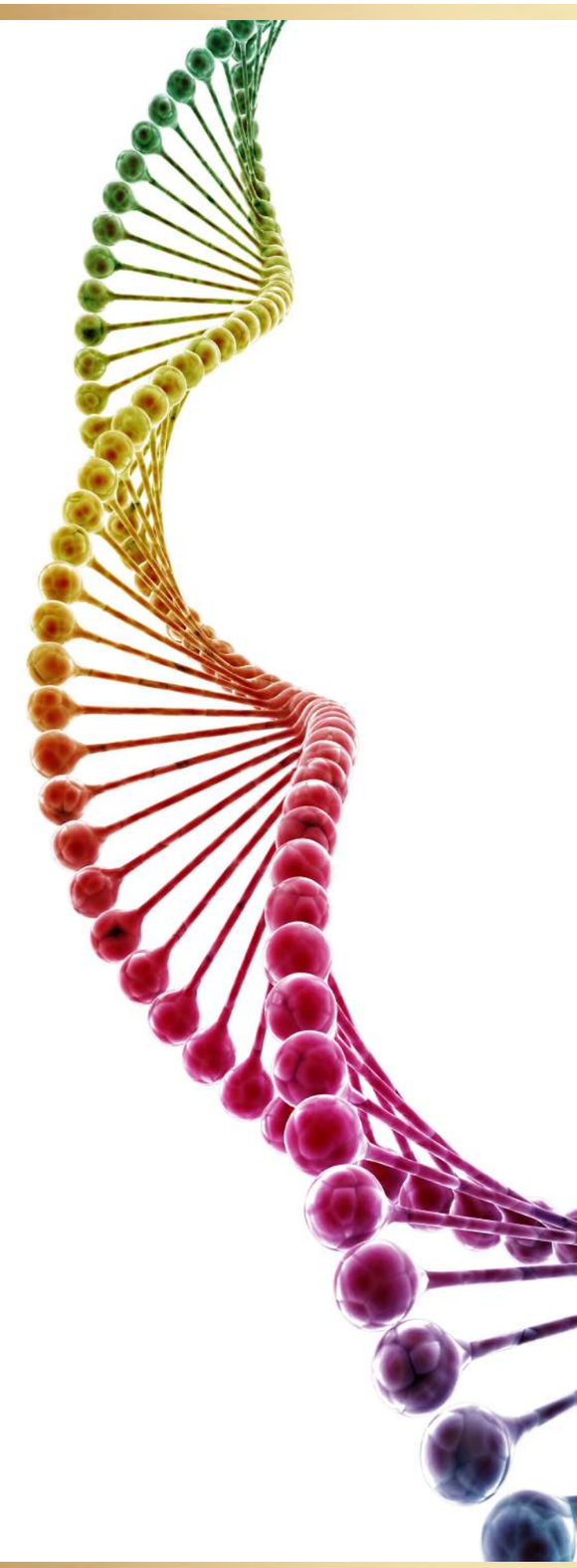
AvenaPLex's profile shows that due to its complex lipid composition, it has the ability to rapidly repair, renew and protect the skin's lipid barrier, helping to prevent and manage the signs of ageing. Its complex of skin-identical lipids, including ceramides, phosphatidylcholine and phosphatidylethanolamine, gives rise to short and long-term protection of aged skin. AvenaPLex contains powerful surface-active molecules to assist in rapid absorption of skin beneficial molecules: immediately supplementing skin lipids, assisting in strengthening the dermis, preventing the loss of elasticity and firmness, and repairing damage.

Independently tested by Stirling, Aug 2018

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

MODE OF ACTION

In this section of the datapack, we share the results of our gene expression analysis. This allows us to see which particular genes are stimulated and consequently which skin mechanisms may be impacted.



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Gene Modulation and Biological Activity

EX VIVO

BACKGROUND

The gene expression analysis was designed to identify how AvenaPLex specifically influences gene expression in the skin and consequently understand the mechanisms regulating those skin functions. For this study, real human skin models (NativeSkin®) were used. Alongside the skin models, a large qPCR-array genes list was processed. The use of NativeSkin® is particularly unique as these human skin models hold normal skin function of in-vivo human skin.

METHOD

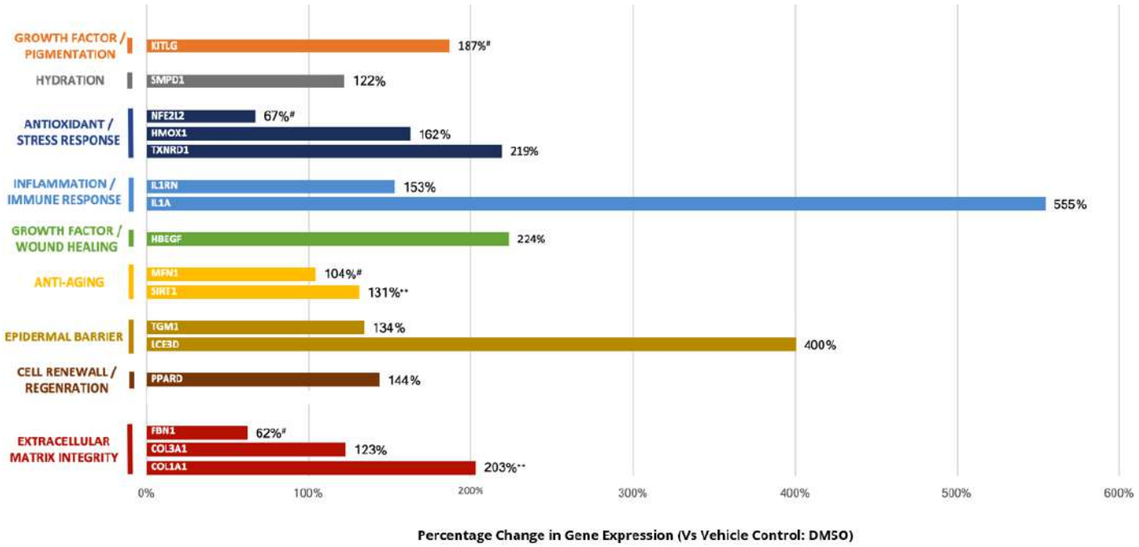
Tissue Model – Genoskin's ex vivo NativeSkin® model was used for this study, which includes normal skin barrier function, a mature stratum corneum, a functional basal layer and contains all cell types and skin appendages of in-vivo human skin. Donor tissues were taken from a 47-year-old woman.

Test Material and Time Points – The 2 test material groups were: 1% AvenaPLex (diluted in DMSO) and DMSO (vehicle control). This study included 3 biological replicas per test group. After application of the test materials for 72 hours (at the end of each day, the tissue models were rinsed and treatment was reapplied), the tissue samples were collected and analysed using RNA isolation and cDNA synthesis.

Gene Expression Analysis – The gene expression analysis was performed using a qPCR-based array that contains 107 genes which regulate a range of skin functions. Each gene was measured twice.

RESULTS

Figure 1: 1% AvenaPLex Gene Expression Analysis Results



Significant: **= p<0.01 (99%), #=p<0.1 (90%)

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EX VIVO

Gene Modulation and Biological Activity

RESULTS (CONT.)

The results show that 1% AvenaPLex increases the performance of genes that play an important role in skin biology:

Gene Function	Gene ID	Interpretation
Growth Factor and Pigmentation	KITLG	Promotion of melanogenesis (production of melanin which helps to protect the cells of the epidermis from UV light) via MITF[1]
Antioxidant and Stress Response	NFE2L2	Protection of cells against oxidative stress[2]
Inflammation and Immune Response	IL1A	Orchestration of dermal collagen turnover and stimulation of hyaluronic acid production[3]
Anti-Ageing	MFN1	Improvement of mitochondrial quality and activity[4]
	SIRT1	Protection of collagens from MMP9 degradation after UV exposure[5]
Epidermal Barrier	LCE3D	Maintain epidermal integrity and barrier function[6]
Extracellular Matrix Integrity	COL1A1	Help the skin to maintain extracellular integrity[7]
	FBN1	Production of fibrillin-1 proteins (part of molecules that forms in the spaces between cells)[8]

(For the non-significant upregulation, by increasing the sample size, from N = 3 to 4 or 6,it would allow to achieve significance or by increasing the time of application)

CONCLUSION

AvenaPLex is able to stimulate the expression of genes involved in mitigating and preventing many ageing and inflammatory mechanisms, with relevance to major signs of facial ageing and inflammation:

- Anti-wrinkles (improves mitochondrial quality and activity)
- Improved skin cell energy and metabolics (improves mitochondrial activity and antioxidants protect mitochodria)
- Skin elasticity (maintains extracellular matrix integrity)
- Skin hydration and skin firmness (maintains epidermal integrity and barrier function)
- Anti-redness (protects cell against oxidative stress)

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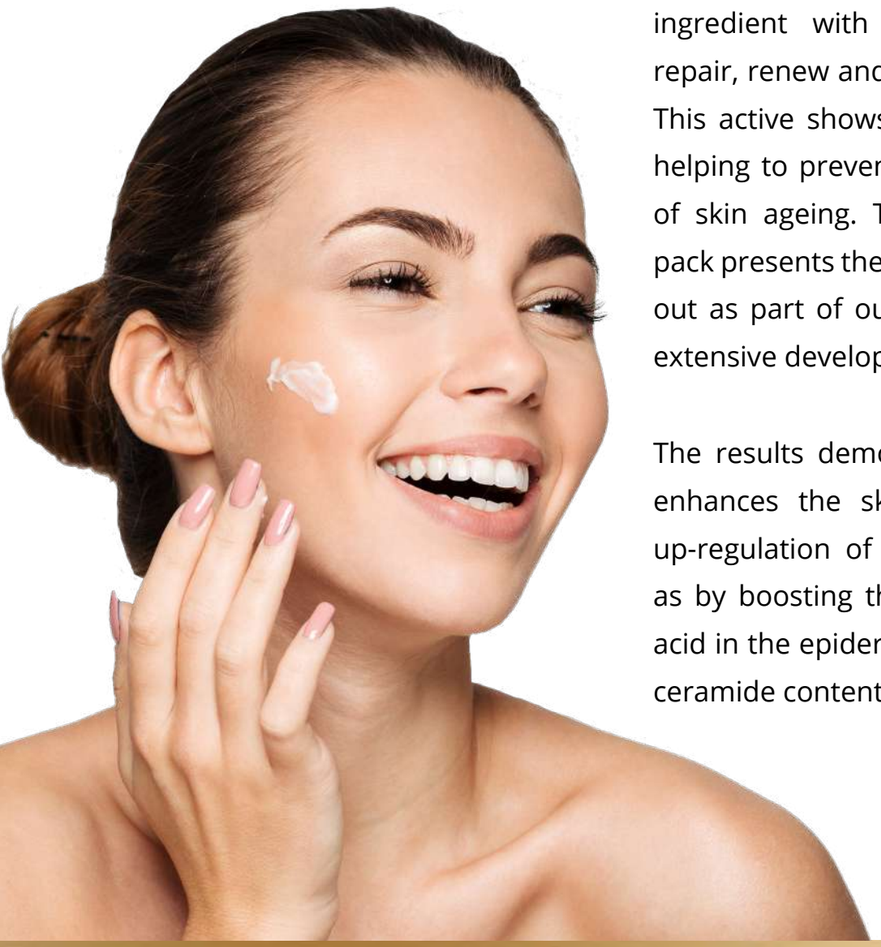
EFFICACY ON SKIN



AvenaPLex is a powerful oat active ingredient with a proven capacity to repair, renew and protect the skin barrier. This active shows efficacy on the skin by helping to prevent and manage the signs of skin ageing. This section of the data pack presents the variety of studies carried out as part of our rigorous research and extensive development process.

The results demonstrate that AvenaPLex enhances the skin barrier through the up-regulation of key gene markers such as by boosting the content of hyaluronic acid in the epidermis, increasing the skin's ceramide content, and more.

IN VIVO

Cutaneous Skin Hydration

BACKGROUND

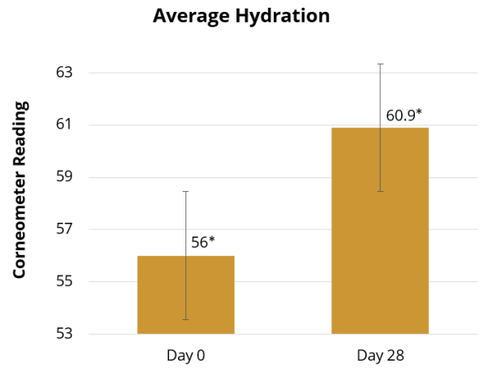
A study was undertaken to assess the cutaneous hydration of AvenaPLex over a 28-day period.

METHOD

The study was a single-centre, open, controlled user study carried out by a group of 22 female volunteers aged between 35 and 68 years old. Participants were only selected for this study if they had oily skin (as determined by a dermatologist) and had no previous history of skin conditions. Participants were provided with 100% AvenaPLex to apply once each evening to the face during the 4-week study period with the following instructions:
"Apply a thin layer evenly on the face and massage until the product has absorbed."

At Day 0, after 15 minutes of acclimatisation in a controlled room, each participant had their face examined by a certified dermatologist. Epidermal moisture of the stratum corneum was assessed by a non-invasive in-vivo instrumental testing method based on the electric properties of the skin (electrical capacitance). Hydration measurements were taken with Corneometer CM825 equipped with a 49 mm^2 probe. Three consecutive measurements, of the capacitance, were performed on the test sites - forehead, temples, cheekbones, jawline, and chin. This process was repeated at Day 28 and the results compared.

RESULTS



The results show that AvenaPLex significantly increased skin hydration by 9%, with an improvement of up to 26% for one volunteer.

CONCLUSION

AvenaPlex significantly increased skin hydration after 28 days of use. Despite participants in the study already having oily skin and no previous dry skin conditions, daily application of AvenaPLex alone (with no other moisturising factors) significantly increased skin hydration. Upon analysis of these results, combined with the results of the Barrier Function and Hydration Increase: Gene Stimulation Study (page 8), we can conclude that a daily application of AvenaPLex will increase the production of the skin's natural moisturising factors, and will improve the skin's natural lipid barrier resulting in a rapid increase in hydration.

Independently tested by Evalulab, Jul 2019

Significant: *=p<0.05 (95%)

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Barrier Function and Hydration Increase: Gene Stimulation

EX VIVO

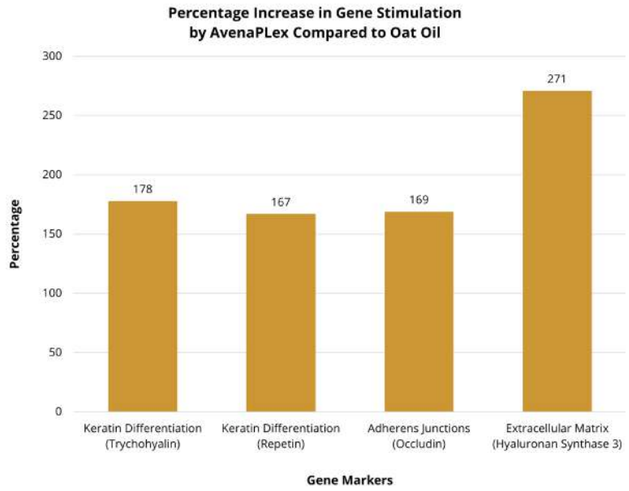
BACKGROUND

The study was designed to compare AvenaPLex with standard oat oil in a barrier function and hydration gene array model.

METHOD

AvenaPLex and standard oat oil were applied topically to a reconstructed human epidermis model at 0.005% and 0.017% respectively in a water/DMSO/Ethanol carrier (also used as a control). This concentration of standard oat oil (0.017%) was calculated to deliver the same total concentration of polar lipids as AvenaPLex but not at the same ratios, ruling out any concentration effects. The genes associated with barrier function and hydration were measured using a GPCR Array.

RESULTS



	Gene Stimulation Compared to Control	
Gene Markers	Oat Oil (0.017%)	AvenaPLex (0.005%)
Keratin Differentiation (Trychohyalin)	87	155
Keratin Differentiation (Repetin)	69	115
Adherens Junction (Occludin)	81	137
Extracellular Matrix (Hyaluronan Synthase 3)	83	225

The results show that AvenaPLex significantly increases the performance of key gene markers assays when compared to standard oat oil. This can be attributed to AvenaPLex's unique ratios of polar and non-polar lipids. Of particular note in these results is the up-regulation of Hyaluronan Synthase 3, as hyaluronic acid is a key part of the skin's natural moisturising factor.

CONCLUSION

AvenaPLex gives enhances the performance in key gene markers assays when compared to standard oat oil.

Independently tested by Bioalternatives France, Apr 2017

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Cell Viability

EX VIVO

BACKGROUND

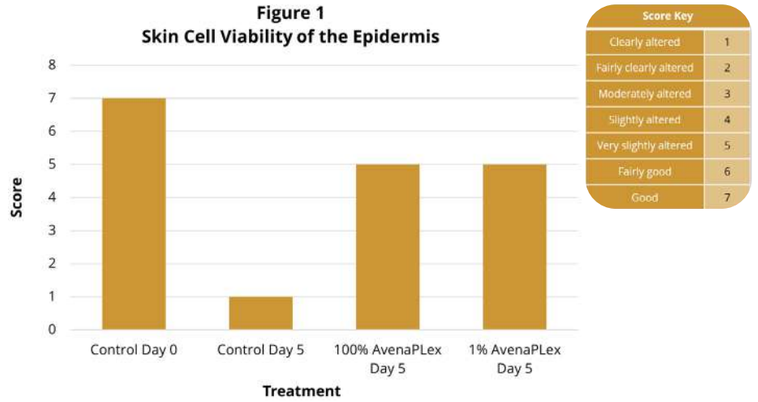
The study sought to assess skin cell viability (the metabolic activity of cells) following the application of AvenaPLex.

METHOD

The study was performed on human explants prepared and installed in a Perfex vivo system with the circulation of BEM (Bio-EC's Explant Medium). The measurement of cell viability, assessed by microscopical observation, was taken at day 5 after the explants had been treated with 1% or 100% AvenaPLex.

RESULTS

Figure 1
Skin Cell Viability of the Epidermis



The results show that after 5 days without any treatment, skin cells are clearly altered compared to day 0 (Figure 1). However, a clear improvement in skin cell viability is induced by a treatment with 1% or 100% AvenaPLex, demonstrating the ingredient's ability to protect skin cells from dying as fast as without treatment. Moreover, the results show that the use of 1% AvenaPLex could be as efficient as using 100% in a formulation.

Independently tested by Laboratoire Bio-EC, Mar 2019

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Cell Viability

EX VIVO

RESULTS (CONT.)

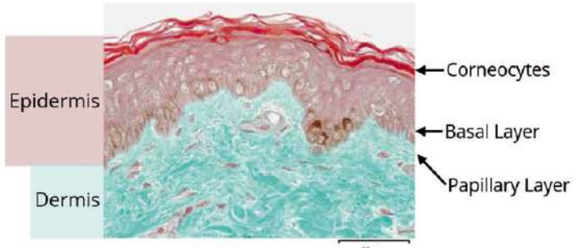


Figure 2: Control at Day 0

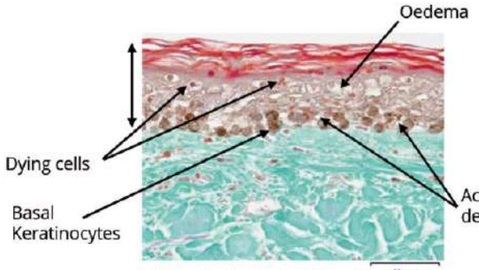


Figure 3: Control at Day 5

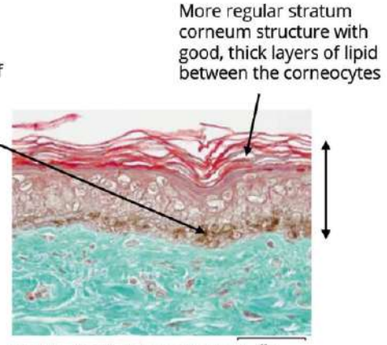


Figure 4: 1% AvenaPLex at Day 5

In the images above, it is evident that when compared to the control (Figures 2 and 3), there is a significant increase in the thickness of epidermis cell layers at day 5 when using 1% AvenaPLex (Figure 4). They also demonstrate that AvenaPLex induces a regular stratum corneum structure with thick layers of lipid between the corneocytes when compared to the control. Furthermore, the reduction of cell detachments and increase in healthy epidermis cells seen in Figure 4 (compared to Figures 2 and 3), shows that AvenaPLex induces a much healthier epidermis to provide long-term skin benefits. In addition to these long-term effects, AvenaPLex also provides instantaneous benefits to the skin, rapidly replenishing the crystal liquid structure of the stratum corneum. This lipid matrix is extremely important as it maintains skin hydration, acts as a barrier to external stressors, reduces itchiness, and, when optimally replenished, ensures skin looks radiant.

CONCLUSION

AvenaPlex improves cell viability when used at both 1% and 100%, preventing cells from damaging as fast as without treatment.

Independently tested by Laboratoire Bio-EC, Mar 2019

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Ceramide Increase: Raman Spectroscopy

EX VIVO

BACKGROUND

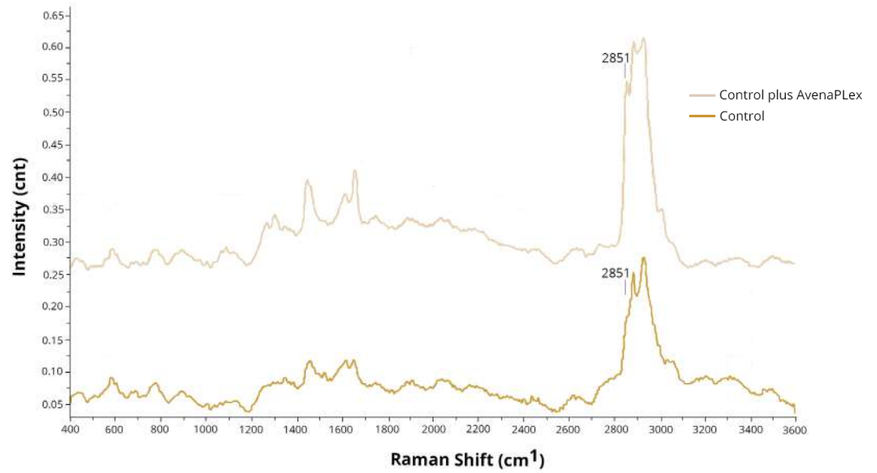
The study was designed to analyse the increase in ceramides on the skin with a single application of AvenaPLex.

METHOD

The study was carried out using a skin explant from a 59-year-old female on which there was potential for age-related reduction in skin ceramide concentration. The explant was divided into two and a single application of 100% AvenaPLex was applied to one explant. After one day, the lipid conformation of both explants was measured using Raman Spectroscopy, a non-destructive method of investigation based on the detection of inelastically-diffused photons following the interaction of a sample and a laser.

A long focal microscope objective was used to focus the laser light on the surface of the sample and to collect the back scattered light. The Raman Stokes signal was recorded with a Charge-Coupled Device detector (CCD camera). Raman measurements were performed on 4 to 6 points of the stratum corneum, the living epidermis, and AvenaPLex in the 400–3800 cm^{1} spectral range.

RESULTS



The results show that applying AvenaPlex to the skin increases the level of essential ceramides within the skin, with the control sample showing only a small peak at 2851 relating to ceramides, and the explant with applied AvenaPlex showing a significant increase in the ceramide peak at 2851.

CONCLUSION

During the course of ageing, ceramide levels become deficient, and this is also true in drier skins. AvenaPlex has been proven to be a good source of skin-supplementing ceramides.

Independently tested by Laboratoire Bio-EC, Nov 2018

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Ceramide Increase: Immunostaining

EX VIVO

BACKGROUND

The study was designed to assess the ceramide content on the skin's surface following the application of AvenaPLex.

METHOD

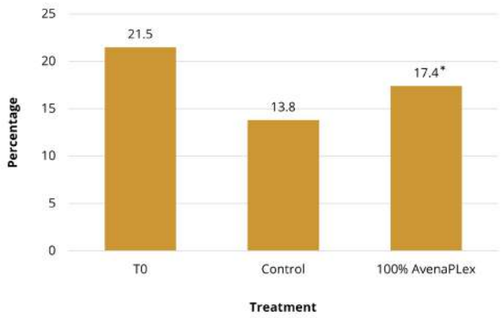
The study was performed on human explants prepared and installed in a Perfex vivo system with circulation of BEM (Bio-EC's Explants Medium). The explants were treated with 100% AvenaPLex at day 0 and day 1, at which point the ceramide content of these explants was compared against a control. This ceramide content was determined using immunostaining and image analysis of the skin explants.

RESULTS

The results show that the application of 100% AvenaPLex induces a significant increase in the skin's ceramide content. More specifically, the application of 100% AvenaPLex induces a 26%* greater increase in the skin's ceramide content than the control. It is also evident that AvenaPLex replenishes lost ceramides through multiple layers of the stratum corneum.

The below images show a significant increase in the thickness of the ceramide layer (observed in pink) following the application of 100% AvenaPLex (Figure 4), compared to the results seen in the control (Figure 3)

Figure 1
Percentage of Surface Occupied By Ceramides in the Stratum Corneum at Day 1



It is also evident that AvenaPLex replenishes lost ceramides through multiple layers of the stratum corneum.

Measurement of the Ceramide Surface at Day 1

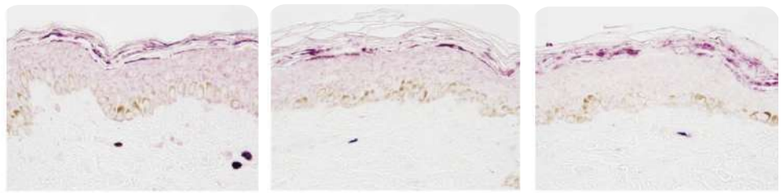


Figure 2: Control at Day 0

Figure 3: Control at Day 1

Figure 4: 100% AvenaPLex at Day 1

CONCLUSION

The clear increase in stratum corneum total ceramide content by AvenaPlex was significant suggesting a positive benefit on skin barrier function. Oat ceramides in the form of AvenaPlex can be effectively delivered into the stratum corneum.

Significant: * = p<0.05 (95%)

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Identical Lipids: Raman Spectroscopy

BACKGROUND

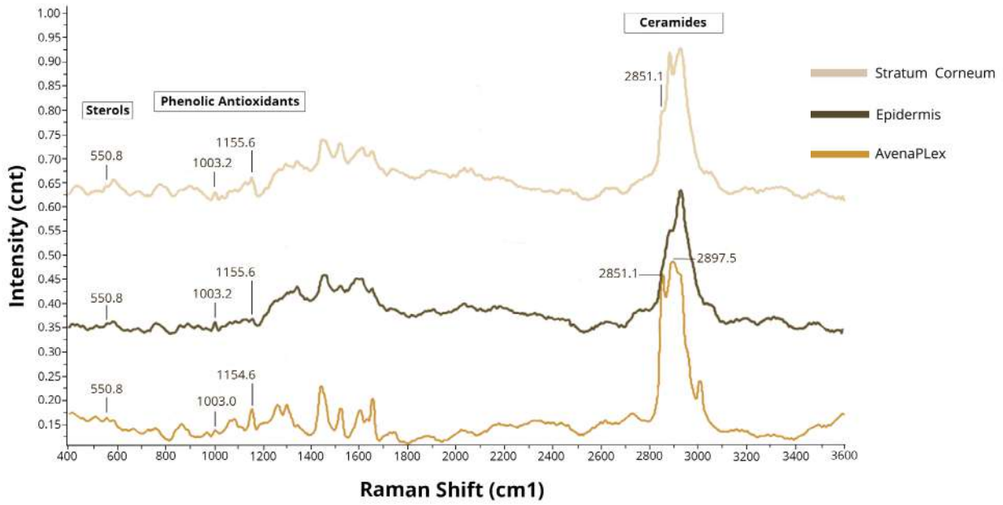
The study was designed to compare the lipid ratios in AvenaPLex with the lipid ratios found in the stratum corneum and epidermis.

METHOD

The study was carried out using Raman Spectroscopy, a non-destructive method of investigation based on the detection of inelastically-diffused photons following the interaction of a sample and a laser.

A long focal microscope objective was used to focus the laser light on the surface of the sample and to collect the back scattered light. The Raman Stokes signal was recorded with a Charge-Coupled Device detector and measurements were performed on 4 to 6 points of the stratum corneum, the living epidermis and AvenaPLex in the 400-3800 cm^{1} spectral range.

RESULTS



The results show that the AvenaPLex Raman profile is highly correlated with that of the stratum corneum and the epidermis. Of particular importance are the peaks around 500 which relate to sterols, peaks around 1003 and 1155 which relate to phenolic antioxidants, and peaks around 2851 and 2897 which relate to ceramides.

CONCLUSION

These peaks show that AvenaPLex is a good source of lipids to supplement the skin's natural profile and is, therefore, particularly beneficial for dry and aged skin conditions.

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Lipid Barrier Improvement

EX VIVO

BACKGROUND

The study sought to assess the neutral and polar lipid content of the skin following the application of AvenaPLex.

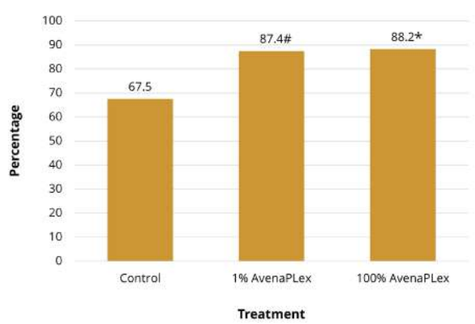
METHOD

The study was performed on human explants prepared and installed in a Perfex vivo system with the circulation of BEM (Bio-EC's Explants Medium). To measure neutral lipid content, the explants were treated with 1% and 100% AvenaPLex at day 0, 1, 2, 3 and 4. The neutral lipid content of these explants was then compared with the content of non-treated explants (control) at day 5. For the assessment of polar lipids, explants were treated with 100% AvenaPLex, with the content of non-treated explants (control) compared at day 1 and 5. The neutral and polar lipid content was determined using immunostaining and image analysis of the skin explants.

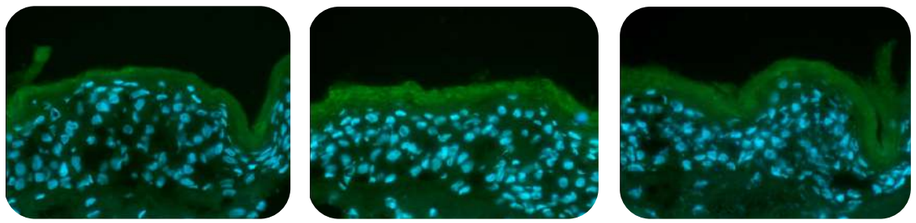
RESULTS: NEUTRAL LIPIDS

The results show that applications of 100% and 1% AvenaPLex induce a significant increase in the neutral lipid content of the explants at day 5. More specifically, the application of 100% AvenaPLex induces a 31%* greater increase in neutral lipid content than the control, whilst that of 1% AvenaPLex induces a 29% greater increase when drawing the same comparison. It should also be noted that the difference in efficacy between AvenaPLex at 1% and AvenaPLex at 100% is only very slight.

Percentage of Surface Occupied by Neutral Lipids in the Stratum Corneum at Day 5



Measurement of the Neutral Lipid Surface at Day 5 (Shown in Green)



Control | 1% AvenaPLex | 100% AvenaPLex

Independently tested by Laboratoire Bio-EC, Mar 2019

Significant: * = p<0.05 (95%), # = p<0.1(90%)

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

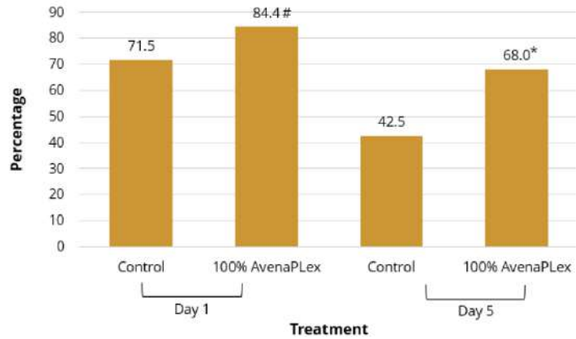
Lipid Barrier Improvement

EX VIVO

RESULTS: POLAR LIPIDS

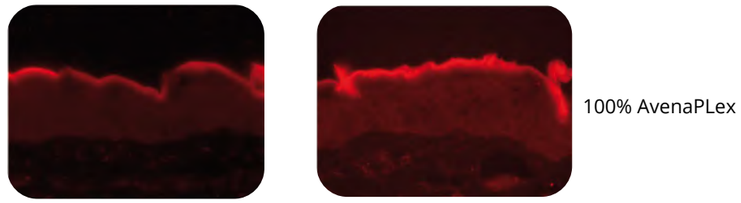
The results show that application of 100% AvenaPLex induces a significant increase in the polar lipid content of the explants at day 1. More specifically, this application of 100% AvenaPLex induces an 18%# greater increase in polar lipid content than the control on day 1. At day 5, this application of 100% AvenaPLex induces a 60%* greater increase in polar lipid content when drawing the same comparison against the control.

Percentage of Surface Occupied by Polar Lipids in the Stratum Corneum



Measurement of Polar Lipid Surface at Day 1

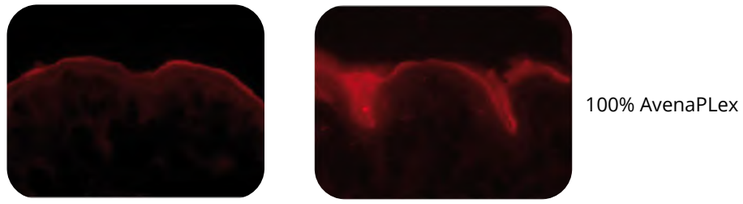
Control



100% AvenaPLex

Measurement of Polar Lipid Surface at Day 5

Control



100% AvenaPLex

CONCLUSION

AvenaPlex supplements and restores skin barrier lipids.

Independently tested by Laboratoire Bio-EC, Mar 2019

Significant: * = p<0.05 (95%), # = p<0.1(90%)

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Barrier Function

IN VIVO

BACKGROUND

The study was designed to assess the effect of 1% AvenaPLex in a base formulation on skin barrier function compared to a placebo.

METHOD

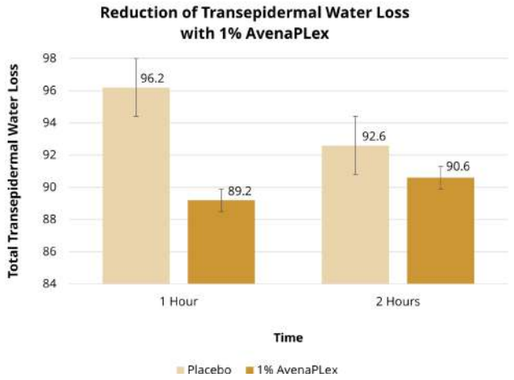
The study comprised 11 volunteers all over the age of 40, and involved measuring transepidermal water loss (TEWL) of the skin. Measurements were taken using a Tewameter, and made before product application, and repeated at both 1 hour (±10 minutes) and 2 hours (±15 minutes) after a single application.

The following formulation was used in this study:

Phase	Trade Name	INCI Name	% w/w
A	Purified Water BP	Aqua	93.00
B	Sepiplus 400	Polyacrylate-12, Polyisobutene, Polysorbate 20	5.00
B	**AvenaPLex**	***Avena sativa* (Oat) Kernel Extract**	**1.00**
C	Euxyl PE9010	Phenoxyethanol (90%), Ethylhexylglycerin (10%)	1.00

*Placebo formulation was identical minus 1% AvenaPlex – the remaining % was made up of water.

RESULTS



AvenaPLex outperformed the placebo formulation in its ability to reduce TEWL following skin application. After one hour, 73% more subjects showed a reduction in TEWL following the application of AvenaPLex compared with the placebo, and this reduction in TEWL was up to 36% greater in some subjects. These results show that AvenaPLex is effective at rapidly repairing the skin lipid barrier to reduce TEWL. The application of these skin beneficial lipids should improve the condition of aged skin.

CONCLUSION

As the skin ages, the production of critical skin lipids such as ceramides decreases. This is particularly significant over the age of 40. As a result, the condition of the skin deteriorates. The skin surface becomes dry and dull as the stratum corneum lipid barrier becomes less coherent. The skin feels tight and itchy. Deeper down the skin becomes less firm and elastic. These effects are compounded by environmental challenges such as wind, sun, cleansing products, and pollution. The application of AvenaPLex will counteract this condition.

Independently tested by CUTEST, Jan 2018

Epidermal Barrier Integrity

IN VIVO EX VIVO

BACKGROUND

The most important constituent of the permeability barrier is the intercellular lipid lamellae in the stratum corneum. During epidermal differentiation, these lipids are synthesised in the keratinocytes, stored in the lamellar bodies, and released into the intercellular spaces of the stratum corneum. The synthesis and storage of the lipids in the lamellar bodies and their release is essential for an effective permeability barrier that protects the skin from penetration by harmful agents (such as allergens, irritants, and microorganisms) and regulates transepidermal water loss.[1] The objective of this study was to evaluate the influence of AvenaPLex on skin morphology, more precisely on the intercellular lipid lamellae, for 8 weeks in comparison to an untreated control test site. The epidermal barrier was visualised and evaluated semi-quantitatively using morphometric analysis.

METHOD

Product Treatments (IN VIVO)

Over a period of 8 weeks, 6 healthy Caucasian women (phototype II and III) aged between 43 to 59 years old applied 1% AvenaPLex facial serum twice a day, in the morning and evening, on one volar forearm (the other volar forearm was left untreated).

Non-Invasive Sampling with Lipbarvis - Suction Blister Induction (IN VIVO)

Skin sampling was completed using a suction blister method. Plexiglass suction chambers with circular openings were placed on the skin of the test sites and connected to a vacuum pump (about 550 to 850 mbar). The blisters were induced within 2.5-3.0 hours. The roofs of the generated suction blisters were removed under sterile conditions. During the blister formation, the epidermis is separated from the dermis within the lamina lucida of the epidermal basement membrane.

Embedding of Suction Blister Samples for Transmission Electron Microscopy (TEM) (EX VIVO)

One small part of each suction blister sample was washed, dehydrated, and embedded in epoxy resin. A homogeneous layer of corneocytes was then chosen and prepared: perpendicular sections of the stratum corneum were prepared with an ultramicrotome (Ultracut S Leica Microsystems, Wetzlar, Germany) using a diamond knife. For TEM examination, a TEM CM 10 (FEI, Eindhoven, Netherlands) was used. In healthy skin as well as in dry skin, an intercellular space (ICS) is framed by two corneocytes. Within the chosen areas, an ICS (nm2) and intercellular lipid lamellae (ICLL) (nm) were semi-automatically selected and marked. In order to compare ICLL in the different samples, the ratio ICLL/ICS was normalised to an area of 1,000 nm. The normalised ICLLs (nICLL) were used for subsequent statistical analysis. Measurement was taken after 8 weeks. No measurement was taken at day 0 as results were to be compared against untreated.

The following formulation was used for this study:

Phase	Trade Name	INCI Name	% w/w
A	Purified Water BP	Aqua	90.95
A	Mekirol RS (Rapeseed) 995	Glycerin, Aqua	3.00
A	Euxyl PE9010	Phenoxyethanol, Ethylhexylglycerin	1.00
A	Versene NA2 Crystals	Disodium EDTA	0.05
B	Sepiplus 400	Polyacrylate-13, Polyisobutene, Polysorbate 20	4.00
B	**AvenaPLex**	***Avena Sativa* Kernel Extract**	**1.00**

Independently tested by Microscopy Services Dähnhardt GmbH, Mar 2021

RESULTS

Integrity of the Epidermal Barrier (TEM)

The TEM analysis shows the intercellular lipids. Values between 40 and 70 indicate very dry skin, and values between 70 and 100 indicate dry skin. A value of 180+ indicates healthy skin.[1] An 8-week application of 1% AvenaPLex resulted in statistically significantly higher values of nICLL, indicating an improved skin barrier function in comparison to the untreated test site. Specifically, the amount of intercellular lipid lamellae is significantly 14% greater in the sample treated with 1% AvenaPLex than in the untreated sample.

Figure 1:
Skin Barrier Integrity
After 8 Weeks of Treatment

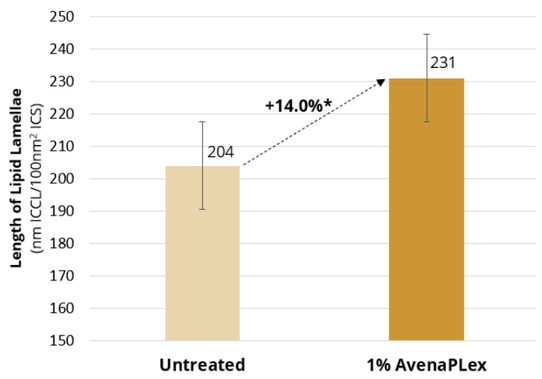


Figure 2: TEM Images of the ICLL in the Intercellular Space in the Stratum Corneum, at 8 Weeks

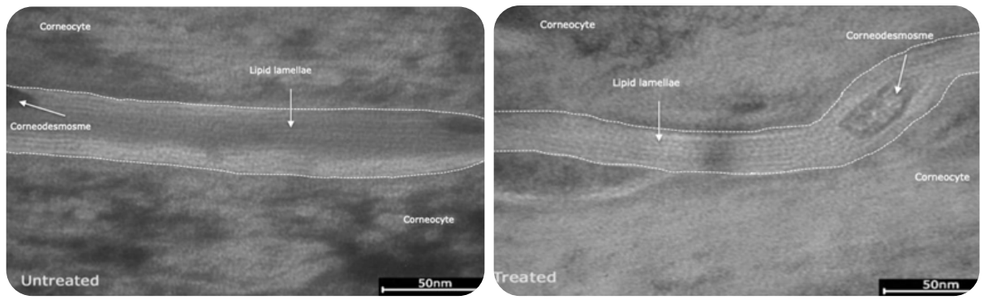


Figure 3: Visual Interpretation of the Intercellular Spacing

Untreated

Treated with 1% AvenaPLex

Figure 2 shows TEM images of the intercellular space (marked with the dotted lines) between the corneocytes in the stratum corneum of the suction blister samples. The intercellular space is filled with the lipid lamellae (arrow in figure 2) and is covered by two different corneocytes. The difference of the intercellular space in the stratum corneum of the untreated and treated samples is visually illustrated in figure 3. In the treated samples, the amount of intercellular lipid lamellae is greater than in the untreated samples. The lipid lamellae are also more densely packed and better organised in the treated samples. This indicates an improved quality of the epidermal barrier.

Significant: * = p<0.05 (95%)

Epidermal Barrier Integrity

IN VIVO EX VIVO

CONCLUSION

Reorganisation of the lipid lamellae in the intercellular space occurs in several steps. Penetration of the lipophilic components from the serum into the intercellular space allows a first reorganisation phase, leading to homeostasis in the epidermis. This causes the water transport to be normalised in the stratum corneum and stratum granulosum, and restores the environmental conditions for many important biomolecules (proteins, enzymes etc). This results in a barrier repair which favours the production and transport of lamellar bodies from the stratum granulosum to stratum corneum, and an increased funnelling and incorporation of lipids into the intercellular space.[2] The importance of the quality of the first step (reorganisation) is evidenced by the differences in the skin with 1% AvenaPLex and the untreated skin. After 8 weeks of treatment using 1% AvenaPLex, the length of the lipid lamellae continued to increase in the intercellular space.

Independently tested by Microscopy Services Dähnhardt GmbH, Mar 2021

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Physiology:
Hyaluronic Acid and Ceramide Increase

IN VIVO EX VIVO

BACKGROUND

The lipid matrix of the stratum corneum, which contains various types of ceramides, lipids, and hyaluronic acid, plays a major role in the barrier function of the skin. The morphology of the ceramides holds the corneocytes and the intercellular matrix in order to maintain skin integrity. The ordered alignment of lipids forms a closed system to prevent TEWL and makes the stratum corneum more impermeable. As a result, a change in the amount and organisation of the stratum corneum ceramides can cause skin disorders with barrier defects. The objective of this study was to evaluate the influence of AvenaPLex on skin physiology for 8 weeks in comparison to an untreated control test site. The epidermal barrier was visualised and evaluated semi-quantitatively using morphometric analysis.

METHOD

Product Treatments (IN VIVO)
Over a period of 8 weeks, 6 healthy Caucasian women (phototype II and III) aged between 43 to 59 years old applied 1% AvenaPLex facial serum twice a day, in the morning and evening, on one volar forearm (the other volar forearm was left untreated).

Non-Invasive Sampling with Lipbarvis – Suction Blister Induction (IN VIVO)
Skin sampling was done by the suction blister method. Plexiglass suction chambers with circular openings were placed on the skin of the test sites and connected to a vacuum pump (about 550 to 850 mbar). The blisters were induced within 2.5-3.0 hours. The roofs of the generated suction blisters were removed under sterile conditions. During the blister formation, the epidermis was separated from the dermis within the lamina lucida of the epidermal basement membrane.

Immunohistochemistry (EX VIVO)
One small part of each suction blister sample was washed, dehydrated, and embedded in epoxy resin. A homogeneous layer of corneocytes was then chosen and prepared: perpendicular sections of the stratum corneum were prepared with an ultramicrotome (Ultracut S Leica Microsystems, Wetzlar, Germany) using a diamond knife. Sections were treated in washing buffer for 60 minutes to prevent nonspecific binding. The primary antibodies, anti-Hyaluronic Acid (Cloud Clone Corp.) diluted 1:15 in washing buffer, and anti-Ceramides antibody (EnzoLife Sciences) undiluted, were applied onto the sections. After washing four times with washing buffer the sections were incubated for 180 minutes in darkness. The samples were washed again (five times), stained, and embedded for visualisation of the nuclei with Roti - Mount Fluor Care DAPI (Roth).

The following formulation was used for this study:

Phase	Trade Name	INCI Name	% w/w
A	Purified Water BP	Aqua	90.95
A	Mekirol RS (Rapeseed) 995	Glycerin, Aqua	3.00
A	Euxyl PE9010	Phenoxyethanol, Ethylhexylglycerin	1.00
A	Versene NA2 Crystals	Disodium EDTA	0.05
B	Sepiplus 400	Polyacrylate-13, Polyisobutene, Polysorbate 20	4.00
B	**AvenaPLex**	***Avena Sativa* Kernel Extract**	**1.00**

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

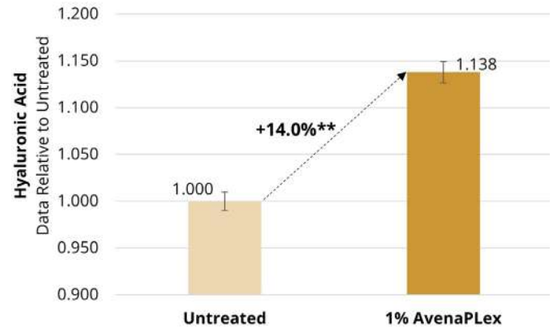
Skin Physiology:
Hyaluronic Acid and Ceramide Increase

IN VIVO EX VIVO

RESULTS: HYALURONIC ACID

Skin Physiology – Detection of Hyluronic Acid (Fluorescence Microscopy)
Hyaluronic acid is a highly cross-linked polysaccharide with the ability to bind large amounts of water. In addition to binding water, hyaluronic acid is also important for cell growth, membrane receptor function, and adhesion.[1] It is particularly localised in dermal areas where the cells are less densely packed, and it is also detectable in the lower layers of the epidermis. In young skin, hyaluronic acid is found near collagen and elastin fibres, while in aged skin this connection is missing. In addition, there is a physiological decrease in the hyaluronic acid content of aged skin.[2]

Figure 1:
Skin Physiology by
Immunofluorescence of Hyaluronic Acid



The results show that the hyaluronic acid content of the samples treated with 1% AvenaPLex for 8 weeks is significantly 14% higher than that of the untreated samples.

Figure 2: Hyaluronic Acid Fluorescence Staining, at 8 Weeks

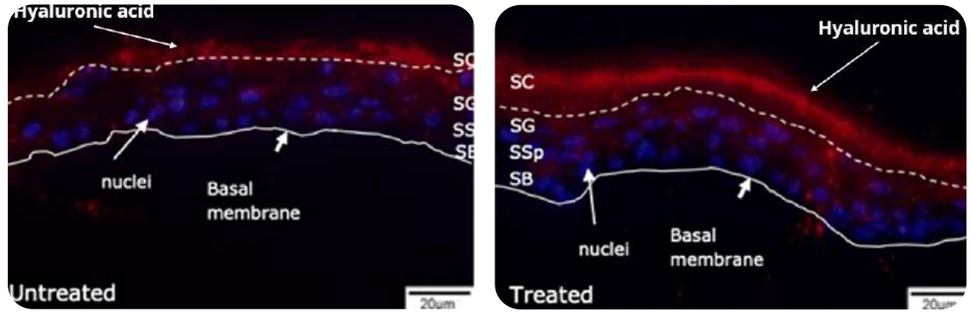


Figure 2 shows the immunofluorescence labelling of hyaluronic acid (red) and nuclei staining (blue) in semithin sections of the suction blister samples. In both samples (treated and untreated), the red fluorescence labelling is clearly detectable in all layers of the epidermis: stratum corneum (SC), stratum granulosum (SG) stratum spinosum (SSp), and stratum basale (SB). The basal membrane and the interface between SG and SC are marked by lines. The intensity of fluorescence in the treated samples is significantly higher than in the untreated samples.

(Significant: **=p<0.01 (99%))

Independently tested by Microscopy Services Dähnhardt GmbH, Mar 2021

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Skin Physiology:
Hyaluronic Acid and Ceramide Increase

IN VIVO EX VIVO

RESULTS: CERAMIDES

Skin Physiology – Detection of Ceramides (Fluorescence Microscopy)

Ceramides are an essential component of the skin lipid barrier and can be found in the epidermis from the stratum spinosum (SSp) and stratum granulosum (SG) up to the stratum corneum (SC). The lower layers (SSp and SG) mostly contain glucosylceramides, which are localised in the lamellar bodies. In the upper layers, ceramides are mainly found in the intercellular space between corneocytes. While in the lower layers (SSp and SG) mostly glucosylceramides can be found, localised in lamellar bodies, in the upper layers (SC) you will mainly find ceramides in the intercellular space between the corneocytes.[3] It has been shown that there is a physiological decrease in the ceramide content of aged skin.

The results show that the ceramide content of the samples treated with 1% AvenaPLex for 8 weeks is significantly 10% higher than that of the untreated samples.

Figure 3:
Skin Physiology by Immunofluorescence of Ceramides

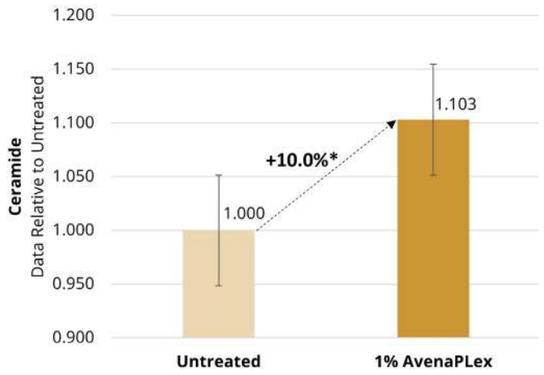


Figure 4: Ceramides Fluorescence Staining, at 8 Weeks

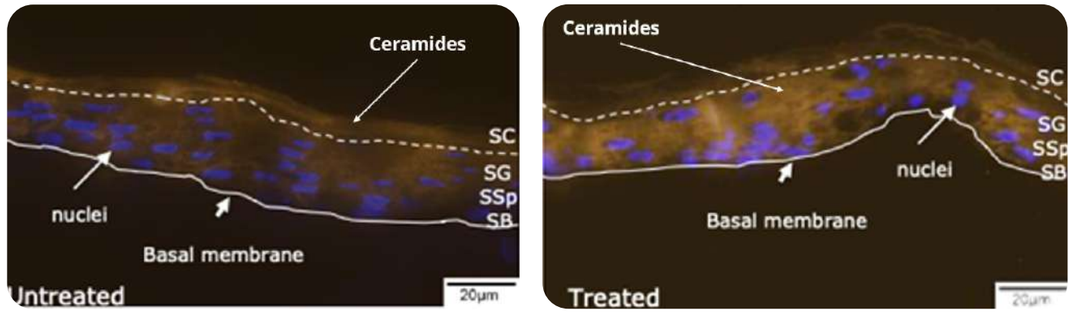


Figure 4 shows the immunofluorescence labelling of the ceramides (yellow) and nuclei staining (blue) in semithin sections of the suction blister samples. In both samples (treated and untreated), the yellow fluorescence is distributed over the whole epidermis. In the lower layers of the epidermis (SSp & SG), mostly glucosylceramides are labelled whereas in the SC only ceramides are labelled. The basal membrane and the interface between SG and SC are marked by lines. The intensity of fluorescence in the treated samples is significantly higher than in the untreated samples.

CONCLUSION

Application of 1% AvenaPLex for 8 weeks resulted in a statistically significant increase in the length of the intercellular lipid lamellae in the SC and the amount of detectable hyaluronic acid and ceramides in the epidermis (stratum corneum, stratum granulosum, stratum spinosum). The increased length of the intercellular lipid lamellae in the SC correlates with a stronger fluorescence signal in the immunolabelling of the ceramides in the epidermis. The increased hyaluronic acid content also contributes to improved hydration in the epidermis.

Significant: ** = p<0.05 (95%)

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Anti-Ageing:
Anti-Wrinkle and Improving Skin Hydration

IN VIVO

BACKGROUND

Skin ageing is a complex biological process influenced by a combination of endogenous/intrinsic factors (genetics, hormones and metabolic processes) and exogenous/extrinsic factors (sun exposure, pollution, chemicals). Together, these factors lead to cumulative structural and physiological alterations which result in progressive changes in each skin layer as well as changes in skin appearance.[1] To follow the skin physiology (in vivo/ex vivo) study, AvenaPLex was evaluated for its anti-wrinkle effect on the skin and skin hydration improvement over 12 weeks, in comparison to a placebo.

METHOD

Product Treatment

Two panels of 20 Caucasian women, aged between 40 to 59 years old, with sensitive or healthy skin types were studied. Over a period of 12 weeks, one panel applied 1% AvenaPLex facial serum on the whole face, and the other panel applied a placebo facial serum on the whole face. The application was carried out twice a day, both morning and evening. Skin measurements were taken at day 0 (before application of the treatment), then at week 4, week 8 and week 12.

Measurement of Anti-Wrinkle Efficacy

Average roughness was evaluated with a PRIMOS-CR, an optical system that generates measurements in three dimensions on the surface of the skin. Wrinkles (crow's feet area) were assessed by the parameter Ra (µm) which is defined as the average of absolute values of the profile heights in the roughness profile. The lower the value Ra is, the less rough the skin is.

Visual Support

Using PRIMOS-CR, high-resolution photographs were taken at day 0 (before the treatment) and at week 12 (after the treatment).

Measurement of Skin Hydration Efficacy

Skin hydration was measured by a Corneometer CM 825 on the forehead of the participants. Cutaneous hydration measurements are based on electrical capacitance.

Self-Evaluation

After 12 weeks of continuous use of products, all participants completed a subjective evaluation questionnaire.

The following formulation was used in this study:

Phase	Trade Name	INCI Name	% w/w
A	Purified Water BP	Aqua	90.95
A	Mekirol RS (Rapeseed) 995	Glycerin, Aqua	3.00
A	Euxyl PE9010	Phenoxyethanol, Ethylhexylglycerin	1.00
A	Versene NA2 Crystals	Disodium EDTA	0.05
B	Sepiplus 400	Polyacrylate-13, Polyisobutene, Polysorbate 20	4.00
B	**AvenaPLex**	***Avena Sativa* Kernel Extract**	**1.00**

*Placebo facial serum formulation was identical minus 1% AvenaPLex – remaining % was made up with water.

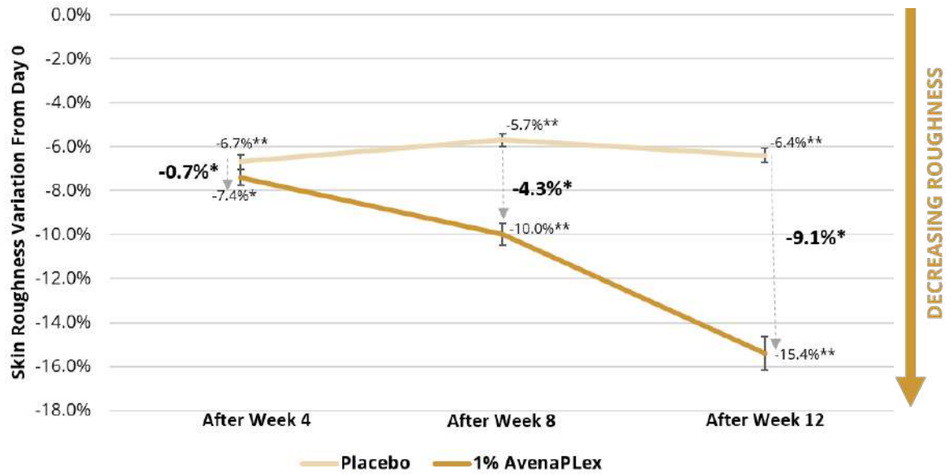
info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

RESULTS: ANTI-WRINKLE

Assessment of Anti-Wrinkle Efficacy

As the skin ages, the thickness of the dermis decreases. The number of glycosaminoglycans, collagen, and hyaluronic acid produced by fibroblasts and elastin reduces. This degradation leads to reduced mechanical tension in the skin and facilitates the formation of wrinkles.[2]

Figure 1:
Skin Roughness (Wrinkle) Reduction After 12 Weeks With 1% AvenaPLex



Skin roughness variation is defined as the evolution, in percentage, of the skin roughness measurement before treatment (at day 0) and after treatment (after 4, 8, or 12 weeks). After 4 weeks of treatment, 1% AvenaPLex significantly reduces wrinkles by 7.4%, compared to before the treatment. This reduction continues to significantly decrease after 8 weeks with up to 10% reduction of wrinkles and up to 15.4% after 12 weeks. Contrastingly, with the placebo facial serum treatment, wrinkle reduction does not exceed 6.7%. Furthermore, after 8 and 12 weeks of treatment with the placebo, the depth of wrinkles increased by 1.6% and decreased by only 0.1% from week 4. This graph demonstrates that replenishing skin ceramides and hyaluronic acid with AvenaPLex (as demonstrated in the skin physiology study) will help reinforce the skin and reduce roughness (wrinkles).

Significant: *=p<0.05 (95%), **=p<0.01 (99%)

Anti-Ageing:
Anti-Wrinkle and Improving Skin Hydration

RESULTS: ANTI-WRINKLE (CONT.)

Assessment of Visual Support

With ageing, skin becomes thinner and wrinkled.

Figure 3: PRIMOS-CR Images
Participant Applying AvenaPLex Facial Serum at Day 0 (Before Treatment) and at Week 12

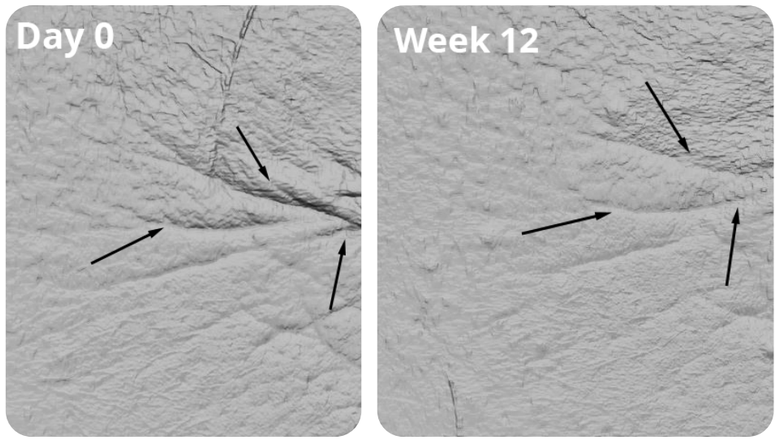


Figure 4: PRIMOS-CR Images
Participant Applying Placebo Facial Serum at Day 0 (Before Treatment) and at Week 12

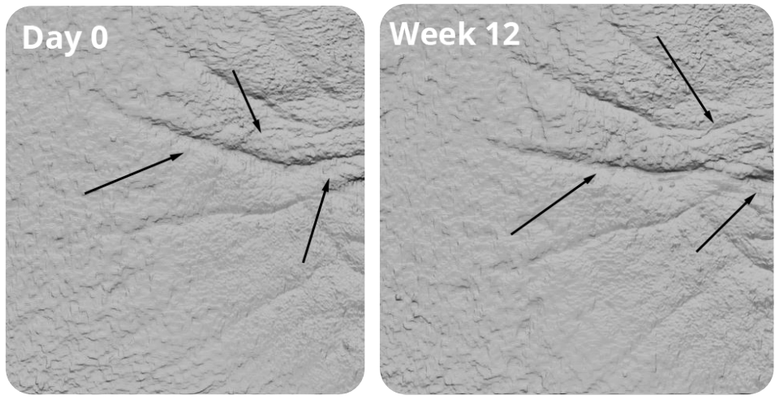


Figure 3 shows that after 12 weeks of application, 1% AvenaPLex visibly reduces the appearance of crow's feet wrinkles in comparison to day 0. Figure 4 shows that after 12 weeks of application, the placebo facial serum did not reduce the appearance of crow's feet wrinkles in comparison to day 0.

Independently tested by Zurko BioResearch, May 2021

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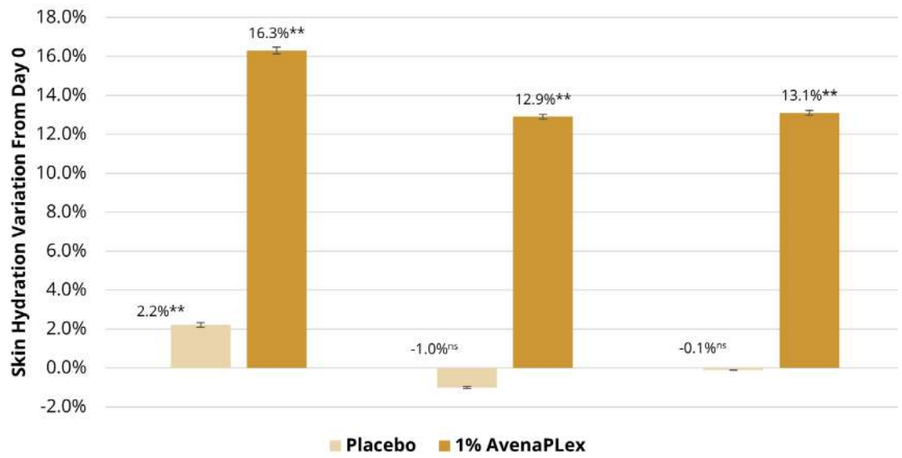
RESULTS: SKIN HYDRATION

Assessment of Skin Hydration Efficacy

Skin hydration variation is defined as the evolution, in percentage, of the skin hydration measurement before treatment (at day 0) and after treatment (after weeks 4, 8, or 12). After 4 weeks of treatment, 1% AvenaPLex significantly increases skin hydration by 16.3%. This is in comparison to the placebo facial serum which only significantly increased hydration by 2.2%. After 8 weeks and 12 weeks, 1% AvenaPLex significantly increased skin hydration by 12.9% and 13.1%, respectively. This is in comparison to the placebo facial serum which reduced skin hydration by 1.0% after 8 weeks and by 0.1% after 12 weeks. The study was performed in winter, from January.

Figure 5:
Skin Hydration Improvement After 12 Weeks With 1% AvenaPLex



Dryness observed in aged skin correlates with an overall decrease of approximately 30% in total SC lipids[3]. AvenaPLex will help replenish these skin lipids lost through ageing due to its unique lipid profile, and therefore improves skin hydration in both the short and long term.

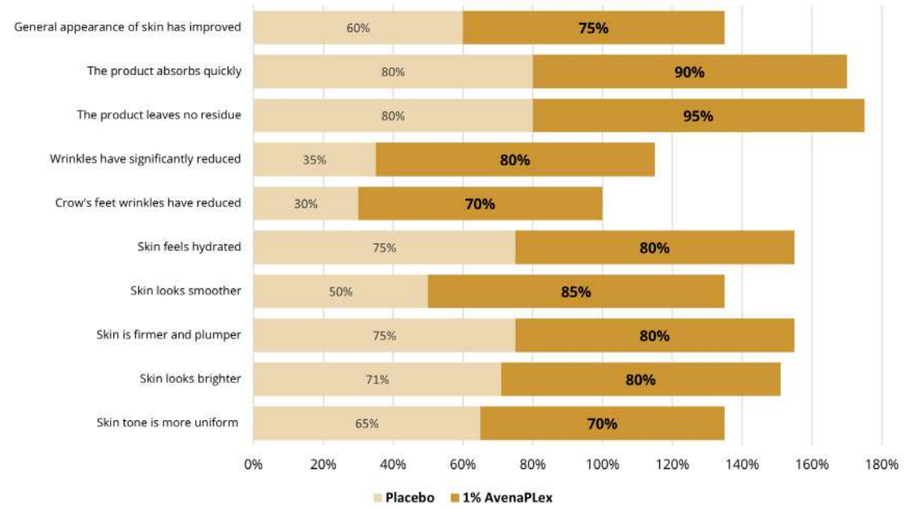
Significant: **=P<0.01 (99%), Ns= Non-significant

Anti-Ageing:
Anti-Wrinkle and Improving Skin Hydration
IN VIVO

RESULTS: SUBJECTIVE EVALUATION

After 12 weeks of treatment, 80% of participants using the 1% AvenaPLex facial serum observed that wrinkles had significantly reduced and 85% said that crow's feet wrinkles had reduced. This is higher than the participants using the placebo facial serum who affirm a 35% and 30% reduction, respectively.

Figure 6:
Subjective Evaluation of the Efficacy of 1% AvenaPLex After 12 Weeks



CONCLUSION

Both intrinsic and extrinsic factors are responsible for skin ageing. The changes associated with the skin ageing process are varied: the epidermis becomes thin and the skin lipid content of the dermis decreases, as well as skin hydration. The subcutaneous tissue loses volume, and on the surface, older skin appears wrinkled and dry. It has been demonstrated that total SC ceramide content declines with age. Research shows evidence that topical application of ceramides and/or sphingolipids to the skin leads to improved moisture regulation, smoother and general amelioration of the cutaneous barrier.[4]

AvenaPLex significantly decreased wrinkles and significantly increased skin hydration after 12 weeks of treatment. Analysis of these results, combined with the results of the skin physiology study (pages 23-25) demonstrated that applying 1% AvenaPLex increases the number of ceramides in the epidermis leading to a reduction in the appearance of wrinkles. Moreover, the results of the 'Barrier Function and Hydration Increase: Gene Stimulation' study (page 11), show that a daily application of AvenaPLex will increase the production of the skin's natural moisturising factors, and will improve the skin's natural lipid barrier resulting in an increase in hydration, which has been demonstrated in this study.

Consumer Perception: Skin Application

BACKGROUND

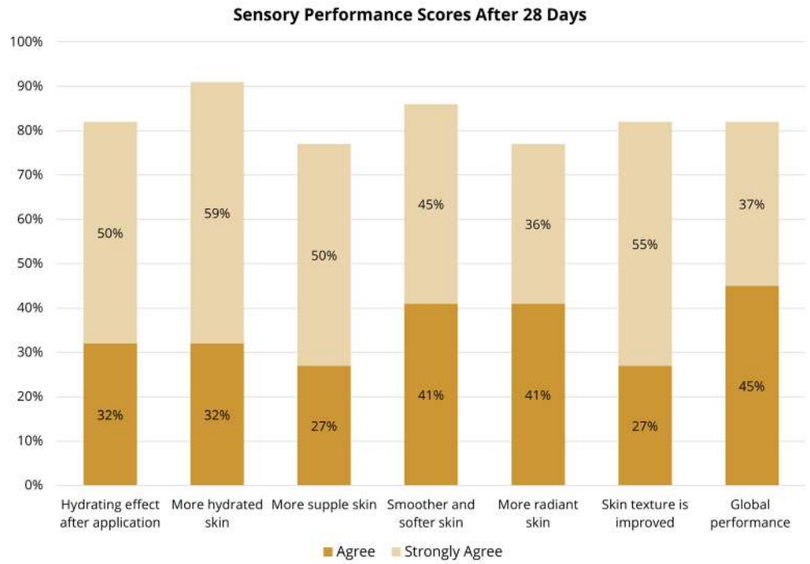
A study was undertaken to assess the sensory performance of AvenaPLex amongst a group of consumers.

METHOD

The study was a single-centre, open, controlled user study carried out by a group of 22 participants aged between 35 and 68 years old. Participants were only selected for this study if they had oily skin (as determined by a dermatologist) and had no previous history of skin conditions. Participants were provided with AvenaPLex to apply once each evening to the face during the 4-week study period, with the following instructions:
"Apply a thin layer evenly on the face and massage until the product has absorbed."

At the end of the 28-day study, participants completed an evaluation form where they scored the performance of the product in the following areas: hydrating effect after application, ongoing skin hydration, skin suppleness, skin smoothness and softness, improvement in skin radiance, improvement in skin texture, and overall product performance.

RESULTS



CONCLUSION

The consumer perception study shows that after 28 days of product use, 91% of the participants noticed that their skin was more hydrated. 86% of participants agreed that their skin felt smother and softer and 82% agreed it improved the texture of their skin. The score for more radiant and supple skin was 77%.

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IN VIVO

Comedogenicity

BACKGROUND

A study was undertaken to assess the comedogenicity potential (the tendency of an ingredient or product to clog pores) of AvenaPLex. The objective of the study was to evaluate whether AvenaPLex caused an increase in micro cysts, blackheads, papules, or pustules when used regularly over a 28-day period.

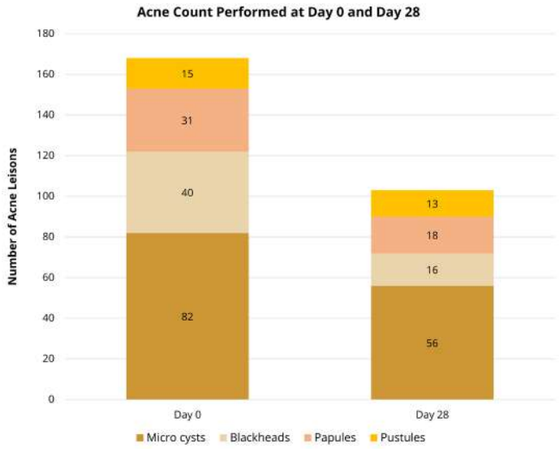
METHOD

The study was a single-centre, open, controlled user study carried out by a group of twenty-two participants aged between 35 and 68 years old, with oily skin. Participants were provided with 100% AvenaPLex to apply once each evening to the face during the 4-week study period, with the following instructions:
"Apply a thin layer evenly on the face and massage until the product has absorbed."

At Day 0, after 15 minutes of acclimatisation in a controlled room, each participant had their face examined by a certified dermatologist, using a magnifying glass, who recorded the number and type of lesions present.

This process was repeated at Day 28 and the results compared.

RESULTS



The result shows that AvenaPlex did not induce acne. AvenaPlex improved overall skin condition over 28 days by reducing the number of each type of acne lesions.

CONCLUSION

AvenaPlex does not produce, nor increase, primary lesions in a significant manner. AvenaPlex is considered non-comedogenic and has been tested under the control of a dermatologist.

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Protection and Reduction of Stress-Induced Skin Redness

IN VIVO

BACKGROUND

The human skin is constantly exposed to outdoor pollution, such as particle matter and UV light, which impacts it in a negative way. Ageing is eminently influenced by these environmental factors as up to 90% of symptoms of premature facial ageing is related to cumulative exposure to sun (UV light). Pollution mechanisms involve the release of proinflammatory cytokines, upregulation of collagenases, direct DNA oxidation and indirect modifications of DNA, proteins and lipids related to ROS production[1]. This induces harmful oxidative stress which degrades the structure of the skin and stimulates the appearance of inflammation factors. This in-vivo study was designed to assess the ability of AvenaPLex to protect and repair UV-induced erythema (skin redness) on a panel of participants.

METHOD

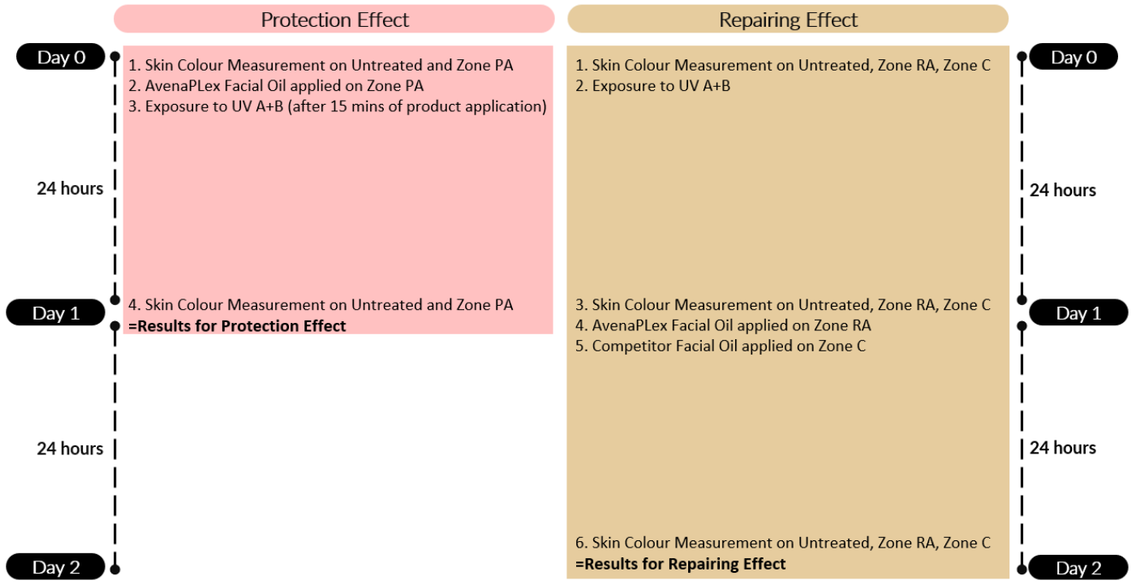
Product Treatment:

20 Caucasians females, aged between 18 and 41 years old, with Fitzpatrick skin phototype I, II and III, were provided with AvenaPLex facial oil and a competitor facial oil. Participants applied products on their back before and after induced erythema by an exposure to UVA (320-400 nm) + UVB (medium wave 280-320 nm) with the UV value of 1.5 MEDu.

Measurement of Skin Redness:

A measurement of skin colour intensity of the zones for erythema effects was performed by colorimetry through Miravex Antera 3D. Parameter a* was measured and is an indication of the skin redness. Skin images were taken at Day 0, 1 and 2.

Chronology of the Study:



Key:

Zone PA	Protection AvenaPLex
Zone RA	Repair AvenaPLex
Zone C	competitor product

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Protection and Reduction of Stress-Induced Skin Redness

IN VIVO

Formulations used in this study:

Phase	Trade Name	INCI Name
A	**AvenaPLex**	***Avena Sativa* Kernel Extract**
A	Oat Oil	*Avena Sativa* Kernel Oil
A	Crodamol AB	Alkyl (C12-15) Benzoate

AvenaPLex facial oil was diluted with Crodamol AB – a non-greasy emollient. Anhydrous system was chosen to dilute because AvenaPLex will be included in the oil phase of the formulation so it will be applied onto the skin in this form.

Phase	Trade Name	INCI Name
A	Competitor Product	Glycerin, *Avena Sativa* Kernel Extract, Potassium Sorbate
A	Crodamol AB	Alkyl (C12-15) Benzoate

RESULTS

After UVA exposure, singlet oxygen, H2O2, and hydroxyl free radicals are generated. These can cause damage to cellular proteins, lipids, and saccharides. UVB acts mainly in the epidermal basal cell layer of the skin. It induces a decrease of antioxidants in the skin, impairing the skin's ability to protect itself against the free radicals generated by exposure to sunlight[2].

RESULTS (PROTECTION EFFECT)

Assessment of Skin Redness Protection

Figure 1: Skin Redness at Day 0 and Day 1

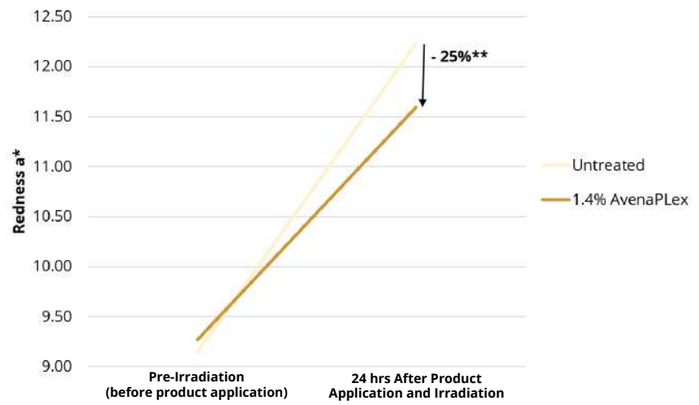

Figure 1 shows that AvenaPLex provides protection to the skin from UV damage, when applied before exposure to irradiation. After 24 hours, there is significant difference, a 25% reduction of erythema, between the untreated skin and Zone PA which was treated with 1.4% AvenaPLex facial oil.

Independently tested by Bio-EC Mar 2020

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RESULTS (PROTECTION EFFECT) CONT.

Assessment of Visual Support

Figure 2: Miravex Antera 3D Images Before and 24h Post UV Exposure

Untreated skin of a participant versus Zone PA treated with 1.4% AvenaPLex applied before radiation of UV A+B:

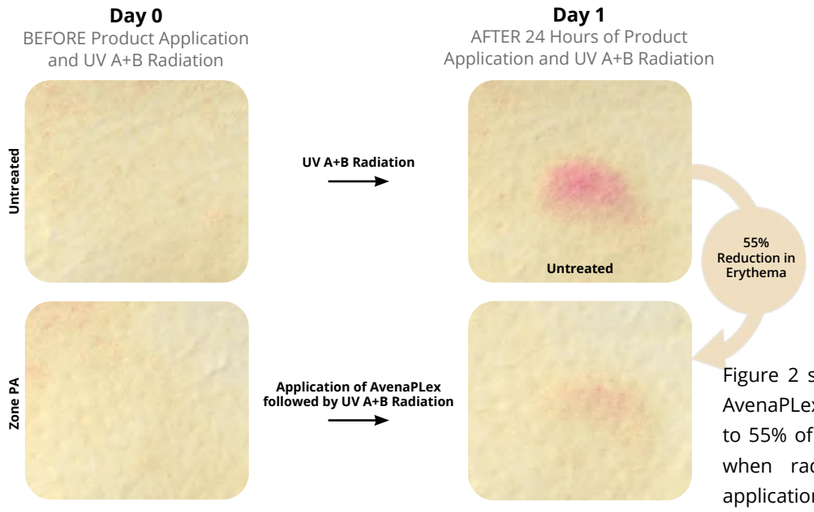
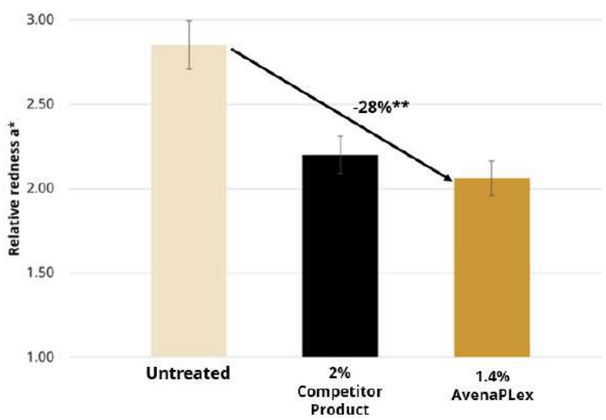


Figure 2 shows that after only 1 application, AvenaPLex visibly reduces skin redness (up to 55% of reduction, compared to untreated) when radiation of UV A+B occurs post application.

AvenaPLex gene expression analysis (pages 7-8) indicates that AvenaPLex will protect cells against oxidative stress (significant upregulation of NFE2L2 by 67% and significant upregulation of SIRT1 by 131%) and protects against cytotoxic damage from UV exposure (upregulation of HMOX1 by 162%). Indeed, due to its complex of lipid content and antioxidants (such as avenanthramides) working together, AvenaPLex will prevent oxygen radical formation by increased oxidative stress resistance and enhanced NER repair system (Nucleotide Excision Repair (NER) - a particularly important excision mechanism which removes DNA damage induced UV.

Assessment of Skin Redness Reduction

Figure 3: Skin Redness Induced After 48 hours after UV Irradiation and 1 Application of Products Compared to Measurement Before Irradiation



AvenaPLex also demonstrated the reduction effect of erythema, when radiation of UV A+B was applied before application of the product. After 48 hours, 1 application of AvenaPLex significantly reduced the erythema-induced redness by 28%, compared to the untreated zone and by 6% compared to the competitor product.

Protection and Reduction of
Stress-Induced Skin Redness

IN VIVO

RESULTS (REPAIRING EFFECT) CONT.

Assessment of Visual Support

Figure 4: Miravex Antera 3D Images before and 48h post UV Exposure

Untreated skin of a participant versus Zone RA treated with 1.4% AvenaPLex applied after radiation of UV A+B:

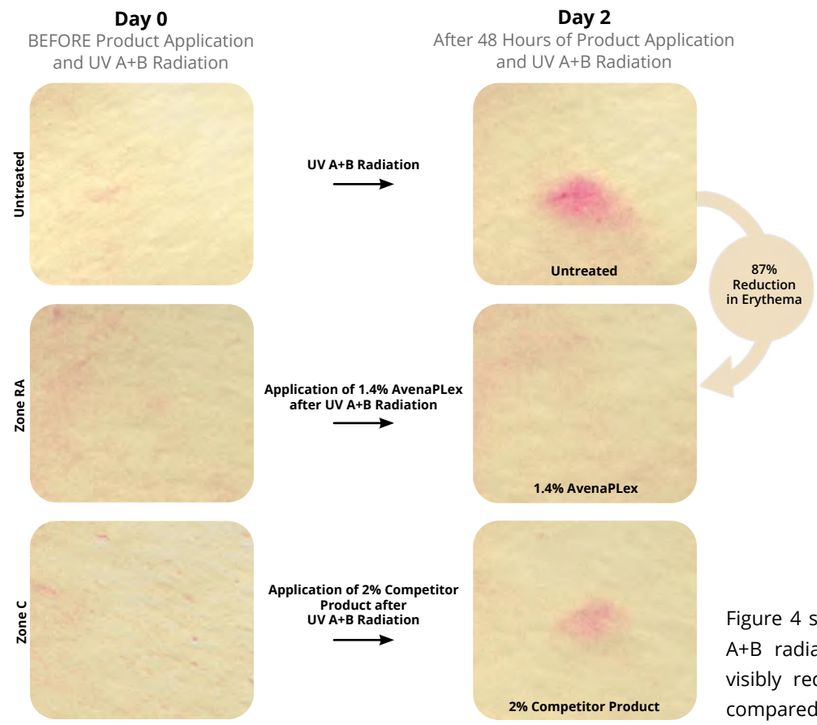


Figure 4 shows that after the exposure to UV A+B radiation, 1 application of AvenaPLex visibly reduces skin redness by up to 87%, compared to untreated.

AvenaPLex gene expression analysis (pages 7-8) indicates that AvenaPlex reduces oxidative stress in fibroblasts by supporting the reduction and recovery of peroxiredoxins, proteins important in the detoxification of highly reactive peroxides, including hydrogen peroxide and peroxynitrite (upregulation of TXNRD1 by 219%). AvenaPlex also has the tendency to reduce inflammation by inhibiting the activity of transcription factors, which plays a key role in proinflammatory signaling pathways, such as nuclear factor kB (NF-kB), through ligand-dependent transrepression (thanks to the upregulation of PPAR by 144 %).

CONCLUSION

This study demonstrates that UV radiation can impact the skin in a negative way. UV radiation and pollution induces harmful oxidative stress which degrades the structure of the skin and stimulates the appearance of inflammation factors resulting in skin redness. Chronic exposition of UV radiation induces erythema and in the long-term leads to premature skin ageing and depigmentation. The application of AvenaPLex, after irradiation, limits the appearance of skin redness. When applied before the irradiation, AvenaPLex reduces the appearance of redness more quickly. AvenaPLex can therefore act as a photoprotective active and has a similar effect to that of a commercial anti-redness product. Due to its location adjacent to the oxygen-rich extracellular environment, the epidermis requires well-developed defences against oxygen radical damage. Several polyphenols found within the antioxidant profile of AvenaPLex has potent anti-inflammatory properties and can be used to rapidly soothe irritated skin, reducing redness and providing relief from erythema.[3]

CREDENTIALS

Concluding the AvenaPLex data pack, we share the notable credentials of this unique active lipid complex. These include:

- Oxidative stability of the product in comparison to other oils
- Its hypoallergenic and non-irritant qualities demonstrated through the HRIPT test
- Biodegradability of AvenaPLex tested with a manometric respirometry test

IN VIVO

Human Repeat Insult Patch Test

BACKGROUND

A Human Repeat Insult Patch Test (HRIPT) was carried out to determine the cutaneous irritation (contact dermatitis) and sensitisation (contact allergy) potential of 6 oat-derived ingredients (Oat COM USP; Oat Lipid e; **AvenaPLex**; and **aura***firm* P, N, and S) when applied to the skin of healthy participants.

METHOD

The study consisted of 52 volunteers (male and female aged 20-78) and 3 phases: Induction, in which 10 patches were repetitively applied over the course of 3 weeks; Incubation, a rest period; and Revealing, a challenge phase. Repeated contact with a potential allergen in the formula, if present, generates a series of immunological reactions in the body of the test subject (the volunteer) and induces a visible reaction on the application site. Any reactions were observed, recorded and evaluated by a dermatologist to confirm the allergenicity of the product and hence the product's safety.

Repeated Skin Contact Test (Induction Phase): Prior to applying the patches, the test area - upper back, between the two shoulder blades - was carefully examined. A patch containing the test products and the control was applied to the test area and left in contact with the skin for 48 hours. When this first patch was removed at the laboratory 48 hours after application, the observation area was rinsed with water, dried, and examined for any skin changes. Following the examination, a new patch with fresh test product was applied.

The test products were applied on the selected zones every second day, 3 times per week, over 3 consecutive weeks.

Rest Period (or Incubation Phase): After the completion of the Induction Phase, a Rest Period of 10 to 14 days took place.

Challenge Phase (or Revealing Phase): The application site used during the Challenge Phase was different to the one used in the Induction Phase. For this phase, the patch was removed at the laboratory 48 hours after application. The test site was cleaned and examined for any signs of intolerance or irritation.

Throughout the study, the test products (Oat COM USP; Oat Lipid e; **AvenaPLex** and **aura***firm* P, N, and S) were applied at 100% except for Oat COM USP which was diluted with Vaseline.

RESULTS

None of the products tested (Oat COM USP, Oat Lipid e, **AvenaPLex**; or **aura***firm* P, N or S) produced any signs of cutaneous irritation or skin sensitisation. That is, no volunteers showed presence of oedema, vesicles, blisters or ulcerations or reported immediate or delayed reactions such as redness, irritation, itching or other sensations.

CONCLUSION

Oat COM USP, Oat Lipid e, **AvenaPLex**, **aura***firm* P, **aura***firm* N and **aura***firm* S can be considered both hypo-allergenic and non-irritant. Furthermore, given the control provided by a dermatologist during the study, the test products may also bear the claim "tested under the control of a dermatologist" or "dermatologically-tested".

Independently tested by Evalulab, Nov 2020. Full report available on request.

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Oxidative Stability

BACKGROUND

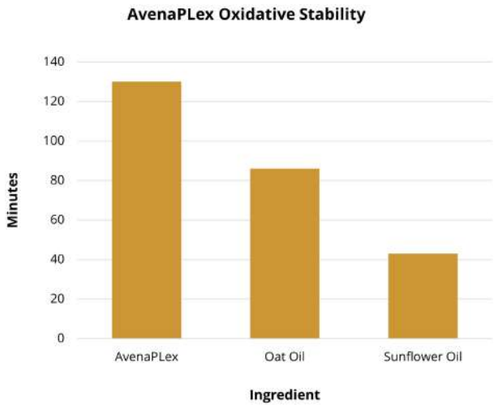
The purpose of this study was to test the oxidative stability of AvenaPLex compared with other oils.

METHOD

A RapidOxy machine was used to test the oxidative stability of the test materials by increasing temperature (to 140°C) and oxygen pressure (7 bar initial) to accelerate the oxidation process.

Sample oxidation is indicated by a fall in pressure to 20% of maximum pressure inside the oxidation chamber. The time taken to reach the set decrease in pressure is the Induction Period, a key characteristic of the oxidation curve that is expressed in minutes.

RESULTS



AvenaPLex had the highest oxidative stability of the 2 oils showing it is very stable and resistant to lipid oxidation.

CONCLUSION

AvenaPLex is a stable oil which contains a number of molecules far more resistant to oxidation than those found in other oils.

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

Biodegradability (Manometric Respirometry Test)

BACKGROUND

A study was undertaken to measure the ready biodegradability of 4 oat-derived ingredients (Oat COM USP, Oat Lipid e, **AvenaPLex**, and Oat SILK 12) in a freshwater environment. Biodegradability is the mechanism whereby microorganisms such as bacteria and fungi break down the organic matter of a product and use the nutrients for energy and growth or make it available to the environment. This degradation is defined as the ratio of the Biochemical Oxygen Demand (BOD) to either the Theoretical Oxygen Demand (ThOD) or the Chemical Oxygen Demand (COD) within 28 days.

METHOD

The 28-day BOD was determined by a procedure following the OECD Guidelines for Testing of Chemicals reference 301F. To begin, the test products were added to water with mineral nutrient stock to allow the development of bacteria. The inoculum used for this test was activated sludge from a sewage treatment works receiving predominantly domestic waste. Following this, air was brought into a bottle to bubble up in a solution that works to capture the carbon dioxide. The air then passed into a test tube in which the bacteria used the oxygen to breathe and produce carbon dioxide, comprised of the oxygen present in the air and the carbon present in the substance. Finally, the carbon dioxide passed into a third bottle where there was again a solution to capture it.

The OXITOP^{R} measuring heads (a data collector used to determine how much carbon dioxide has been rejected by the bacteria) recorded readings of biodegradation every 112 minutes for 28 days. The test solutions were stirred at 20.2 – 23.3°C for the duration of the study.

An equation was used to calculate how much carbon dioxide was given off by the bacteria. The amount of oxygen taken up by the microbial population during biodegradation of the test substance is expressed as a percentage of ThOD or, less satisfactorily, COD. After 28 days the percentage of break down was assessed. It is standard to consider a substance to be easily biodegradable when this exceeds 60% in 28 days.

RESULTS

AvenaPLex, Oat SILK 12, Oat Lipid e and Oat COM USP all gave a positive result, exceeding 60% degradation relative to the ThOD value - or the COD value in the case of Oat Lipid e - with a maximum average degradation of 101%, 98%, 96%, and 91% achieved respectively on day 28.

CONCLUSION

When a product is biodegradable, it decomposes and the carbon and other elements in its molecules can be assimilated into new biomass so they can reappear in another form later. The findings of this study mean it can be concluded that **AvenaPLex**, Oat SILK 12, Oat Lipid e and Oat COM USP are readily biodegradable under environmental conditions.

info@oatcosmetics.com 2 Venture Road, Chilworth, Southampton, SO16 7NP, UK Tel: +44 (0)2380 767228

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Appendix

Alphabetical list of Standard Skin Panel Gene IDs, Gene Names and Functions:

Gene ID	Gene Name	Associated Function(s) in Skin
CASP3	Caspase 3	Cell Renewal/ Regeneration
COL1A1	Collagen Type I Alpha 1	Extracellular Matrix Integrity
COL3A1	Collagen Type III Alpha 1	Extracellular Matrix Integrity
FBN1	Fibrillin 1	Extracellular Matrix Integrity
HBEGF	Heparin Binding EGF Like Growth Factor	Growth Factor/ Wound Healing
HMOX1	Heme Oxygenase 1	Antioxidant/ Stress Response
IL1A	Interleukin 1 Alpha	Inflammation/ Immune Response
IL1RN	Interleukin 1 Receptor Antagonist	Inflammation/ Immune Response
KITLG	KIT Ligand	Growth Factor/ Pigmentation
LCE3D	Late Cornified Envelope 3D	Epidermal Barrier
MFN1	Mitofusin 1	Anti-Ageing
NFE2L2	Nuclear Factor Erythroid 2 Like 2	Antioxidant/ Stress Response
PPARD	Peroxisome Proliferator-Activated Receptors	Cell Renewal/ Regeneration
SIRT1	Sirtuin 1	Anti-Ageing
SMPD1	Sphingomyelin Phosphodiesterase 1	Hydration
TGM1	Transglutaminase 1	Epidermal Barrier
TXNRD1	Thioredoxin Reductase 1	Antioxidant/ Stress Response

GET IN TOUCH

For more information about AvenaPLex, or any other enquires about our offerings at Oat Cosmetics, please contact our Sales team at **sales@oat.co.uk**

www.oatcosmetics.com

The University of Southampton Science Park
2 Venture Road, Chilworth, Southampton, Hampshire, SO16 7NP
Phone: +44 (0)2380 767 228
Email: info@oatcosmetics.com