

Active Beauty

Functional vegan silk

Next generation biopolymers for cosmetics

Crafted by white biotechnology



Givaudan

engage your senses

Biomimicry

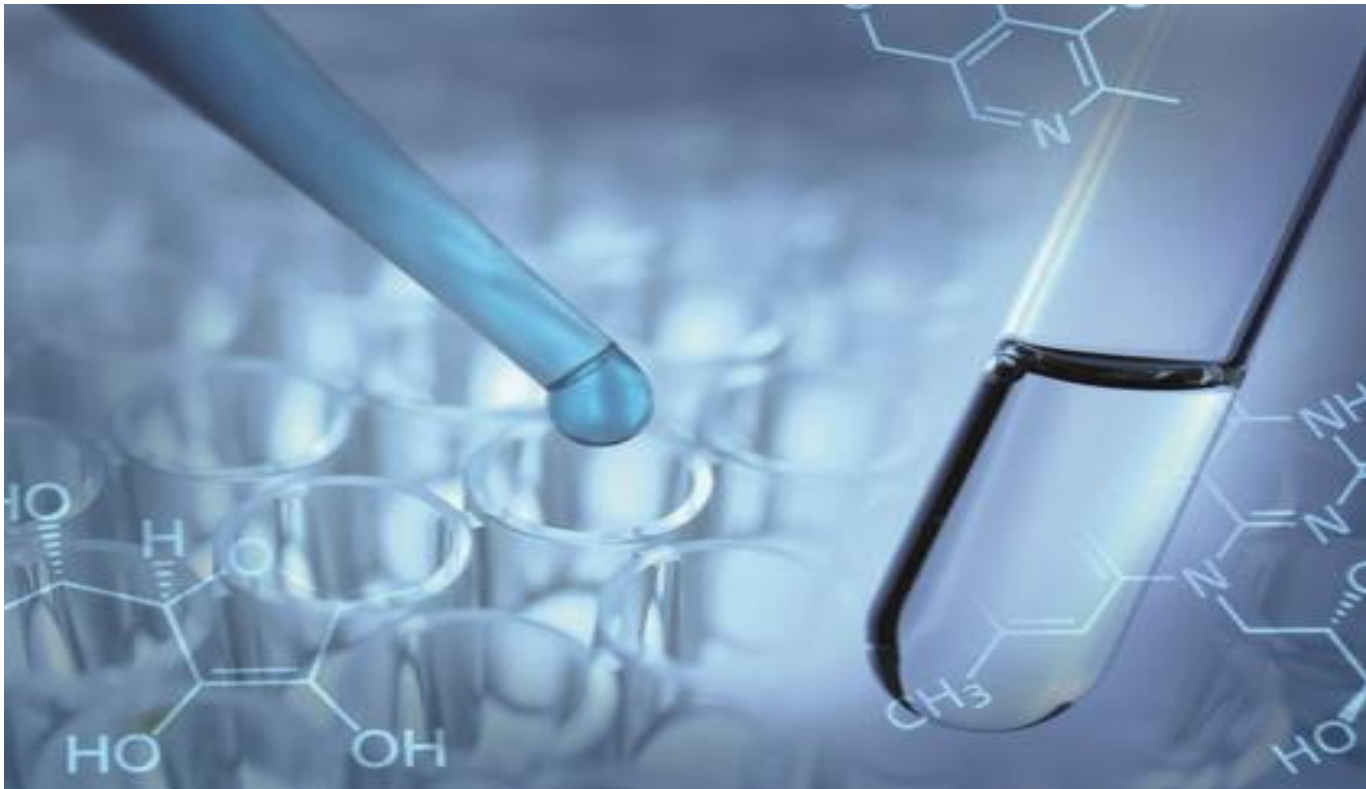
The future of beauty?

“Biomimetic or biomimicry is the study of the formation, structure, or function of biologically produced substances and materials (such as enzymes or silk) and biological mechanisms and processes (such as protein synthesis or photosynthesis) especially for the purpose of synthesizing similar products by artificial mechanisms which mimic natural ones.”

Webster dictionary definition

Biomimicry

Put simple, biomimicry is the fact of reproducing natural processes and substances by imitating nature



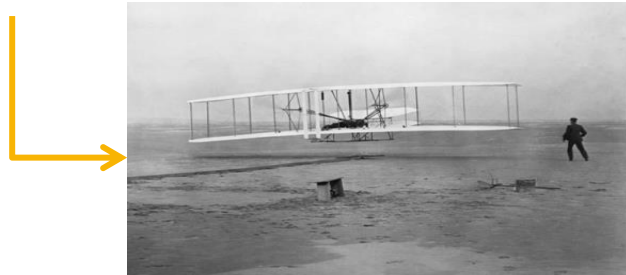
Biomimicry enables **to find new sources of inspiration** and eventually **to innovate.**

Biomimetic innovations

The term appeared after 1950, but several famous innovations were created by mimicking nature

Wright Brothers flying machine

Their first prototype of flying machine heavier than air was inspired by **the pigeon flight**



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The Velcro

It was invented after noticing how **certain plants have deformable hooks** used to stick to animal fur and transport them.



Wetsuit

It was invented after noticing how **certain plants have deformable hooks** used to stick to animal fur and transport them.



Silk

An ancestral ingredient

What is traditional silk?

In nature, it's a protein produced by living creatures

Silks are fibrous proteins containing highly repetitive sequences of amino acids, stored as liquid and transferred into fibres when sheared at secretion.*

Silkworms and spiders have been the most used providers of silk.



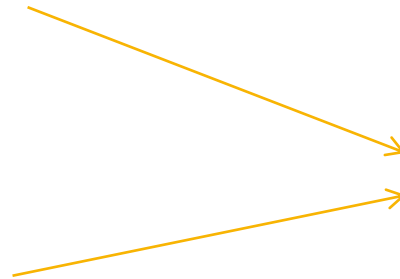
Silkworm



Spider – Dragline silk

Fibroin
(70-80%)
+
Sericin
(20-30%)

Fibroin
(~90%)



Silk fibres

Sources: *Craig, C. L. Evolution of arthropod silks. Annu Rev Entomol 1997,42, 231-267

Traditional silk

A treasured ingredient in many fields



History:

Silk has always been considered as a precious fabric.

Because of its texture and lustre, it has frequently been **linked to luxury and opulence.**

The development of silk **first appeared in Ancient China** before making its way in the rest of the world.

Benefits:

Silk has strong characteristics:

- Very soft feeling
- Strength
- Thermal isolation
- Conditioning
- Nourishment

→ Making it appreciated as much in clothing and furniture as in parachutes or comforter fillers and **in the cosmetic industry.**

Traditional silk

Its high demand is challenging for nature and vs consumers “clean” expectations

Heavy on nature

Worm silk: Need to harvest ~200kg of leaves corresponds 25 mulberry trees to produce 1kg

Spider silk: Limited production in nature and difficult to farm



Animal-derived

Worm silk: Need to boil 5000 worms and cocoon to produce 1kg of silk



Non-clean

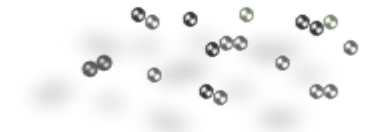
The production resources are heavy in chemicals:

- Hormones
- Formaldehyde
- Chemical disinfectants
- Chemical fertilizer
- Pesticides



Low purity

- Often hydrolysate due to the increased water solubility
- Different variable purity
- Mixture of polymers with different chain lengths



Molecular weight 0.15 – 1 kDa

Clean Beauty

New concerns from consumers

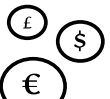
Consumers are becoming more educated about the products they use on a daily basis:



65% of consumers try to live a more ethical lifestyle than a year ago



Safety, certificate, sustainability and origin are the most important criteria after efficacy for a cosmetic ingredient for French consumers⁽¹⁾



51% of US consumers would pay more for a product from a socially responsible company⁽²⁾

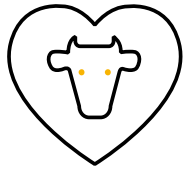


(1) Method: Givaudan on-line survey, G-Source, Target: female, 20 ~ 50 y.o. (balance: 20-30; 30-40; 40-50), NAT REP (national representative), beauty care user, Sample size: 300 in France, Field work: May 2019, (2) Mintel

Clean Beauty

Consumers are turning to solutions that are not harmful

Knowing more, consumers are turning towards products that are **good for them and not harming the fauna and flora.**

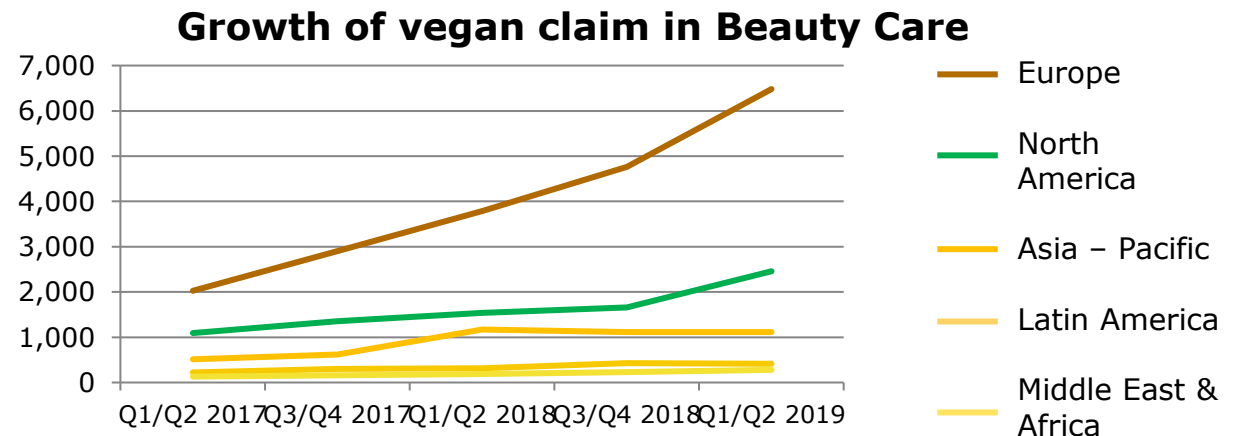


While vegan diets are still niche, **37 to 51% of Europeans say cruelty-free certification is important to them**⁽¹⁾.

Vegan beauty products are perceived **as more natural and kinder to skin.**

Launches of beauty products with “vegan” claim more than doubled globally between 2017 and 2019⁽²⁾.

(1) Source: Lightspeed/Mintel , (2) Mintel GNPD, number of launches with “vegan” claim in beauty category, 81,295 results analysed



» So how can we continue to enjoy the properties of silk while being respectful of nature and compliant with consumers new expectations? «

Silkgel NEO

The breakthrough nature-inspired
polymer

Welcome to the future of cosmetic ingredients

Future

19th century:
natural / animal derived
polymers



20th century:
monomer based
polymers



21st century:
Polymers created by
biomimicry



**Silk
technology**

For decades the cosmetics industry has been **using animal or crude oil derived ingredients** for market products.

New performances



Advanced silk technology

Production of unique new functional defined polymers that mimic natural silk, with improved characteristics



Biotechnological process

Fermentation of bacteria with plant feeds in bioreactors



Purification



Processing with a special technology



VEGAN SILK

Hair & skin care activity

Extra sensorial feeling (silky finish)

Non-hydrolysed, full-length

High purity (>90%), defined polymer molecule

Almost colourless, no smell

Traditional silk vs advanced silk technology

Silk technology production process is sustainable and cruelty-free



Functional silk is registered by *The Vegan Society*

No animal derived sources are used in the whole manufacturing process rendering the proteins vegan.

Thus, functional silk meets all requirements for the registration:

Vegan trademark standards:

- ✓ No animal ingredients
- ✓ No animal testing
- ✓ No Genetically Modified Organisms



Advanced silk technology

A unique opportunity

Thanks to its production process, the functional silk technology meets the expectations of the market when it comes to **Clean Beauty** needs.

- Efficient
- Vegan and cruelty free
- Sustainable & biodegradable
- Free from hard chemicals



Silkgel NEO – a unique cosmetic ingredient

Product features and benefits

Product features



Transparent hydrogel with 3% vegan silk

- Transparent
- Non-sticky
- Robust
- Thixotropic
- Sprayable
- Non-occlusive

Product benefits



- Physical, breathable protection
- “Second skin” effect
- Anti-pollution effect
- Colour protection
- Fixation effect
- Bacterial biofilm reduction

INCI: Water, Silk, 1,2-Hexanediol, Caprylyl Glycol

Silkgel NEO: advanced functional silk properties

Worldwide innovation in non-animal derived silk

1 Physical, breathable barrier **PROTECTIVE EFFECT**

- Film forming properties
- Breathable skin protection
- Anti-pollution effect
- Second skin effect
- Shields from irritants & bacteria
- Biofilm reduction



2 Prolonged efficacy of substances **PROTECTIVE EFFECT**

- Fixation property enhances sustained release of substances, e.g. actives, repellent ingredients
- Long-lasting experience for high performing products

Vegan silk
For hair care



Silkgel NEO - key benefits

Hair care



Hair dye protection

Blond dye colour protection against sea water - *ex vivo*

PROTOCOL

Natural European hair were coloured blond and afterwards either untreated or sprayed with a 1/6 solution of Silkgel NEO (eq. to 16.6%), and then immersed in sea water during 3 days.

Colour was visually controlled and electronic microscopy was used to observe hair surface.

RESULTS

Silkgel NEO has a **protective effect** on the hair: colour stays more vivid and hair surface is smoother



Natural European blond hair, blond coloured

Hair dye protection

Hair colour protection against salt and chlorine water - *ex vivo*

PROTOCOL

Red coloured hair were either untreated or treated with a solution of Silkgel NEO and then immersed in sea water or in chlorinated water for 3 days.

Colour was visually analyzed versus the coloured hair before treatment.

RESULTS

Silkgel NEO showed a very good **protective effect** of the **quality and intensity** of the colour of dyed hair treated with salted water. Tests with chlorine water showed a similar effect.

coloured hair
before
treatment



incubation
in sea
water

unprotected red
coloured hair



Silkgel NEO-treated
red coloured hair

Silkgel NEO
10%



Silkgel NEO
5%



Natural European blond hair, red coloured

Hair dye protection

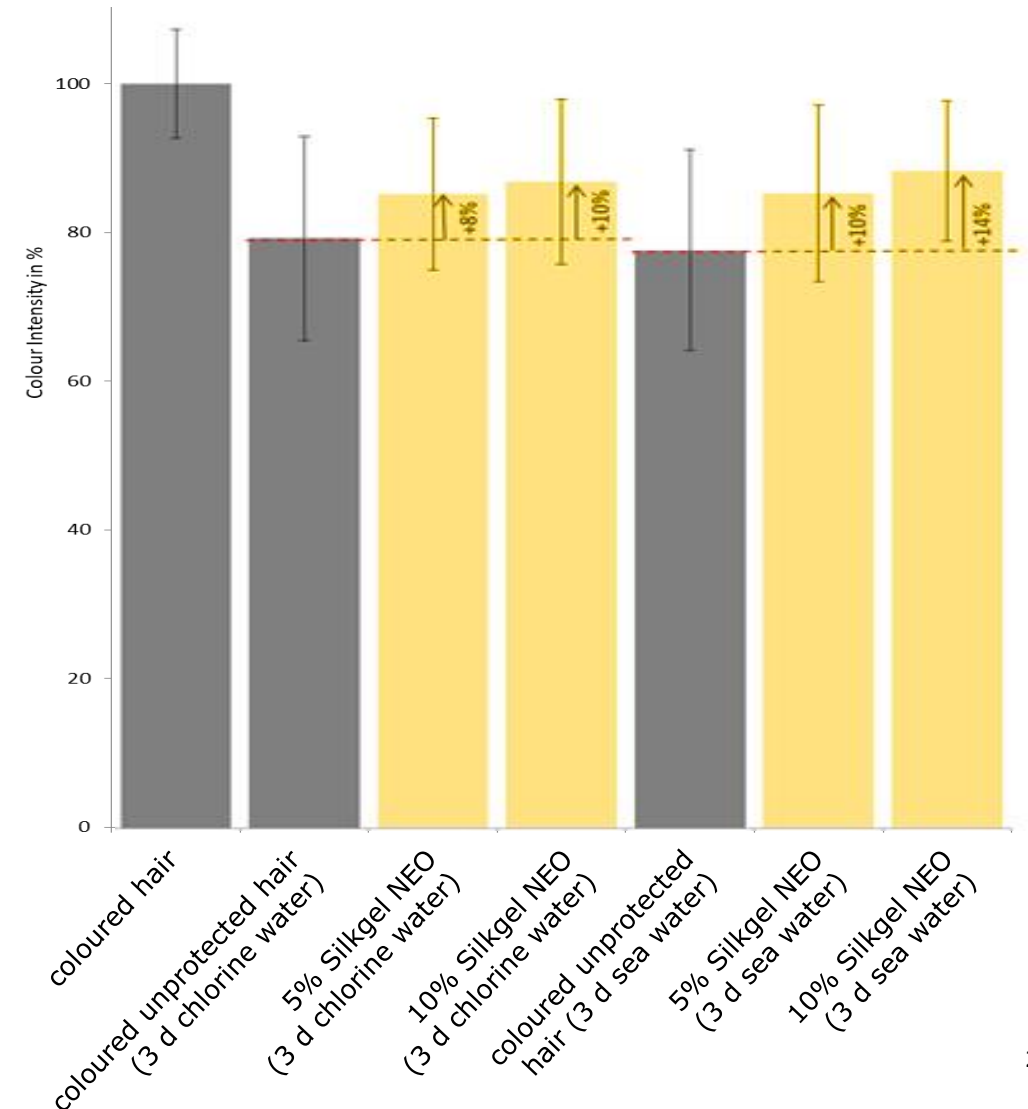
Hair colour protection against salt and chlorine water - *ex vivo*

PROTOCOL

Brightness shift was measured by comparing grayscale values from the image histograms.

RESULTS

Silkgel NEO showed a very good **protective effect** of the **quality and intensity** of the colour of dyed hair treated with chlorine and salted water. Tests showed that at least **85%** of the initial hair colour are still maintained after immersion in chlorine or sea water for 3 days.



Hair protection against dye damages

Sensorial testing after hair colouration - *ex vivo*

PROTOCOL

Natural European hair were coloured red and afterwards either untreated or sprayed with solutions of Silkgel NEO and then immersed in sea water for 3 days.

RESULTS

Silkgel NEO has a **protective effect even at 5%**: colour stays more vivid and the hair surface is smoother.

Additionally, the hair treated with Silkgel NEO showed more smoother silky touch feeling compared to unprotected hair.

untreated
hair



unprotected
hair



Silkgel NEO 5% Silkgel NEO 10%



Natural European blond hair, red coloured

Hair protection against pollution

Protection of hair from PM_{2.5} - *ex vivo*

PROTOCOL

Blond hair were either untreated or sprayed with Silkgel NEO, and then exposed to carbon particles (PM_{2.5}).

Pollution deposition was visually controlled versus the t_0 colour after a simple water rinsing or after a shampoo.

RESULTS

Silkgel NEO **facilitates the removal of carbon particles (pollution)** on the hair fibres during hair rinsing and washing.



Hair wefts (natural European hair, blond) with carbon particles PM_{2.5}

Hair protection against pollution

Protection of hair from PM2.5 - *ex vivo*

PROTOCOL

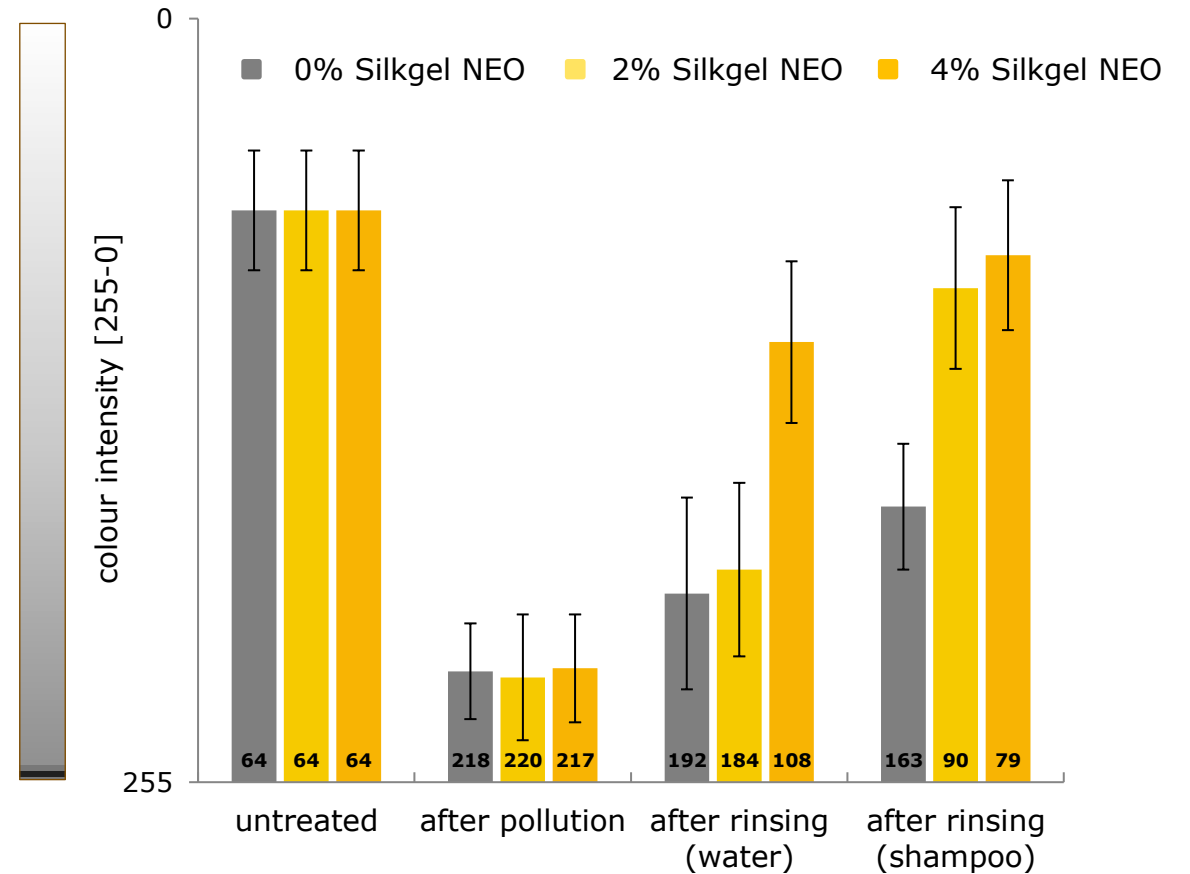
Blond hair were either untreated or sprayed with Silkgel NEO, and then exposed to carbon particles (PM2.5).

Carbon particle-caused brightness shift was measured by comparing grayscale values from the image histograms.

RESULTS

Silkgel NEO at 4% **enables the removal of 71% of PM2.5** after a simple water rinsing

Silkgel NEO **at just 2% enables the removal of 83% of PM2.5** after a shampoo rinsing



Hair protection against pollution

Hair protection from fine carbon particles with leave-in silk conditioning spray - *ex vivo*(1)

PROTOCOL

Blond hair were either untreated or treated with a leave-on conditioner containing 2% of Silkgel NEO, and then exposed to carbon particles (PM2.5).

Carbon particle-caused brightness shift was visually controlled after water rinsing or after shampoo.

VEGAN SILK CONDITIONER

(silicone free, preservative free, plastic free)

Ingredient	Content (%)
Water demin.	73.6
Tri-Natriumcitrat Dihydrat	0.11
Keltrol CG-SFT (Xanthan Gum)	0.05
Kelcogel CG-LA (Gellan Gum)	0.1
Silkgel NEO	2.0
AQUARICH	1.0
Water demin.	3.0
Ajidew ZN-100 (Zinc PCA)	0.15
Ethanol (94%)	20.0
total	100.0

pH-value: **5.5-6.5**

Appearance: **Slightly opalescent**

Product form: **Low viscous gel**

Claims: **Pollution protection**

Hair protection against pollution

Hair protection from fine carbon particles with leave-in silk conditioning spray - *ex vivo*(2)

RESULTS

Silkgel NEO at 2% **improves the efficacy of a conditioner** to remove pollution particles from the hair.



Hair wefts natural European hair, blond

Hair protection from heat

Hair protection from thermal hair damage without silicones - *ex vivo*

PROTOCOL

For the efficacy of Silkgel NEO as hair protection agent the hair were thermally damaged using a straightener (1 min at 220°C) and treated with different hair repair formulations over 20 treatment cycles (1 treatment cycle: washing, drying, straightening).

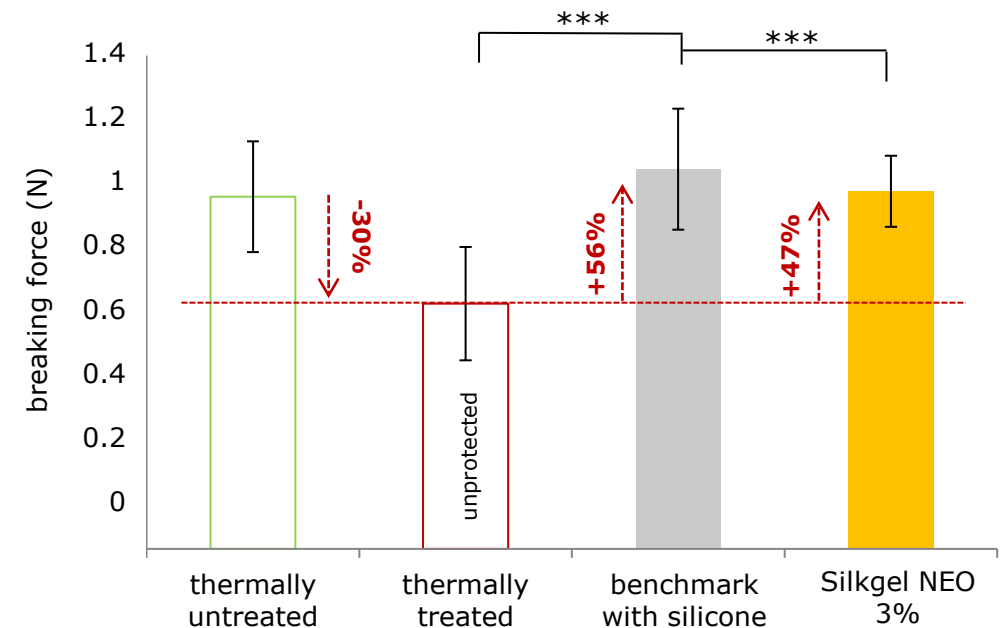
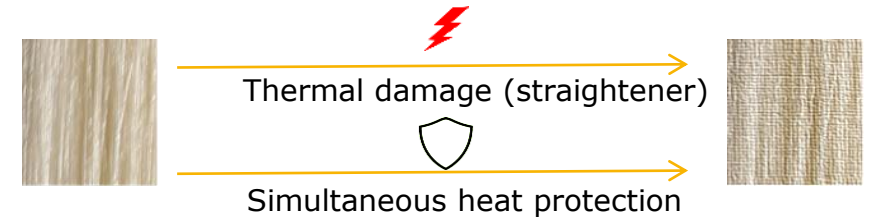
The effects were measured using a standardized tensile testing setup (according to DIN EN ISO 2062) to determine the hair fibres breaking force.

RESULTS

Hair straightening **damages the hair structure**, reducing its resistance of up to 30%.

3% Silkgel NEO in an aqueous solution increased the hairs breaking force **by up to 47%** and shows a **protection effect** similar to a heat protection spray with silicones.

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***p<0.001; benchmark: heat protection spray

Hair repair

Hair repair of thermally damaged hair - *ex vivo*

PROTOCOL

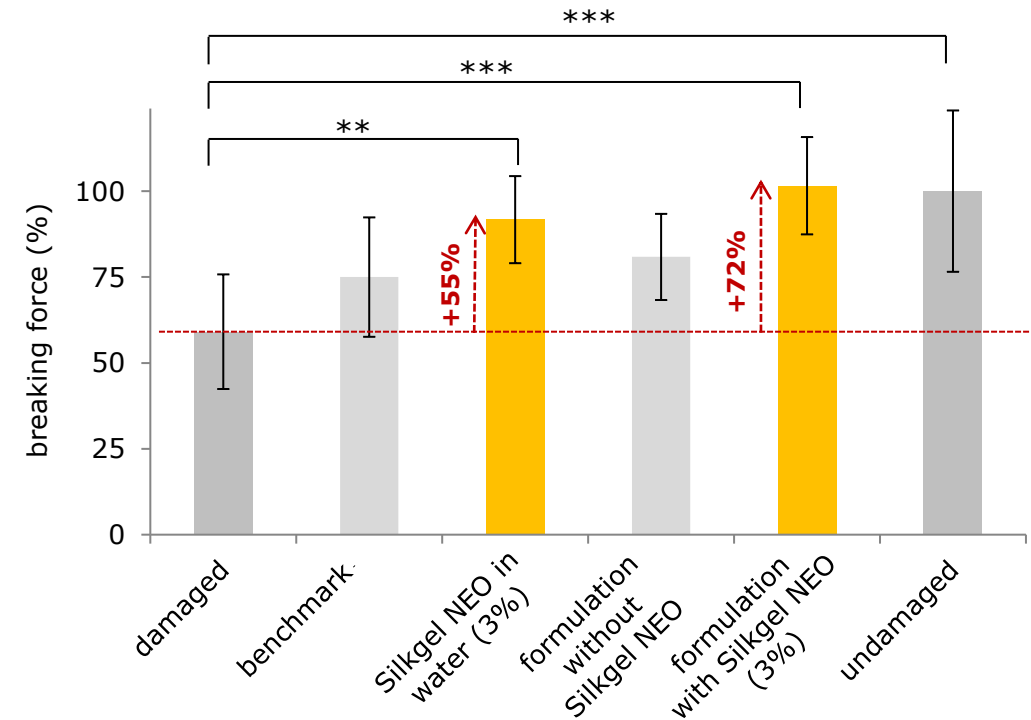
The efficacy of Silkgel NEO as hair repair agent to restore thermally induced damages has been assessed on natural European blond hair. Already damaged hair (20 treatment cycles with hair straightener; each for 1 minute at 220°C) were treated with different conditioner formulations over 14 treatment cycles. The effects were measured using a standardized tensile testing setup (according to DIN EN ISO 2062) to determine the hair fibres breaking force.

RESULTS

Using **3% Silkgel NEO in an aqueous solution** increased the hairs breaking force by **up to 55%**.

Using a **hair conditioner formulation** containing 3% Silkgel NEO increases the hairs breaking force **by up to 72%**.

→ Already damaged hair can be restored by the **application of Silkgel NEO** ***p<0.001; **p<0.01 ; benchmark: Express Repair Conditioner



Hair strengthening

Hair repair and conditioning after dyeing using functional Silk - *ex vivo*

PROTOCOL

The efficacy of Silkgel NEO as hair protection agent during the dyeing process has been assessed on natural European blond hair. The hair were coloured red and treated either with Silkgel NEO or a benchmark hair conditioner.

The effects were measured using a standardized tensile testing setup (according to DIN EN ISO 2062) to determine the hair fibres breaking force.

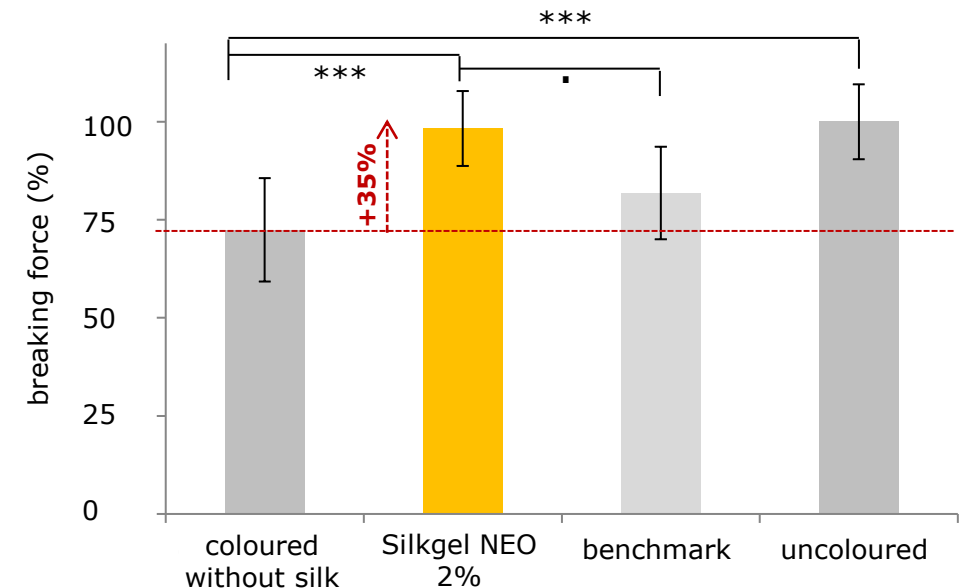
RESULTS

The **colouration** of the hair **damages its structure** reducing its resistance.

The subsequent application of **Silkgel NEO** improves the hairs resistance **significantly**.

Using **2% of Silkgel NEO** in an aqueous solution improved the hairs breaking force by **up to 35%**.

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***p<0.001; . p<0.05; benchmark: nourishing protection milk

Hair protection with Silkgel NEO

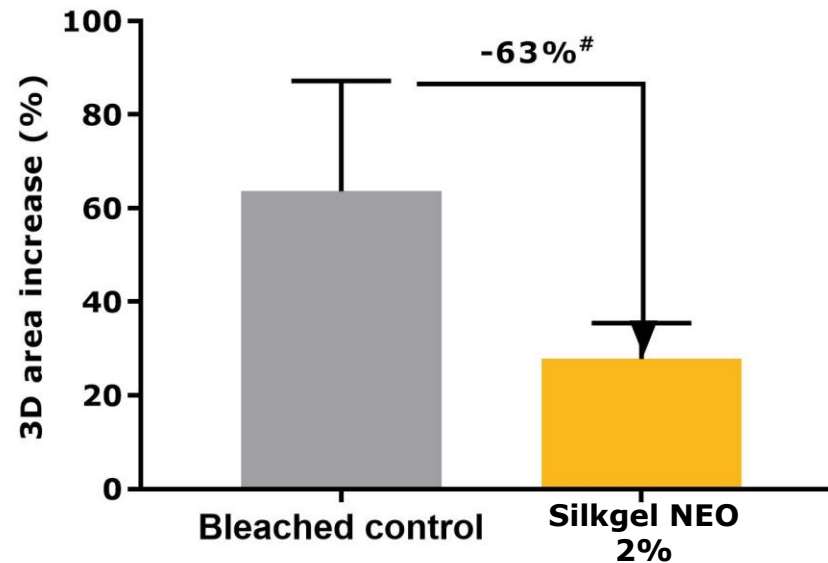
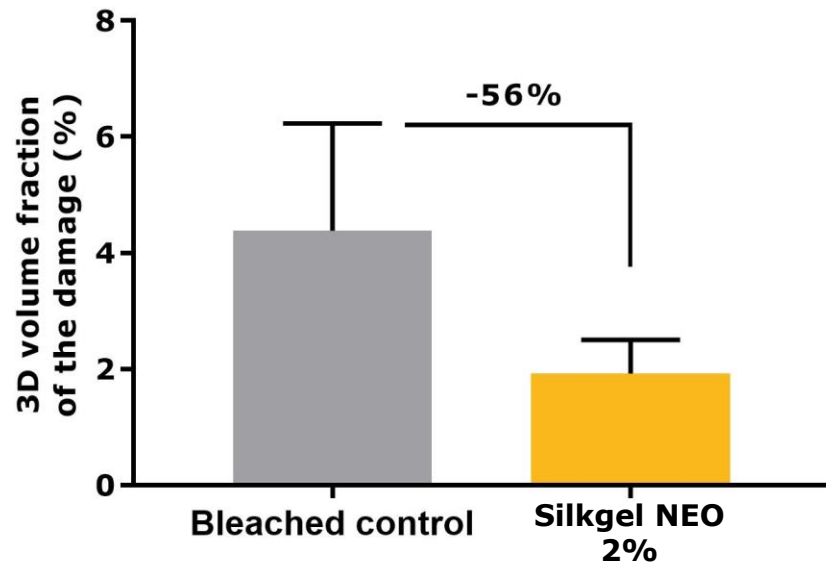
X-ray nanotomography – porosity reduction – *ex vivo*

- Bleaching treatments + thermal straightener damage hair and induce hair porosity and rough-touch effect.
- The hair porosity analysis was performed using X-ray nanotomography.
- Silkgel NEO protects the hair fibre from reduction of the fibre diameter



Hair protection with Silkgel NEO

X-ray nanotomography – porosity reduction – *ex vivo*



The 3D **volume of the damage** is reduced by **56%** and the 3D **surface (porosity)** by **63%** (#p<0.1) with Silkgel NEO

Breakthrough functional silk

For hair care innovations

HAIR PROTECTION

Anti-pollution effect:

protective film shielding the hair from environmental influences such as smog particles which can also penetrate into the hair follicles/skin.

Protects hair **colour** and ensures perfect **long-lasting** colour.

Protects hair from structural **damages** due to straightening or dyeing.



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HAIR Repair

Nourishes without weighing down the hair while at the same time maintaining **volume**.

Improves **smoothness** and provides silky shine.



Additional FIXATION EFFECT

Prolonged persistence of substances e.g. **fragrances** in hair mist products.

Sprayable for comfortable application.



Vegan silk For skin care

Givaudan



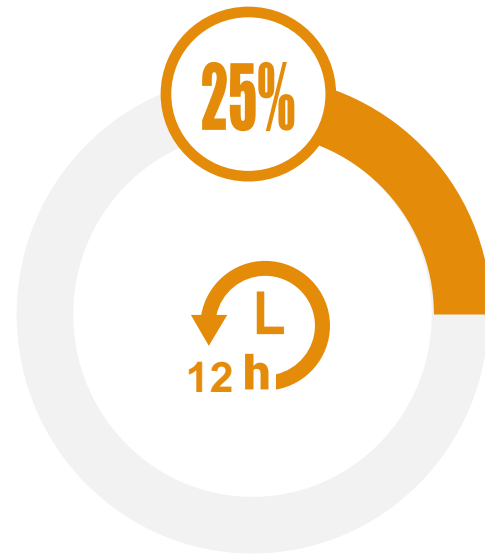
Silkgel NEO - key benefits

Skin care



anti-pollution effect

Up to 26% improved carbon particle removal compared to placebo



long-lasting effect

Increases icaridin[®] fixation up to 25% from 9 to 12 hours



biofilm reduction

Reduction of bacterial adhesion of up to 93%

Anti-pollution

Physical skin protection against PM2.5 - *in vivo*

PROTOCOL

Silkgel NEO solutions (Water, Silkgel NEO and SymDiol® 68) were applied on skin. Then skin samples were exposed to carbon particles (PM2.5), and dipped into warm water 40°C with 1% detergent. Colour intensity was evaluated.

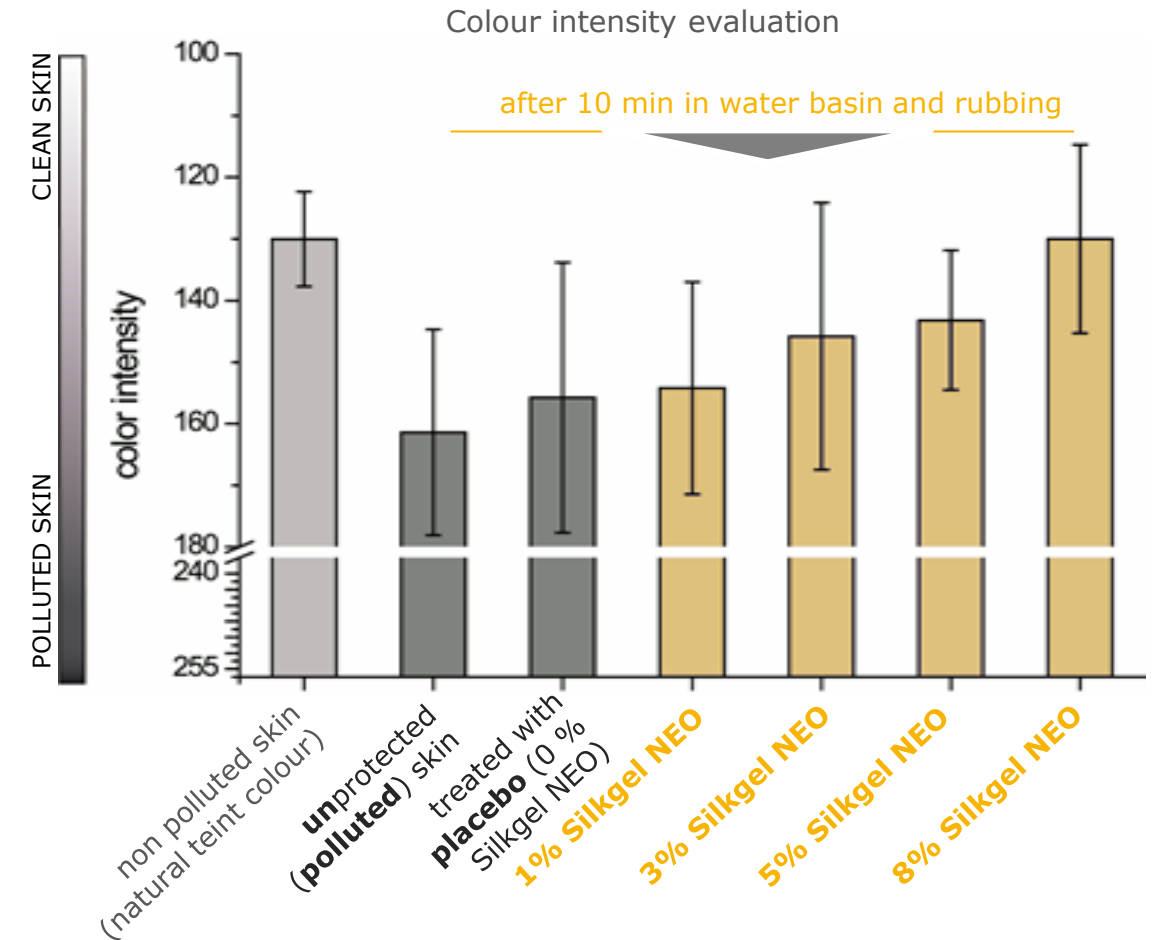
RESULTS

Effective prevention from carbon particle (PM2.5) skin penetration using Silkgel NEO.

Protection of skin from pollutants after 10min in water basin and rubbing.

Untreated skin: high adhesion of carbon particles.

Up to 26% improved particle removal compared to placebo.



Skin protection

Physical protection from irritants - *clinical test*

PROTOCOL

Silkgel NEO in formulation was applied on skin on forearm of 7 test volunteers 15 minutes before the irritation.

Skin was irritated during 5 days with 0.5% NaOH (pH 13,2).

Formula: Aqueous gel containing Silkgel NEO, Aqua, Propylene Glycol, Glycerol, Xanthan gum, Sodium Hyaluronate, 1,2-Hexanediol and Caprylyl Glycol.

RESULTS

Due to its **film forming properties** ("second skin effect"), **Silkgel NEO protects skin from irritating compounds** such as sodium hydroxide.



without protection



1% Silkgel NEO



3% Silkgel NEO



8% Silkgel NEO

Fixative effect on skin

Application for insect repellent icaridin® - *in vivo*

Icaridin® is an insect repellent with broad efficacy against various insects

But pure icaridin® evaporates easily – limiting its efficiency

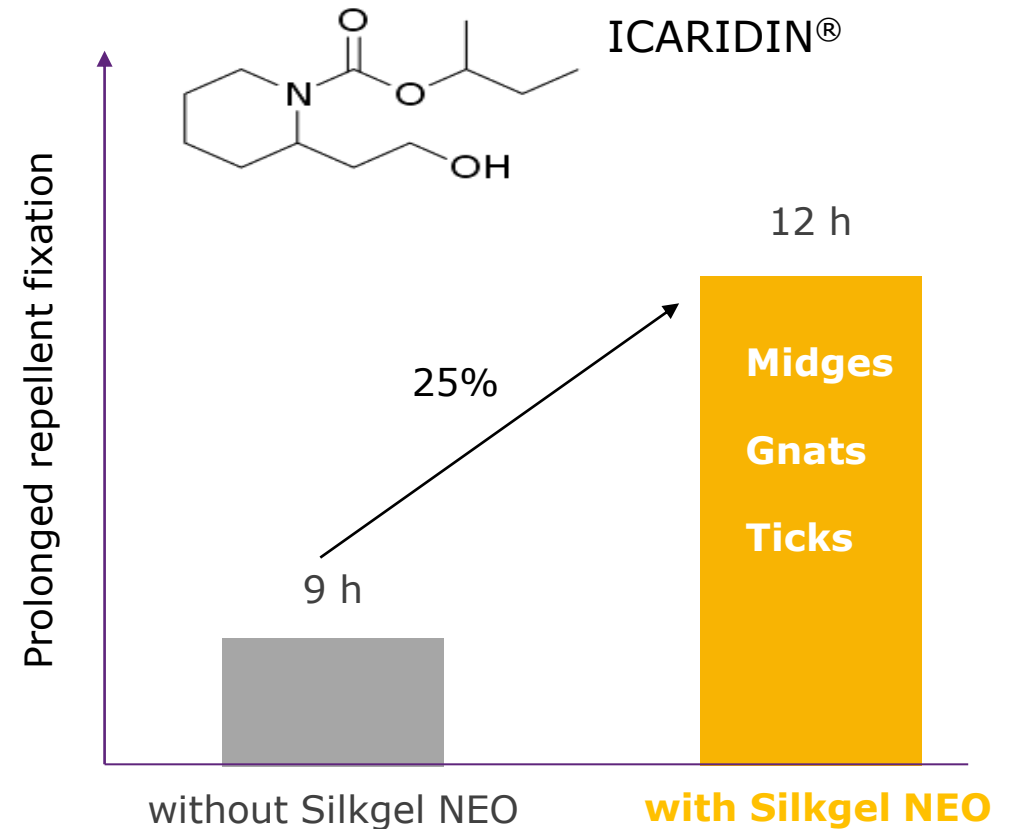
PROTOCOL

A formula containing icaridin® and Silkgel NEO at 2% was applied on human skin and the repellent activity was investigated over the time.

RESULTS

Silkgel NEO increases icaridin® fixation up to 25%, extending the protection of icaridin from 9 hours to 12 hours.

Silkgel NEO in this formulation showed a **reduced stickiness and an improved skin feeling.**



Increased icaridin® fixation with Vegan Silk

Reduction of bacterial adhesion

Anti-biofilm properties on skin - *in vitro*

PROTOCOL

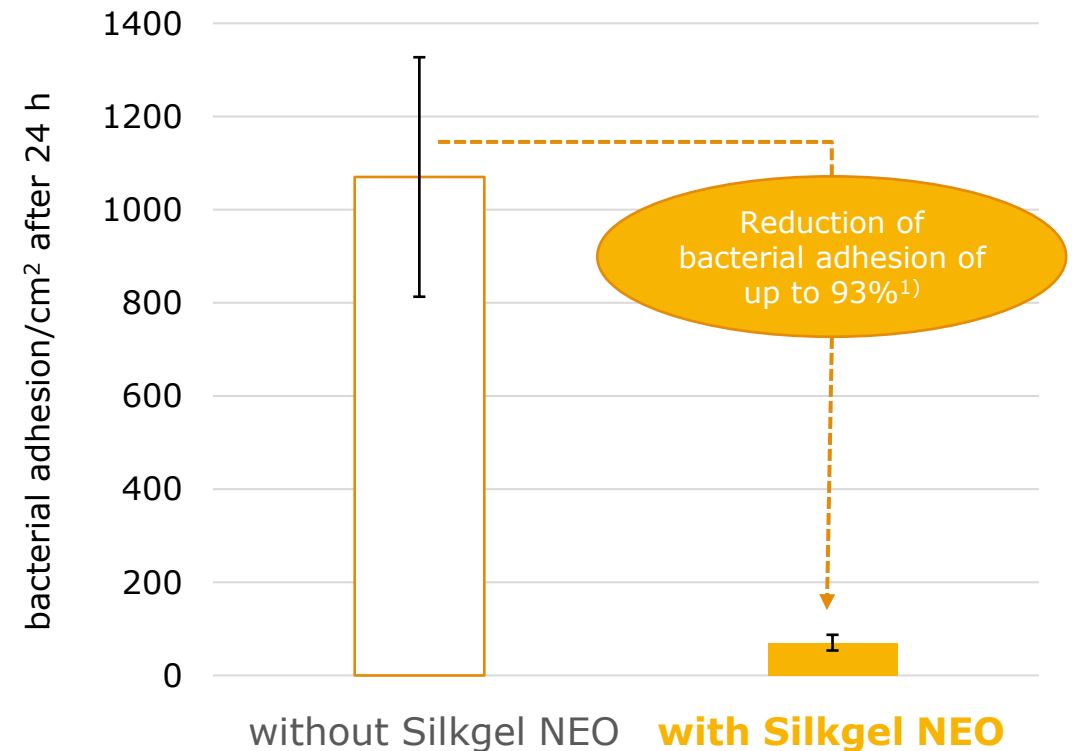
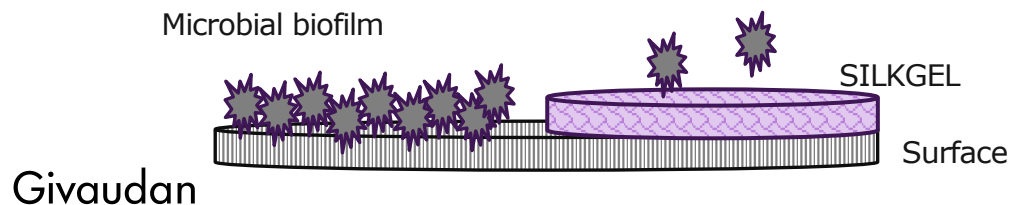
P. aeruginosa was incubated on Silkgel NEO coated plates in comparison to uncoated plates.

The germ reduction on the coated plates could be determined by plate counts.

RESULTS

Silkgel NEO protects the skin from microorganisms biofilm creation due to its' slightly negatively charge and amphiphilic character.

It inhibits up to 93% the bacterial adhesion on skin and their skin penetration.



¹Adhesion test according to ISO 22196

Breakthrough functional silk

For skin care innovations

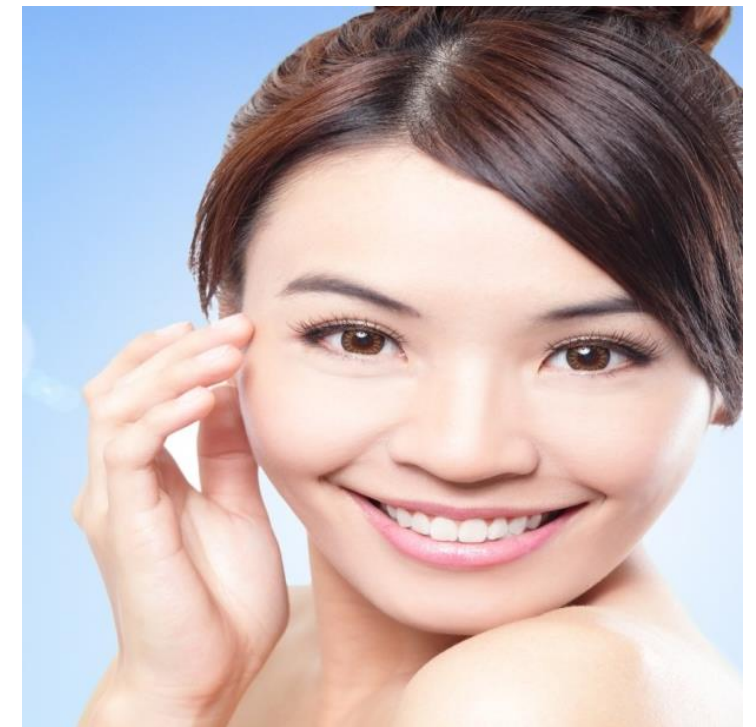
Protection against pollution and irritants



Fixative effect



Reduction of bacterial adhesion



Vegan silk
For colour cosmetics

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Reduction of bacterial adhesion

Anti-biofilm properties on skin - *in vitro*

PROTOCOL

Treatment with pressed and loose powders on forearms, post-treatment with make-up fixing spray containing Silkgel NEO and evaluation of efficacy of the long- wearing effect with paper tissue for ~5 sec. Formula make-up fixing spray: 8% Silkgel NEO, 10% alcohol, 1.5% glycerol, 1% pentylene glycol and 0.2% panthenol.

RESULTS

Silkgel NEO fixates and provides an excellent long-lasting effect of powder products

- Make-up protection during the day.
- Breathable skin protection against the damaging effects of pollution.
- Quick and easy to apply

Paper tissues after pressing on powder treated skin areas

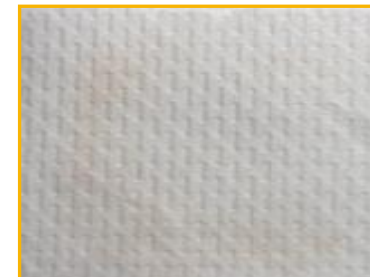
Pressed powder treated **with "Make-up Fixing Spray Silkgel NEO"**



Pressed powder on untreated skin



Loose powder treated **with "Make-up Fixing Spray Silkgel NEO"**



Loose powder on untreated skin





Make up production inspiration

Vegan mascara containing Silkgel NEO for eye lashes care and easy removal



Perfect shape for eyelashes with Silkgel NEO included lash care and protection gel

- Lash care and protection gel with Silkgel NEO
- Silk protects, nourishes, separates and intensifies the eyelashes
- Formulation can be used in combination with mascara

→ **Eye make-up can be removed gently and eyelids can be preserved, thus protecting the beauty of the skin around your eyes**

Vegan silk

Hair & skin benefits

ANTI-POLLUTION

Physical protection against environmental influences with silky and soft skin sensation.



FILM-FORMING EFFECT

Powerful, natural, lightweight: physical, breathable skin and hair protection.

Biofilm reduction: protection of the skin against microbes.



NATURAL BOOSTER

Long-lasting effect enhancing a sustained release of substances, such as actives.

Natural fixation effect - enables complexes with other ingredients.



IMPROVED SENSORIALITY

Silky finish on skin and hair

Extra smoothness



Vegan silk

Take home message

HIGH-TECH COSMETICS: Biotechnological silk increases efficacy and ensures safety and purity.

SILK BIOTECHNOLOGY: Sustainable solution - biodegradability, biocompatibility, vegan and plastic-free.

HIGH-PERFORMANCE: Advanced biotech innovation; world's first and only functional, vegan silk.

VEGAN SILK: Silkgel NEO - physical linked fibrils which form a three-dimensional network.

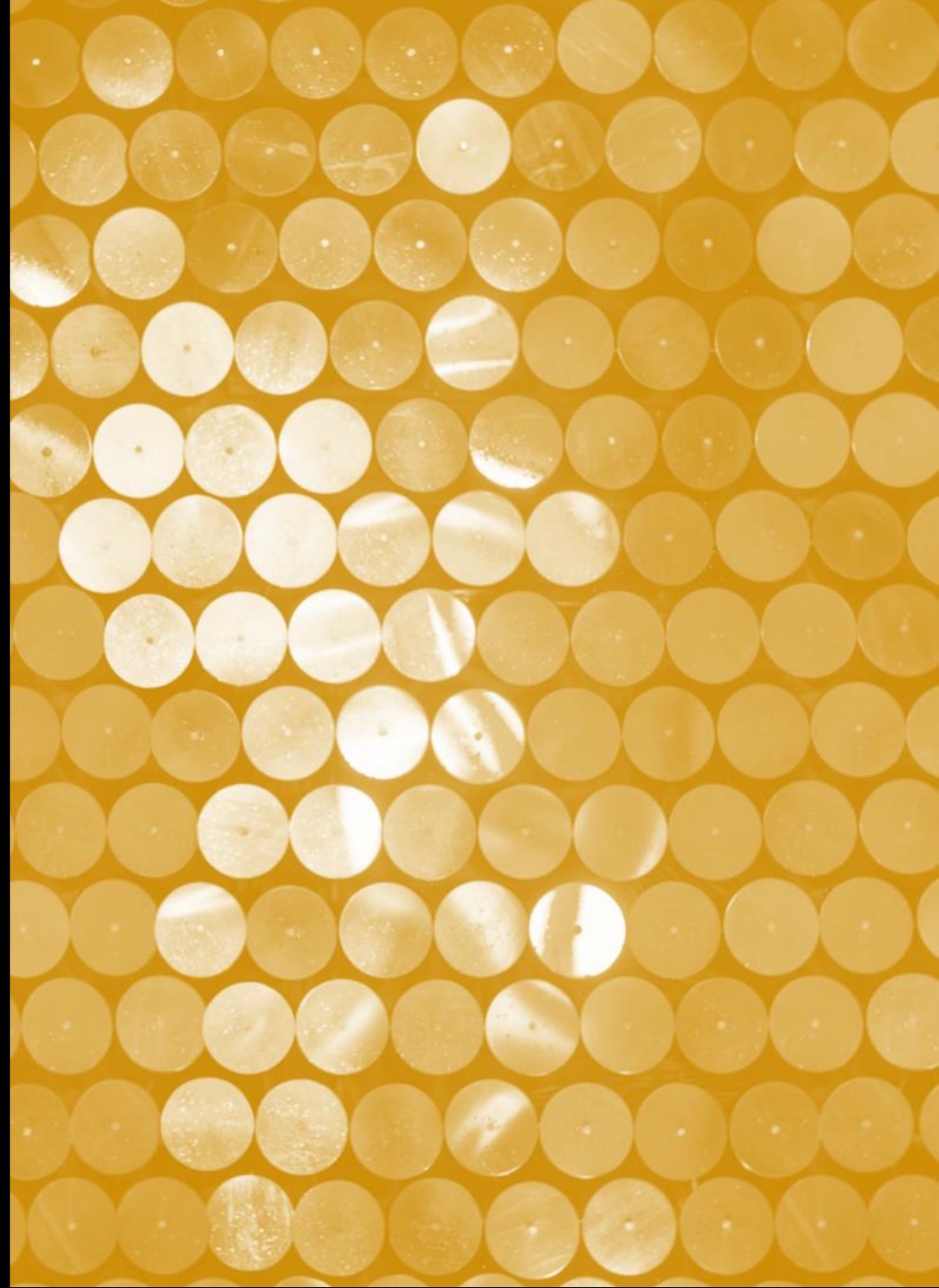
INSPIRED FROM NATURE: Learning from nature and using this knowledge to develop and produce even better properties.

NETWORK IN 3-DIMENSIONS: Breathable, film forming, allergen-free. Vegan silk proteins with unique structure, extremely robust, heat resistant.



Vegan silk

Product inspirations



Applications inspiration

The benefits of biomimetic silk in beauty products

Skin care

- Skin protection cream
- Detox face primer
- Body-mist silk spray
- Protection sheet mask
- Anti-biofilm deodorant
- Silky pre-shave lotion
- Protective after-shave balm
- Insect repellent

Hair care

- Silk conditioning spray
- Pollution protection spray
- Leave-in hair treatment
- Hair colour protection spray
- Hair mist spray
- Scalp treatment
- Silky dry shampoo
- Hair-end silk fluid

Colour cosmetics

- Breathable nail polish
- Make-up fixing silk spray
- Pollution protection foundation
- Silky lipstick brilliant colour
- Mascara eyelash protection
- Eyelash volumizer
- Silky eye shadow



Vegan

(Micro)plastic-free

Silicone-free

Allergen-free

Givaudan

Paraben-free

Sustainable

Dermatologically certified

Clean

Natural

Vegan silk

Consumer claims

- Biomimetic, natural, clean and vegan
- Bring softness and silky feeling to skin and hair
- Breathable skin protection against pollution and irritants
- Colour protection (against colour fading)
- Hair repair effect (protects hair from structural damage due to straightening or dyeing)
- Lightweight conditioning without build-up effect
- Synergy with other actives to boost/ prolong their efficacy



Silkgel NEO – uniqueness

Physical and breathable protection and fixation effect

No animal ingredients, no animal testing



1st

manufacturer of non-animal derived silk



100%

pure silk protein | certified vegan, plastic-free | biodegradable







> 90%

purity, fully functional, full length protein

Technical information

Silkgel

INCI	Silk
Origin	White biotechnology (fermentation)
Preservation	No preservative
Appearance	Transparent to light beige
Solubility	Dispersible in water
Dosage	From 2% Silkgel NEO upwards
Processing	<ul style="list-style-type: none">- Can be easily added to the water phase- Processible under cold and hot- Homogenize the mixture after Silkgel NEO addition- Optimum pH range from 5.5-7.5
Compliance	   

Givaudan



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Thank you

Active Beauty

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82152 Planegg/Munich
Germany

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