

CO₂ supercritique, quelques cas d'étude pour l'industrie cosmétique



Richard Leroux, PhD
Scientific and Technology Manager

PARIS FRANCE
Created in 1964

163 employees

120 patents

PART OF CRODA GROUP SINCE 1997



ISO 14001



ISO 9001



OHSAS 18001



EFFCI



AEO



Sederma expertise

OUR STRENGTH: Focusing on green technologies to extract our actives



FINE CHEMISTRY



PEPTIDES

PLANT CELL CULTURE

Filtration, concentration, freeze drying...



BIOFERMENTATION

Downstream process, filtration, concentration...

- Yeast
- Fungi
- Bacteria
- Micro algae



sederma

PLANT EXTRACT

Extraction (Sol/Liq, Liq/Liq) with solvents from **vegetal origin**



SUPERCRITICAL CO₂ EXTRACTION

To extract lipids of interest from plants (Sol/Liq)

A Specific approach



Croda commitments:

« We are committed to do our business the right way »

1 Mutual Strategy

2 sites : Sederma and Crodarom

3 axis : **Be ACTIVELY committed FOR PEOPLE**
Be ACTIVELY committed FOR PLANET
Be ACTIVELY committed FOR BUSINESS

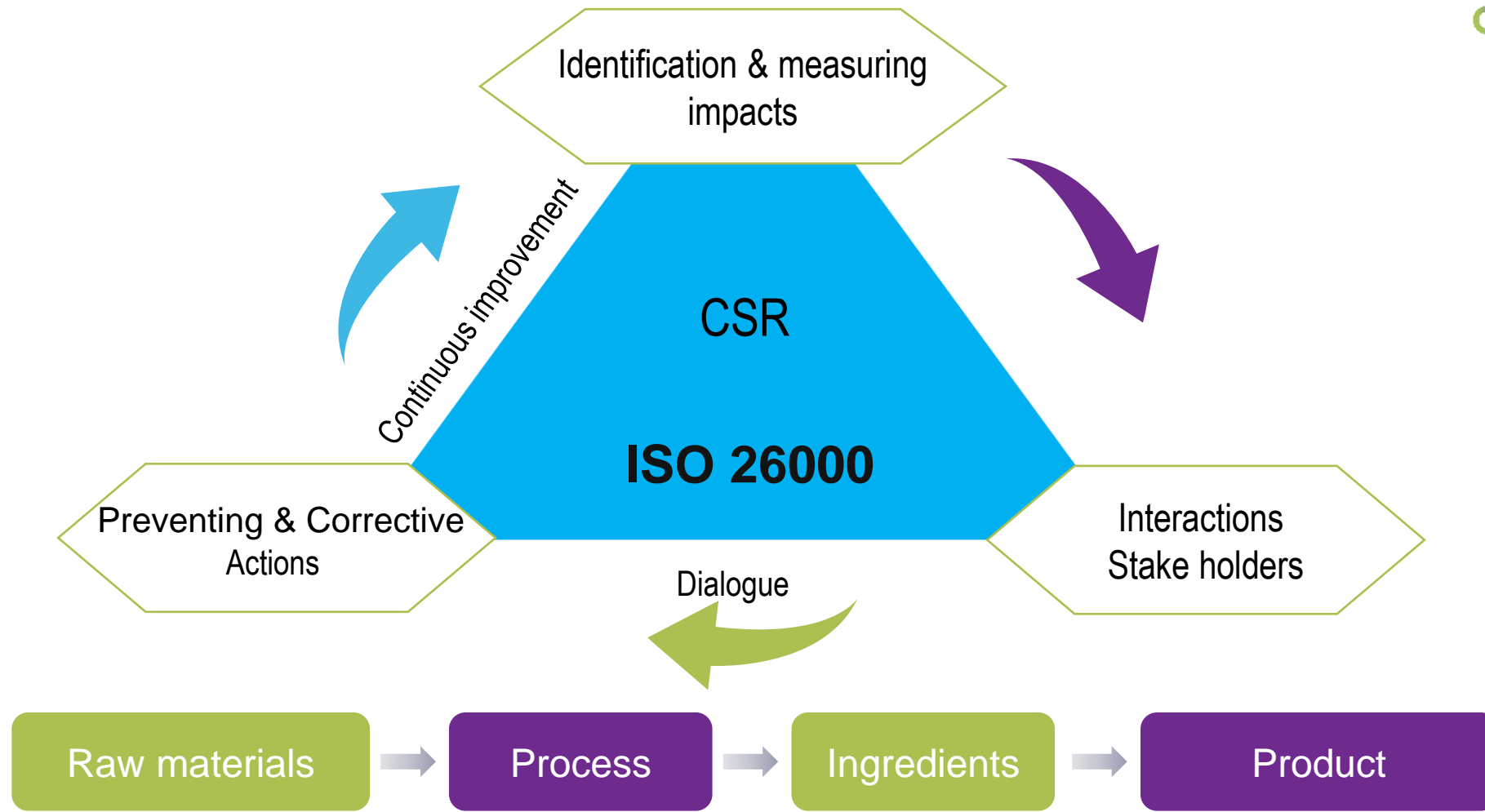


Sederma



Crodarom

Methodology





Respect

Transparency

Together



Minimize social and environmental impacts on our stakeholders without compromising on innovation, quality and security.

FINE CHEMISTRY

PLANT CELL CULTURE

Filtration, concentration, freeze drying...



BIOFERMENTATION

Downstream process, filtration, concentration...

Yeast
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PLANT EXTRACT

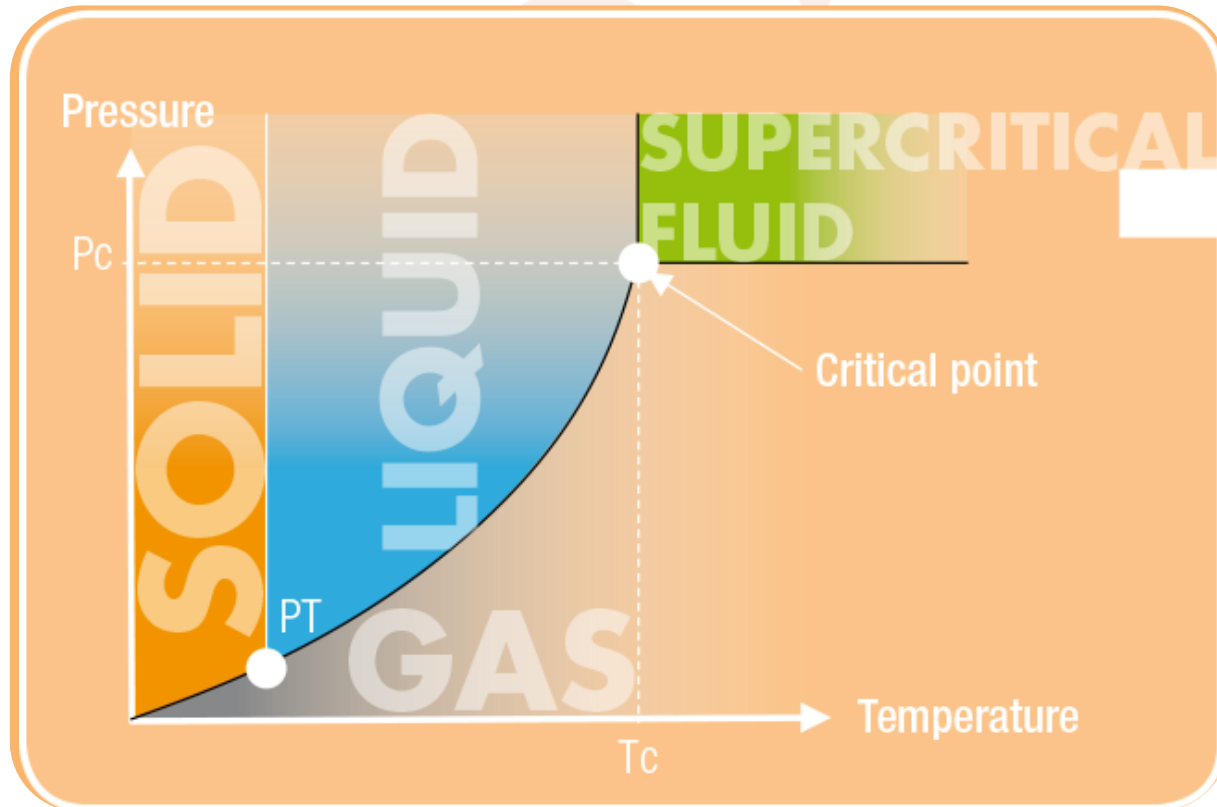
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SUPERCritical CO₂ EXTRACTION

To extract lipids of interest from plants (Sol/Liq)

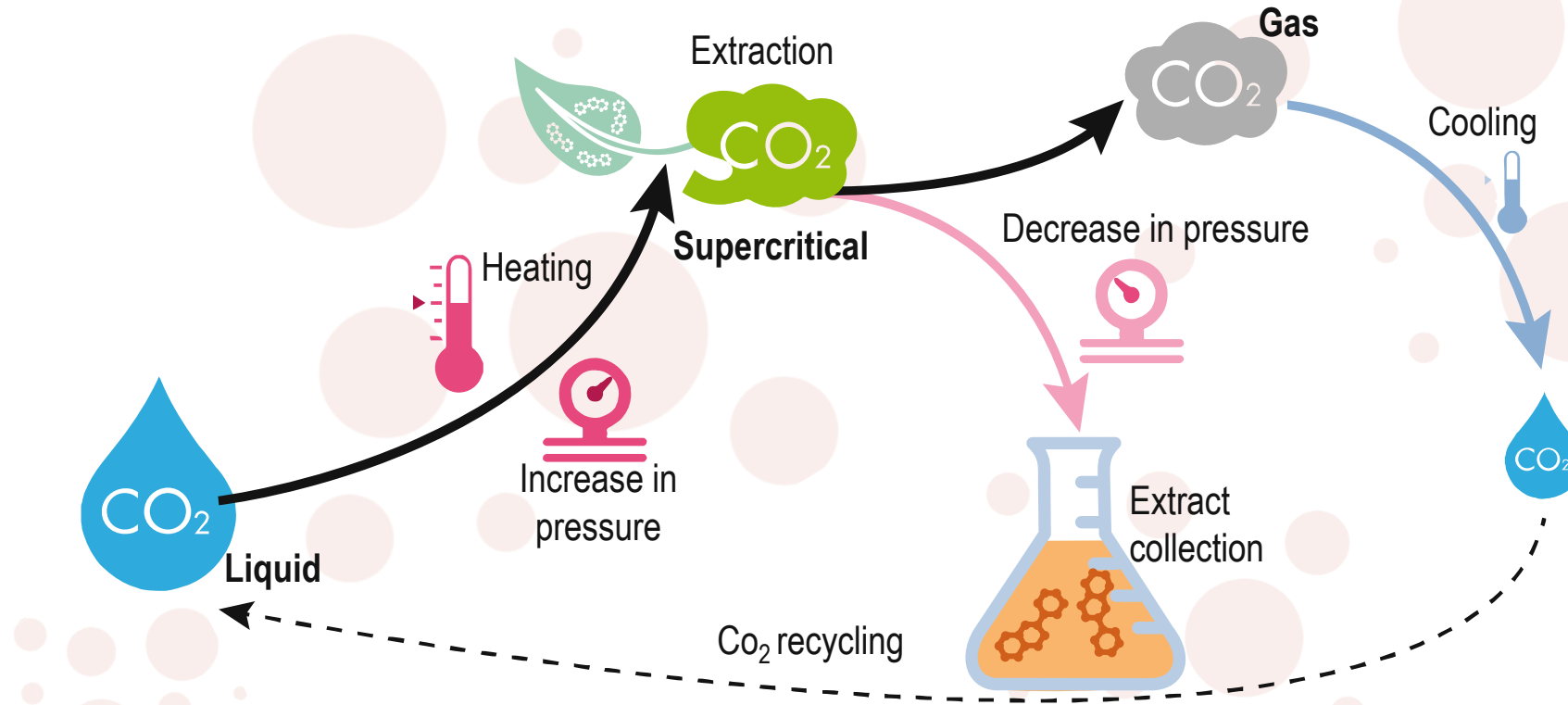
CO₂sc Principle



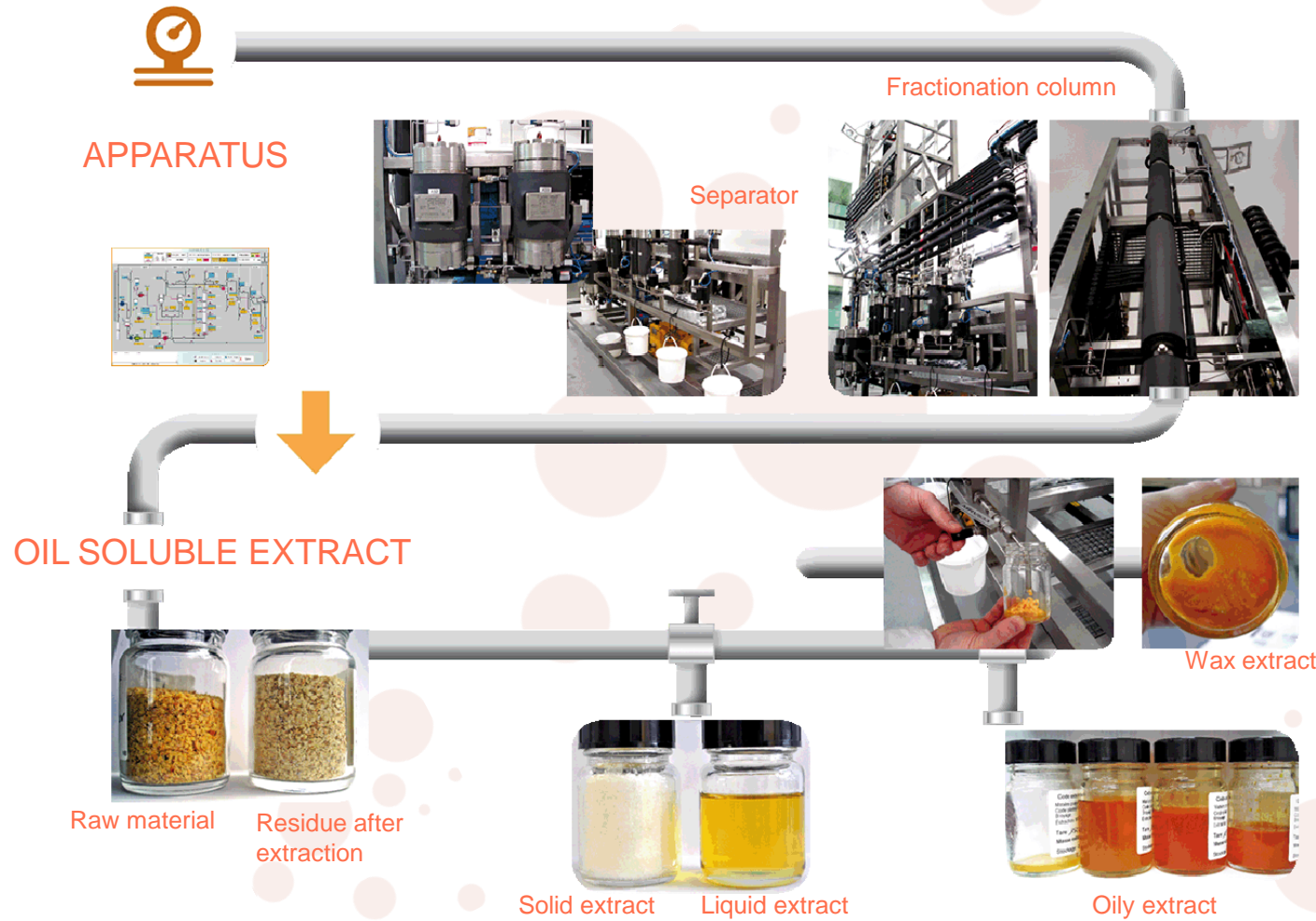
Density = liquid
Viscosity = gas
Diffusivity = intermediate liquid-gas

Critical temperature (T_c) = 31°C
Critical pressure (P_c) = 7.4 MPa

How does it work?



Equipment



THIS TECHNOLOGY IS DEDICATED TO THE EXTRACTION OF OIL SOLUBLE MOLECULES

Lipids
Triglycerides,
fatty acids...

Vitamins

Carotenoids

Terpenes

Phenolic compounds

Phytosterols

Benefits

- High purity
- Non toxic
- Odourless
- Chemically inert
- Non flammable
- No residual solvent
- Low extraction temperature
- Biocide properties



EVALUATION of IMPACTS



- Process characteristics
- Solvents
- Capacity
- Duration
- Temperature (final)
- Energy consumption

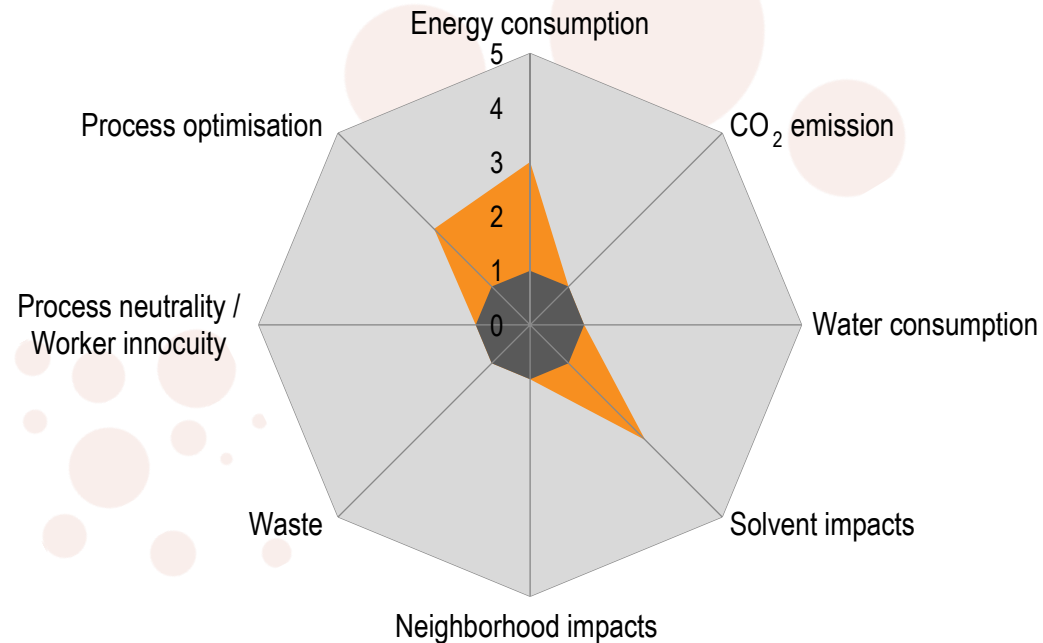
Solid / liquid extraction
 Supercritical CO₂
 5L to 500L or more
 Few hours
 40°C-80°C under pressure
 Medium



Zingiber zerumbet



Apium graveolens



- ### Improvements
- Dedicated electricity meter
 - 100 % CO₂ recycling
 - CO₂ from natural origin
 - 100 % recycled wastes
 - Strong security worker management
 - Process optimisation

Products from Supercritical CO₂ extraction



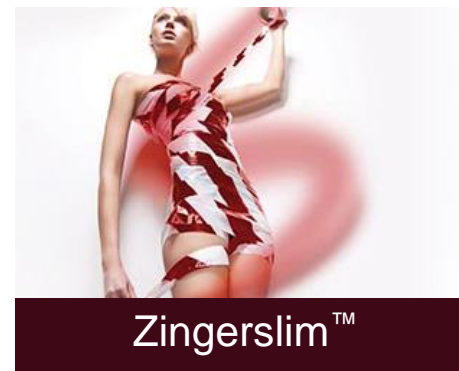
New 2021



Ameyezing™



PoreTect™



Zingerslim™



Apiscalp™



Legance™



NG Shea Unsaponifiable™



Neonyca™

Apium graveolens



Apium graveolens seeds

Celery has been used for a long time in various part of the world. Found in bread on a Neolithic site in Zurich mentioned in the Egyptian texts or on frescoes in Pompeii.

Apium graveolens belongs to the family Apiaceae, all parts can be consumed raw or cooked. Has been used to make various ancestral remedies but has gone out of fashion.

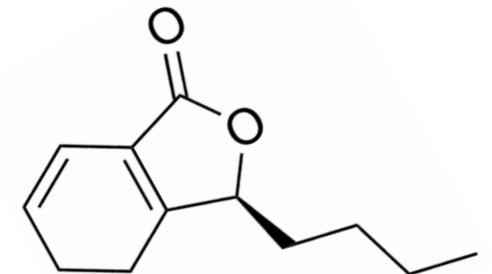
Senkuynolide is a part of a family of molecules whose pharmacological interest is to fight against the harmful effects of stress and age in nerve cells or hepatocytes.



1. Hydrodistillation
2. Hexane
3. Ethanol/Water/Echo sound then solvents
4. Enzymatic
5. CO₂Sc: up to

content

9-12 %
13-20 %
40-45 %
55-65%
71 %



Senkyunolide A

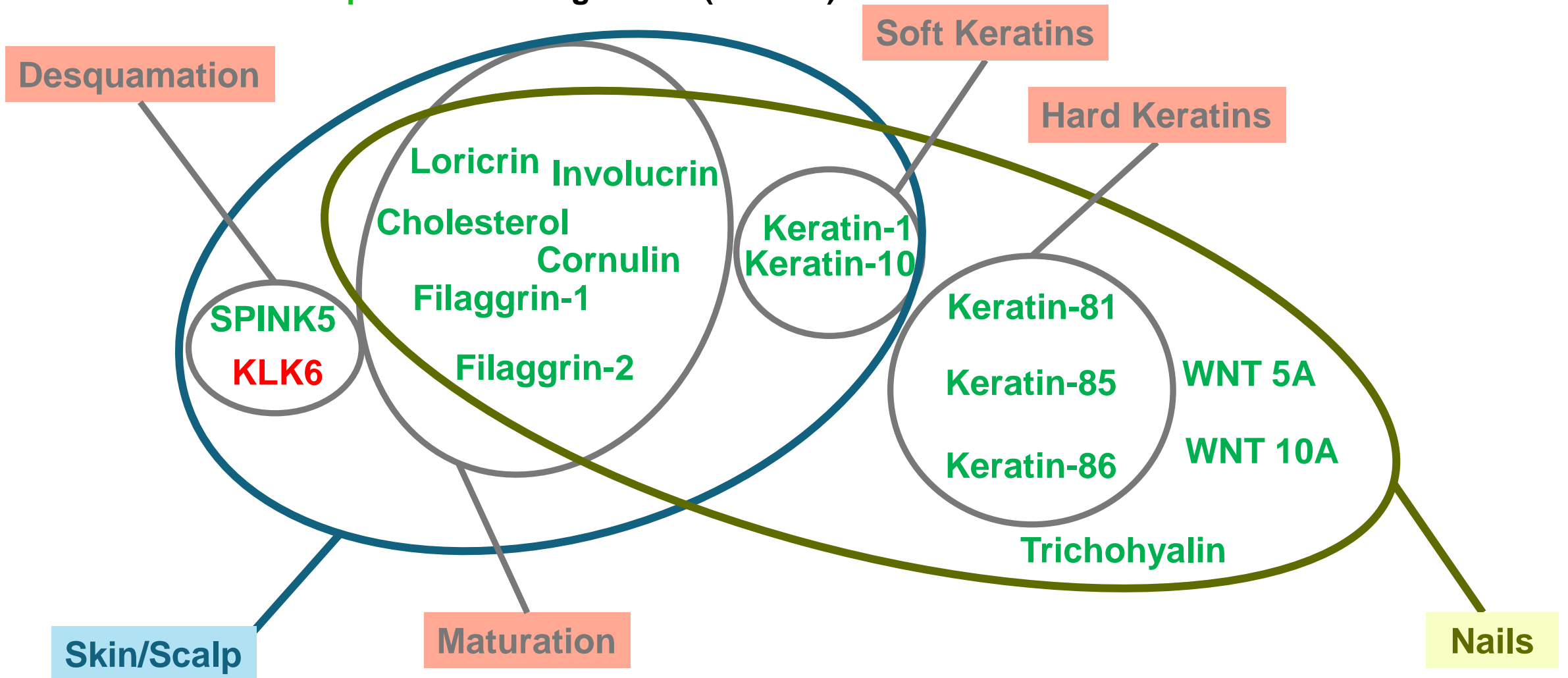
DNA array on keratinocytes culture

Genes **Up-** and **down** regulation (mRNAs)

Loricrin	Involucrin	Filaggrin-1	Filaggrin-2	Cholesterol
Cornulin	SPINK5	Keratin-1	WNT 5A	Trichohyalin
Keratin-10	Keratin-81	Keratin-85	Keratin-86	WNT 10A
KLK6				

DNA array on keratinocytes culture

Genes **Up-** and **down** regulation (mRNAs)





Apiscalp™

Scalp
purity &
comfort



COSMOS
APPROVED

Raw material approved by
Ecocert Greenlife, conform
to the COSMOS Standard

Scalp care

Restoration of the scalp epidermal integrity

– Recovery of the *stratum corneum* integrity

- **Cornified cell envelope:**

Involucrin: x135*, Loricrin: x29.8*, Filaggrin: +91%*, SPRR2B: +139%*

- **Intercellular cement:**

Neutral lipids: x10.5*, Ceramide 2: +107%*, Cholesterol: upregulation

– Regulation of the epidermal maturation

- **Terminal epidermal differentiation:** upregulation of cornulin protein expression

Desquamation: regulation of KLK and SPINK5 protein expressions

Control of the scalp microflora and induced irritation

– Reduction of *Malassezia*-induced irritation

- **Receptors of *Malassezia*:** Toll-like receptor 9 (TLR-9):

-16%* vs placebo

- **Mediators of irritation** (after *Malassezia*-induced stress):

IL-8: -65%* and PGE2: -83%*

– Limitation of the scalp microflora proliferation

- **Restriction of the lipid intake:** - Lipid production: -40%*

- **Antimicrobial peptide synthesis:** - β -defensin 2: +118%*

* $p < 0.01$



Apiscalp™

Scalp
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Scalp care

Purity & Comfort for a happy scalp

VISUAL OBSERVATION (based on scalp macro-photography)

T0



Apiscalp™ T21 days



Volunteer #15

T0



Apiscalp™ T21 days



Volunteer #27

T0



Apiscalp™ T21 days

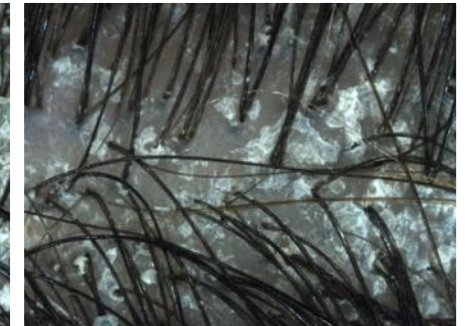


Volunteer #47

T0



Apiscalp™ T21 days



Volunteer #17

Hair treatment with a shampoo and a leave-on, 2% and 3% Apiscalp™, applied at least 3 times/week vs placebo panel (60 volunteers with scalp conditions such as dandruff and itching).



Neonyca™

Nail pampering perfector



Nail care

Solid as a rock, Resilient as a stone, Polished as a gem

Based on the activity of a sCO₂ *Apium graveolens* seed extract, Neonyca™ helps improve **NAIL THICKNESS AND COHESION** while smoothing the nail surface. Moreover, dehydration is significantly reduced. Nails become **BEAUTIFUL AND HEALTHY**.

IMPROVEMENT IN THE NAIL QUALITY

Thickness (Echography & Dermatoscopic camera)

- T1 month.....**+7.2 % up to +56 %**, *p*<0.05/T0
- T4 months.....**+10.9 % up to -71 %**, *p*<0.01/T0

Rehydration (Trans onychial water loss)

- T1 month.....**-3.6 % up to -43 %**, nsd
- T4 months.....**-9.7 % up to -39 %**, *p*<0.05/T0

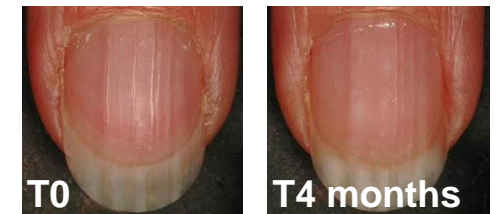
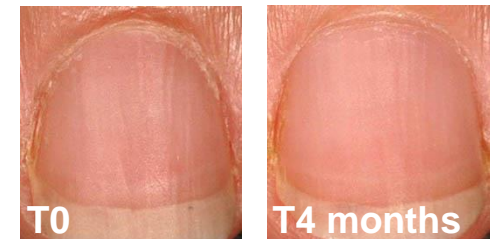
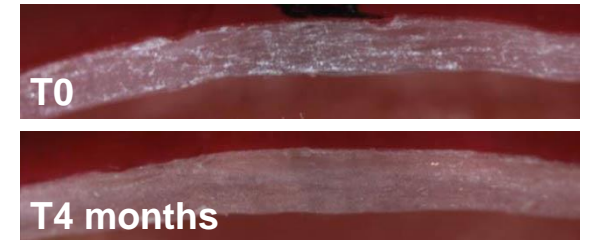
Ridges (Expert assessment)

- Decrease in visible ridges.....**34 %**

Cohesion (Tribometer)

- Force needed to cut the nail.....**+8.2 % up to +89 %**, *p*<0.07/T0

In vivo studies were performed on a total of 31 volunteers who applied a 2 % Neonyca™ colourless nail polish for 4 months 3 times per week.





NG Shea Unsaponifiable™

Skin and lip repair



COSMOS APPROVED

Raw material approved by Ecocert Greenlife, conform to the COSMOS Standard

Nourishing

Golden repair for Sublime lips

NG Shea Unsaponifiable™ soothes the inflamed lips and rebuilds the lip integrity by strengthening the epidermis, **RESTORING THE BARRIER FUNCTION** and **IMPROVING THE MOISTURE LEVEL**.

CORRECT SURFACE AND COLOUR IRREGULARITIES *after 2 days*

- Softness.....**+17%**, $p < 0.05/T0$ up to **+56%**
FOITS method, n=22
- Colour evenness.....**+19%**, $p < 0.01/T0$ up to **+52%**
Newton Technologies, n=25
- Epidermis hydration.....**+28%**, $p < 0.01/T0$ up to **+103%**
MoistureMeter™, n=25
- Cutaneous barrier water loss.....**-21%**, $p < 0.05/T0$ up to **-56%**
VapoMeter™, n=24

45 volunteers (22 to 70 years old), with inflamed and chapped lips applied at least twice a day for 2 weeks a lip balm containing 1,5% **NG Shea Unsaponifiable™**. Study carried out during the winter period.



T0



T2 DAYS

How do your lips feel? *Self-assessment*

- More hydrated.....**100%** of volunteers
- Less chapped.....**96%** of volunteers
- More supple.....**92%** of volunteers
- Softer.....**76%** of volunteers
- Smoother.....**92%** of volunteers

After a 2 day application of a 1.5% NG SHEA unsaponifiable™ balm, a panel of 25 volunteers answered a set of questions.

Zingiber Zerumbet

Plant description

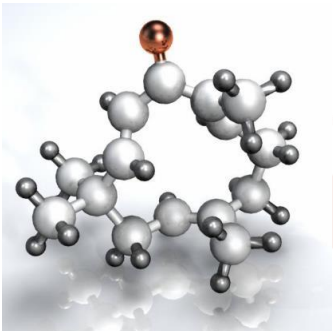
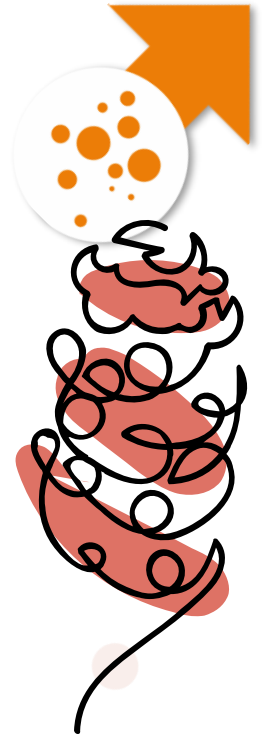
Zingiber Zerumbet Smith commonly known as **wild ginger**, **shampoo ginger**, **bitter ginger** or **pinecone ginger** is an ornamental herbaceous plant native from Asia and belonging to the **Zingiberaceae** wide family.

Leafy and up to 2 m high, it grows wild and can be found in many **tropical and subtropical** countries.

The viscous juice rich in surfactants and obtained from the ornamental inflorescences (pinecones) is famously used in Hawaii, as a **shampoo**.



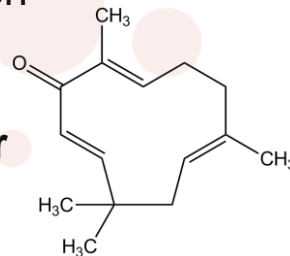
Zingiber zerumbet



Zerumbone

Rich in **terpenoids** (mainly sesquiterpenoids) and **polyphenols**, *Zingiber Zerumbet* has long been used in traditional medicine to cure pain, inflammation, indigestion, poisonous injuries, etc...

Zerumbone is a sesquiterpenoid molecule obtained by supercritical CO₂ extraction of **wild ginger (Zingiber zerumbet)** dried mature rhizomes and solubilised in vegetal butylene glycol.



A responsibly sourced plant for sustainable beauty



Sourcing in the Southern-East region of Madagascar from an Ecocert For Life labelled responsible enterprise.



PLANET

Eco-responsible

- Manual harvesting
- Preservation of the ecosystems (only the adult rhizomes are harvested with official authorisations)

BUSINESS

- Collected in specific bags to ensure quality and to avoid contamination
- Responsible sourcing

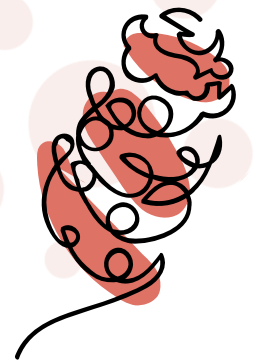
Zingiber zerumbet



PEOPLE

Socially committed

- Non-food ginger
- Support + 2000 families to benefit from additional income
- Fight against malnutrition through school canteens
- Rehabilitation of a maternity hospital
- Construction of a health centre





Fights against dark circles

THE AMAZING BIOCONCEALER FOR NATURALLY BRIGHTER EYES

AMEYEZING™

INCI Name

Butylene Glycol –
Zerumbone

Naturalness according to ISO 16128

Natural content: 0.3 %
Natural origin content: 100 %

Biodegradability

Active ingredient readily
biodegradable in 28 days:
100 %

Use level: 1.5 %

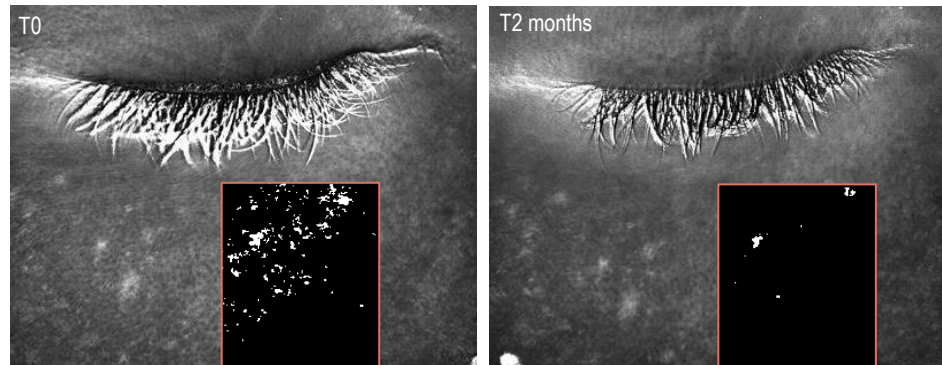
AMEYEZING™ is an eco-socio-designed cosmetic active ingredient, obtained from the supercritical CO₂ extraction of *Zingiber zerumbet* rhizomes. AMEYEZING™ helps improve both **HYPERPIGMENTED** and **VASCULAR** dark circles for a **NATURAL VIBRANT LOOK**.

ENLIGHTENS HYPERPIGMENTED DARK CIRCLES (after 2 months of application)

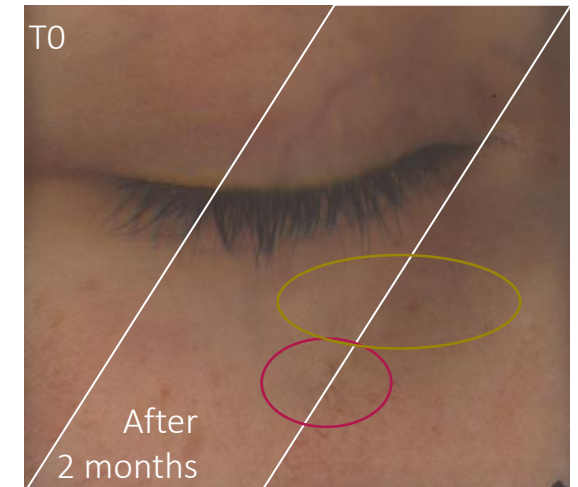
Melanin pigmentation	-10 %/T0 down to -35 %, $p < 0.01$
Colour saturation	-3 %/T0 down to -7.9 %, $p < 0.01$

SELF-ASSESSMENT (after 15 min of application)

“Dark circles are reduced”	73 % respondents, $p < 0.01$
“I look less tired”	86 % respondents, $p < 0.01$
“The eye contour is improved”	79 % respondents, $p < 0.01$
“Eye bags are reduced”	68 % respondents, $p < 0.01$



Vol #21



Vol #21

Sederma (15 female volunteers, mean age 42 [24-65], with hyperpigmented dark circles), 2-month application.
Sederma (25 female volunteers, mean age 55 [43-66], with eye bags), 2-month application with results after 1 month.
Eurofins DermScan (37 male and 74 female volunteers, mean age 42 [19-60], with dark circles and puffiness under the eyes), application for 2 weeks with results after 15 mins of application.



Ameyezing™

Fights against dark circles

REDUCES VASCULAR DARK CIRCLES

(after 2 months of application)

Oxygen saturation +13.6 %/T0 up to +69 %, $p < 0.06$

DEPUFFS THE EYE BAGS

Eye bag volume

after 1 month..... -27.6 mm³/T0 up to -128 mm³, $p < 0.01$

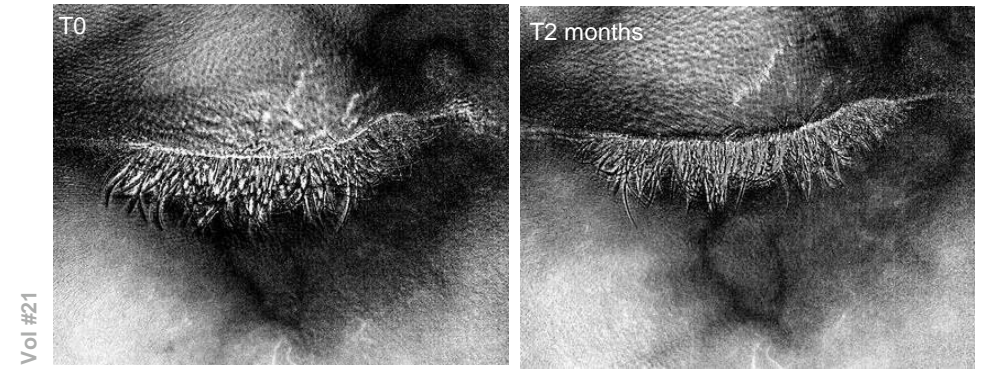
after 2 months..... -40.1 mm³/T0 up to -188 mm³, $p < 0.01$



COSMOS APPROVED

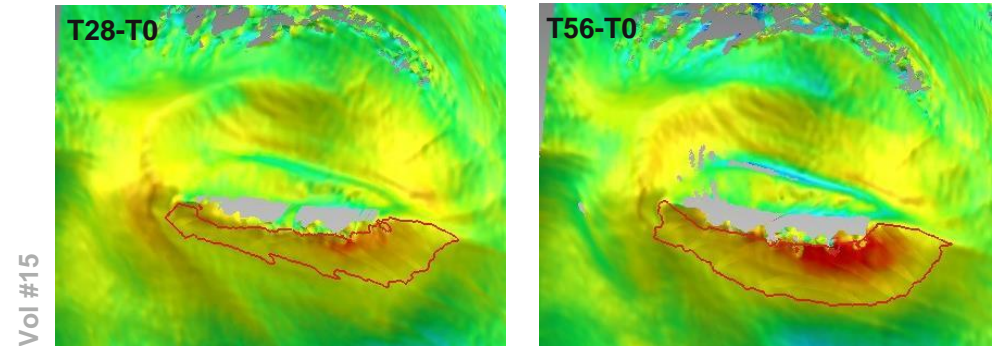
Raw material approved by Ecocert Greenlife, conform to the COSMOS Standard

SpectraCam®



Vol #21

Bio3D Structured-light Scanner Differential images showing the variation between T0 and after the application of AMEYEZING™ 1.5 %



Vol #15

Puffiness variation compared to T0

No change

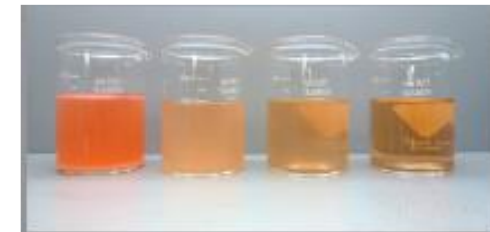
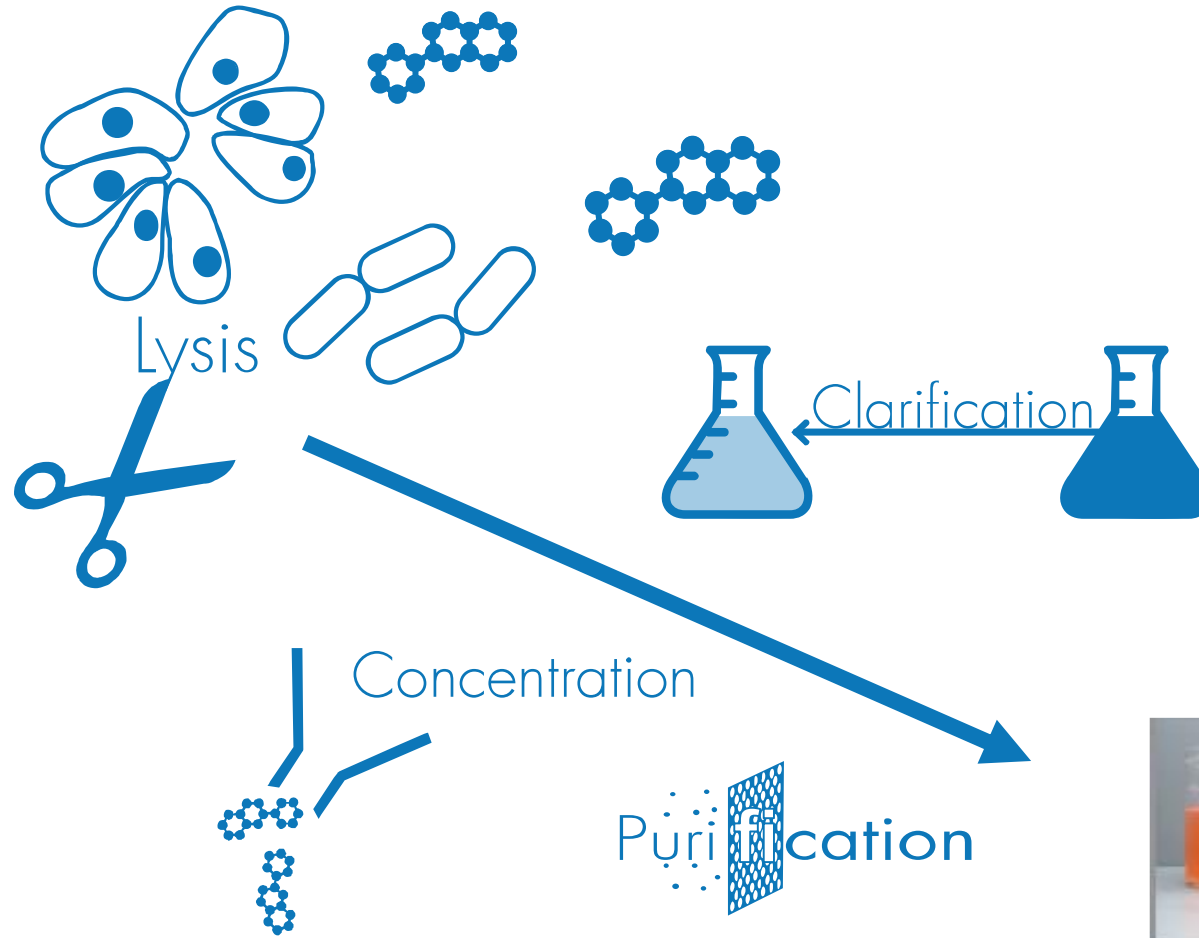
Decrease in puffiness



Increase in puffiness

Area with the greatest reduction

Purification



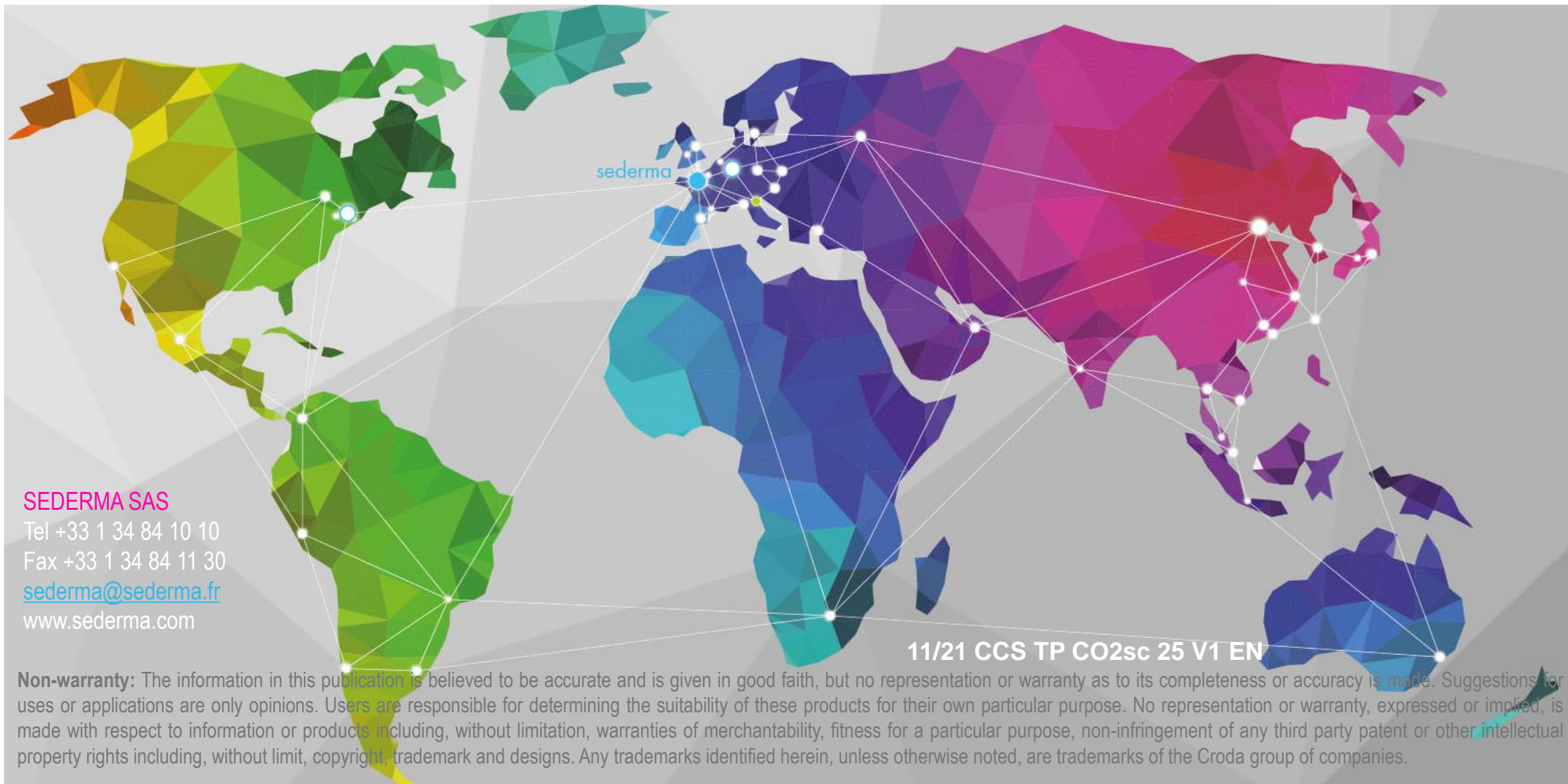
Odour removal by CO₂sc

Conclusion



∞_2SC
Be ACTIVELY
committed

Thank you



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11/21 CCS TP CO2sc 25 V1 EN

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