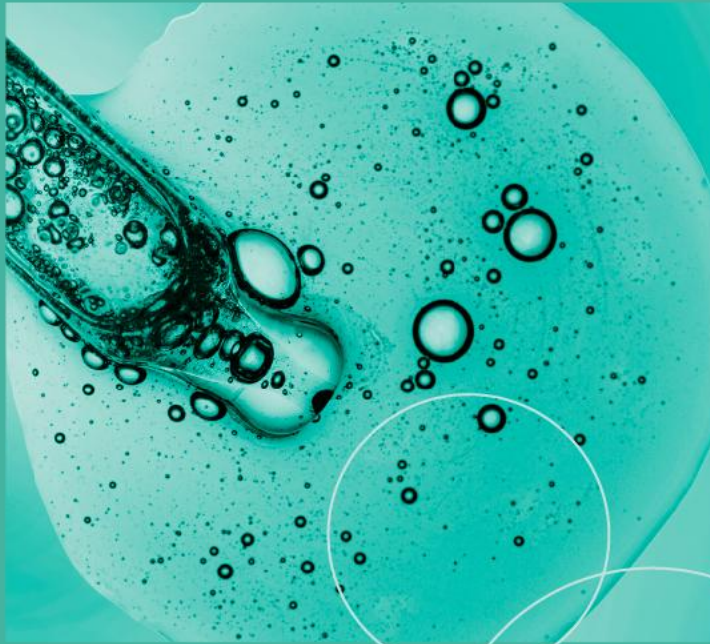
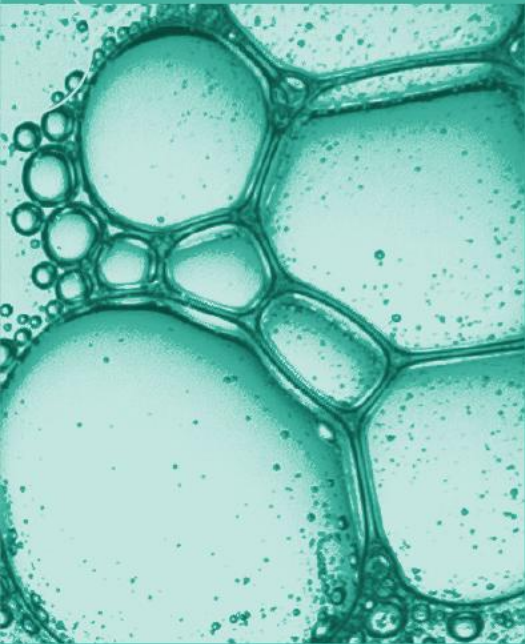


ALPHA-ARBUTIN

Brighten up your uneven skin tone



September 2026

Biotech | Nature, enhanced by science

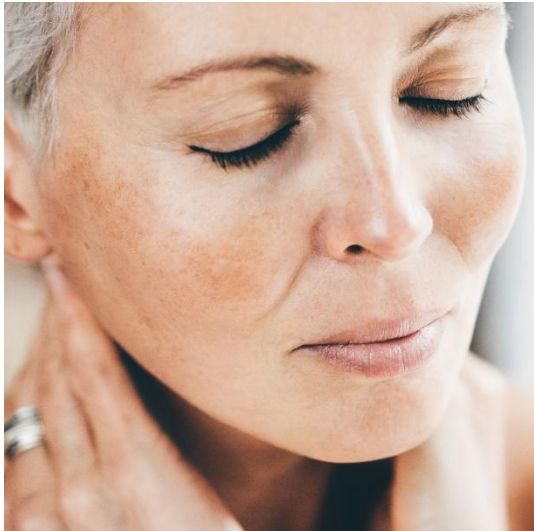


Uneven Skin Tone: A Global Concern



Asia: A Long-Standing Beauty Priority

Across Asia, healthy skin is often associated with a bright, radiant, and even skin tone.



The West: From Brightening to Healthy Aging

In Western markets, reducing age spots and maintaining an even skin tone are increasingly associated with healthy aging.



Pigmentation Irregularities: A Global Skin Concern

Pigmentation irregularities, dark spots, and post-acne marks affect consumers worldwide, making an even skin tone one of the most universal skincare needs.

Broadly, there are 4 main types of pigmentation issues

- **Age spots also known as sunspots or solar lentigines:**
 - Over time as our skin is exposed to UV, and even blue light from the sun and other sources, it is less able to regulate the production of melanin.
- **Freckles**
 - Freckles are small, flat patches of pigment on the skin, caused by genetics or exposure to the sun.
- **Post-inflammatory hyperpigmentation (PIH) marks:**
 - This occurs in response to inflammation in the skin.
 - It's commonly found among acne sufferers and can also be caused by cosmetic procedures such as dermabrasion, laser treatment and chemical peels.
- **Melasma:**
 - Also known as chloasma, melasma is a condition where larger brown or greyish patches of hyperpigmentation develop mainly on the face.
 - Although it can affect both men and women, melasma is most common in women and is thought to be triggered by changes in hormone levels.



Melanin, the vital pigment

- **Melanin is the pigment** that gives our skin its natural color
- **Melanin provides some protection** against UV radiation
 - But melanin alone isn't enough to protect your skin from sun damage. **That's why it's so important to wear sunscreen**
- **Types of melanin**
 - **Eumelanin** is a brown-black pigment, and the most common pigment that we see in skin
 - **Pheomelanin** is a yellow-red pigment, which we typically see in people with lighter skin.
- **Several factors can trigger an increase in melanin production**
 - The main causes are sun exposure, hormonal influences, age, skin injuries and inflammation.



Melanocytes produce the pigment melanin

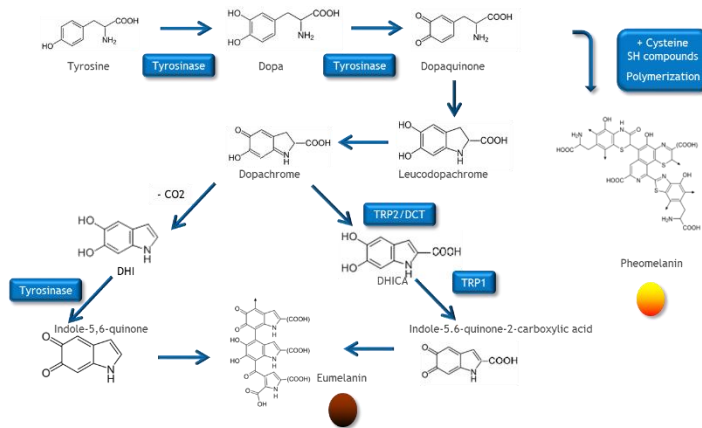
Melanocytes are the cells responsible for production melanin

Melanocytes are part of the basal layer of the epidermis, forming long, finger-like dendrites which reach to neighboring keratinocytes

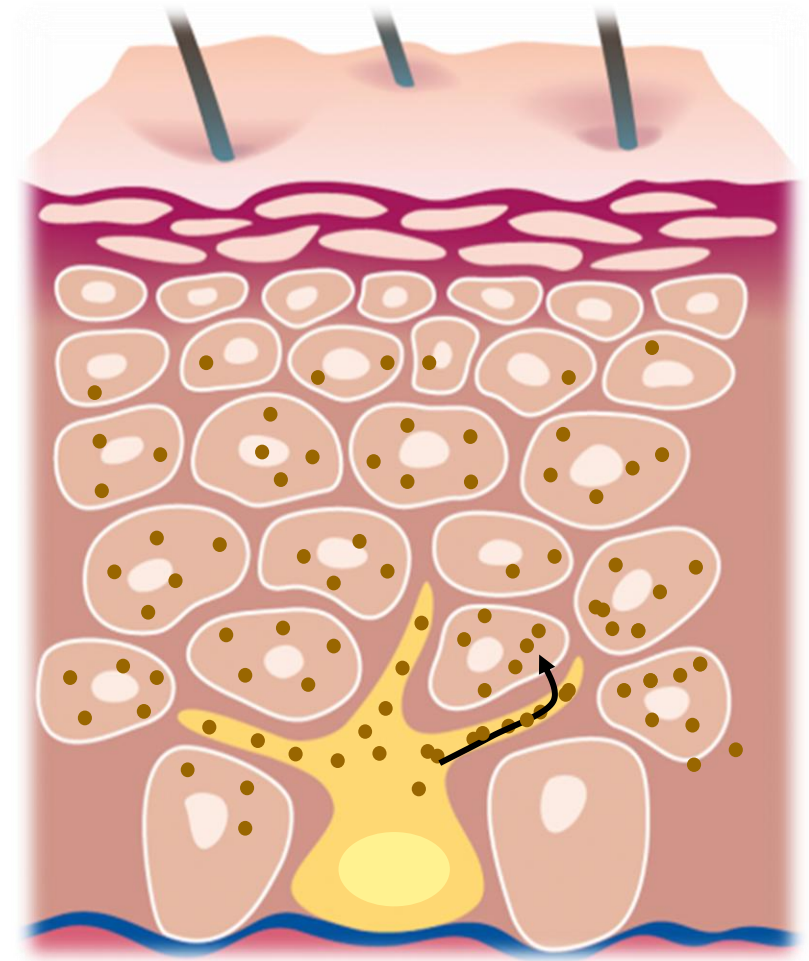
- Melanocytes bear some resemblance to an octopus

Melanocytes produce specific organelles, termed melanosomes (melanin-containing envelopes), in which melanin pigment is synthesized and deposited.

- Melanosomes convert the amino acid Tyrosine in Eumelanin (brown – black) and Pheomelanin (yellow – red)



Once the melanin is formed it is packed into melanosomes, which are then transferred into the adjoining keratinocytes via the dendrites.



ALPHA-ARBUTIN (50 1637 2)

ID Card

INCI NAME:	Alpha-Arbutin		
TECHNOLOGY:	• High performing enzyme related biotechnology, optimized manufacturing process with one enzyme • Highest product quality, purity > 99%, guaranteed absence of hydroquinone ($\leq$ LOQ 3 ppm) • 66% of natural origin (according to ISO 16128), sugar origin: sucrose from sugar cane		
TECHNICAL:	Form: white powder pH of use: 3.5–6.5	Use level: face care up to 2%; body care up to 0.5% Preservative: free	Solubility: water soluble Biodegradability: readily biodegradable
BENEFITS:	• More than 20 times stronger inhibition of tyrosinase than with Beta Arbutin* • More efficient than Ascorbylglucoside* • Has anti-oxidant properties *¹ • Ensures a lighter skin tone after only one month** • Helps to minimize the appearance of dark spots** • Outperforms Hydroquinone and Beta-Arbutin after only one month** • Combination with NIACINAMIDE PC for lighter skin tone, patented* • Combination with NIACINAMIDE PC and REGU®-FADE for lighter dark spots**		
REGISTRATION CERTIFICATION			

* in vitro ** in vivo, ¹Frontiers in Physiology, November 2020 | Volume 11 | Article 586843

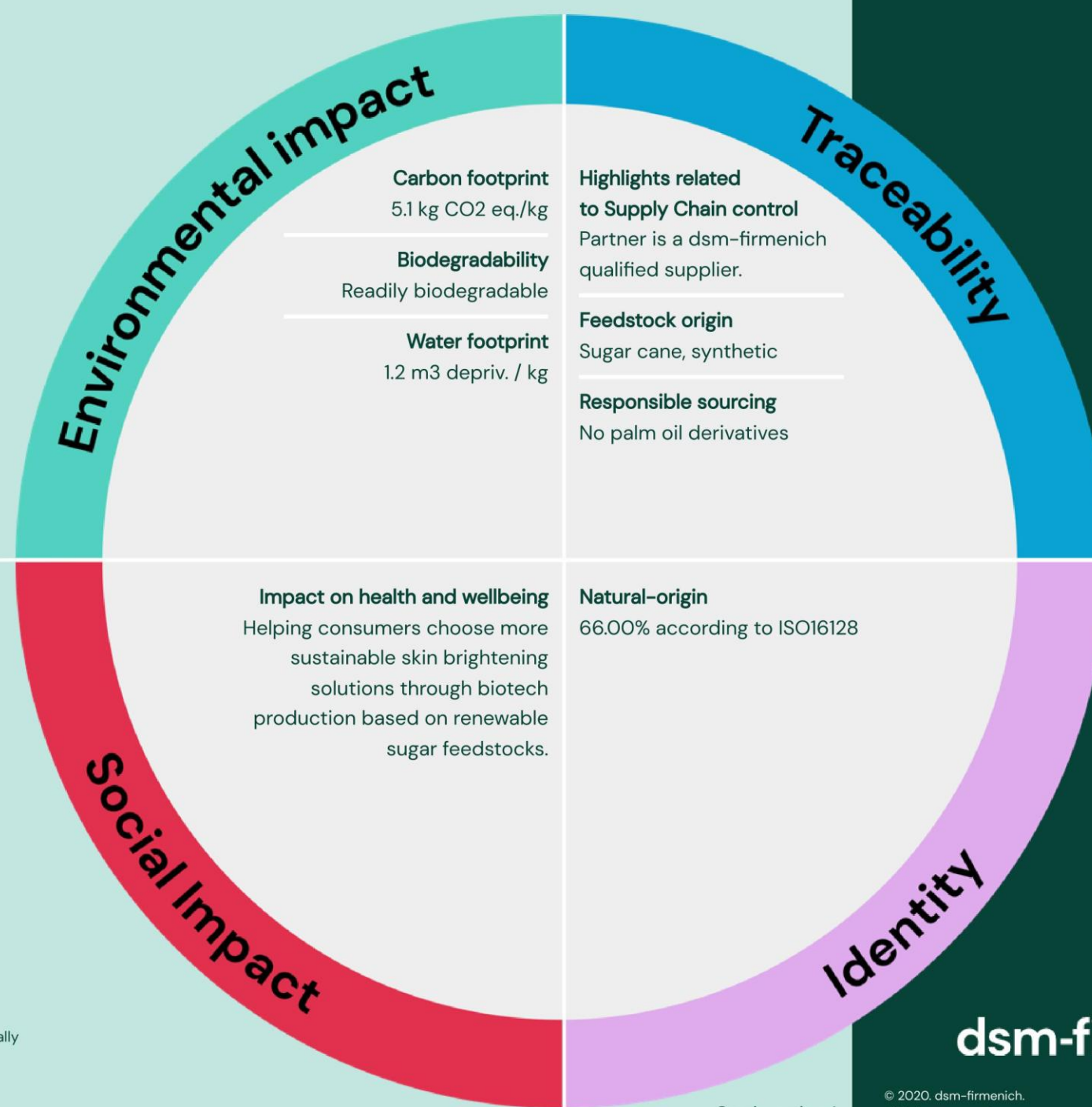
ALPHA-ARBUTIN

INCI name: Alpha-Arbutin

Product codes: 5016372

ALPHA-ARBUTIN is a high-purity, biotech-produced active that helps deliver a brighter, more even-looking complexion with reduced visible age spots.

The carbon and water footprint calculations are based on internally conducted LCA according to ISO 14040/44 guidelines, dsm-firmenich LCA policy and validated by an internal reviewer. The biodegradability is based on relevant OECD tests.



Aligned with and contributing to the
SUSTAINABLE DEVELOPMENT GOALS



dsm-firmenich

Card version 1

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dsm-firmenich PREMIUM ALPHA-ARBUTIN

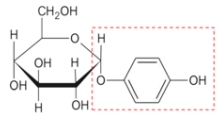
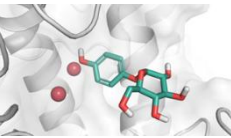
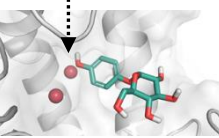
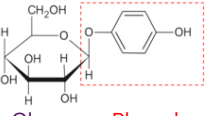
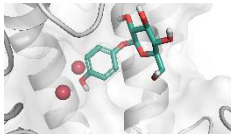
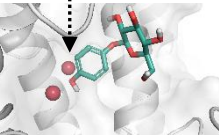
Differentiated solution

KEY DIFFERENTIATORS:	• dsm-firmenich is the pioneer & leader of ALPHA-ARBUTIN • dsm-firmenich ALPHA-ARBUTIN has become a widely trusted ingredient, rated highly for its superior performance • dsm-firmenich made ALPHA-ARBUTIN popular all over the world • High investments in efficacy, safety and market studies to understand the needs of customers and consumers.
HIGHEST PRODUCT QUALITY	• ALPHA-ARBUTIN (50 1637 2): Purity > 99%, guaranteed absence of hydroquinone (< LOQ 3 ppm) • ALPHA-ARBUTIN (50 1637 2): Halal certified • Comprehensive product dossier including all aspects relevant and needed by cosmetic customers • Meets all regulatory and safety requirements in global and regional markets
SUPERIOR EFFICACY	• dsm-firmenich science power demonstrated the superior efficacy of ALPHA-ARBUTIN as Tyrosinase Inhibitor • Outperforms market benchmarks • Even better in combination with NIACINAMIDE PC, patented in India
SAFETY:	• dsm-firmenich has been the only company who responded to the EU calls for data between 2012 and 2022 to demonstrate the safe use of ALPHA-ARBUTIN. Scientific data were generated in various test programs for the submitted dossiers. • dsm-firmenich ALPHA-ARBUTIN is safe for use in cosmetics in a concentration of up to 2% in face creams and up to 0.5% in body lotions assessed by the European Scientific Committee for consumer safety • dsm-firmenich science power demonstrated the stability of ALPHA-ARBUTIN in cosmetic formulations, on the skin surface and on deeper layers.

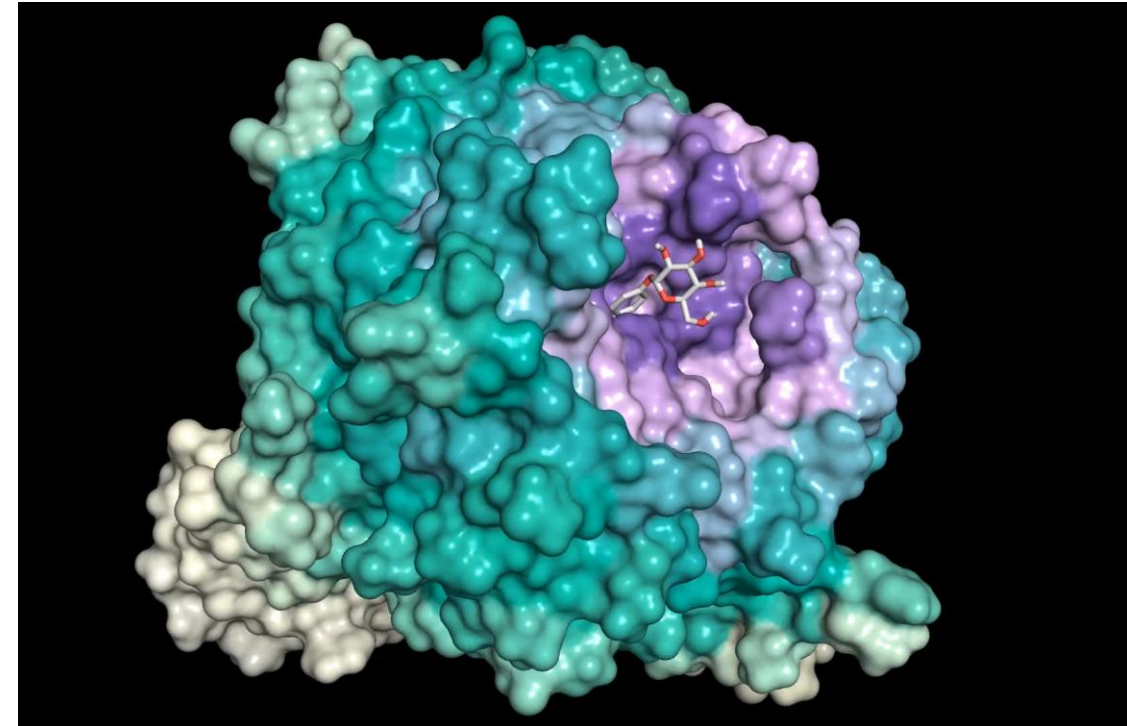
Molecular Docking¹ Study of ALPHA-ARBUTIN as Tyrosinase Inhibitor

Molecular docking results

- ALPHA-ARBUTIN with a strong binding energy ($\Delta G = -2.9$ kcal/mol) shows a similar orientation as the natural substrate L-Tyrosine
- ALPHA-ARBUTIN has the best binding energy of -2.9 kcal/mol, while that of Beta Arbutin is only -2.1 kcal/mol indicating that Beta-Arbutin has difficulties to control melanin
- ALPHA-ARBUTIN has the best orientation to interact in the binding site of Tyrosinase (His85, His244) different to Beta-Arbutin (Gly281)

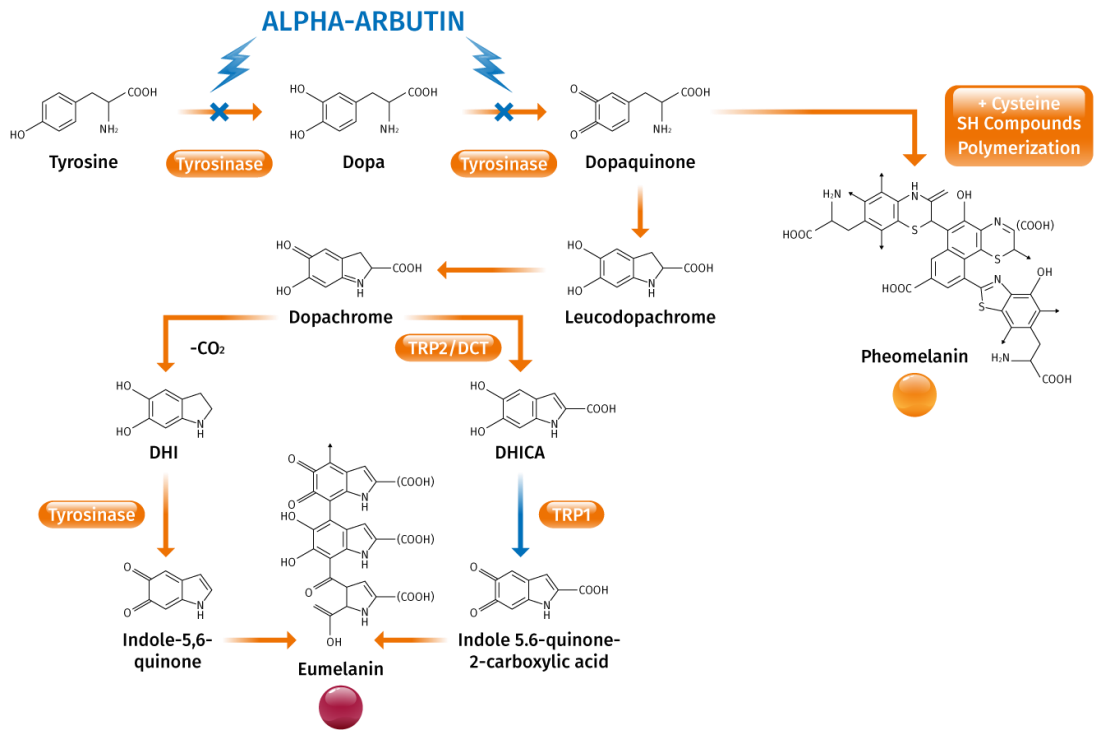
Compounds	Interaction Energy (Kcal/mol)	Tyrosinase Hydrogen-Bonds Interactions	Tyrosinase Intermolecular forces
ALPHA-ARBUTIN  Glucose moiety Phenol moiety	-2.9	His85, His244 	Cu401 
Beta-Arbutin  Glucose moiety Phenol moiety	-2.1	Gly281 	Cu401 

Molecular docking of ALPHA-ARBUTIN as Tyrosinase inhibitor



- The glucose moiety of ALPHA-ARBUTIN forms a strong hydrogen bond network in the binding site of Tyrosinase (His85, His244)
- The phenol moiety of ALPHA-ARBUTIN is close to the Tyrosinase copper (Cu)

More than 10 times stronger inhibition of tyrosinase than with Beta Arbutin *in vitro* dsm-firmenich study



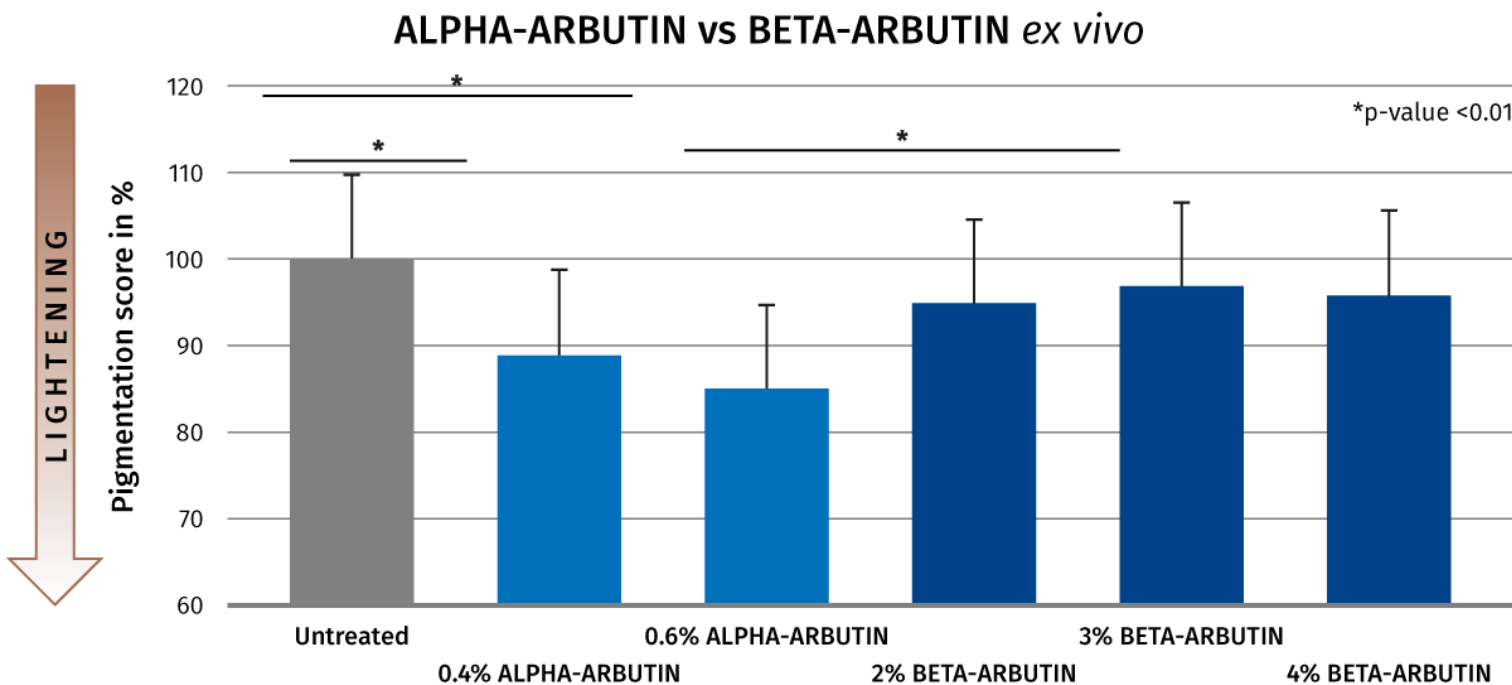
ALPHA-ARBUTIN inhibits tyrosinase activity to regulate melanin production

	MOUSE MELANOMA CELL (B16-F1)	HUMAN TYROSINASE
	IC50	IC50
ALPHA-ARBUTIN	>0.231mM	1.8–2.1 mM
Beta Arbutin	1.874mM	>30 mM

- ALPHA-ARBUTIN exhibits impressive tyrosinase inhibition and is ten times more effective than Beta Arbutin.
- Very low IC50 values indicates the power of ALPHA-ARBUTIN.

Up to 10 times more efficient than with Beta-Arbutin *ex vivo*

dsm-firmenich study



ALPHA-ARBUTIN (0.4%)
is more effective than
Beta-Arbutin (2%, 3%, 4%) after
6 days *ex vivo*

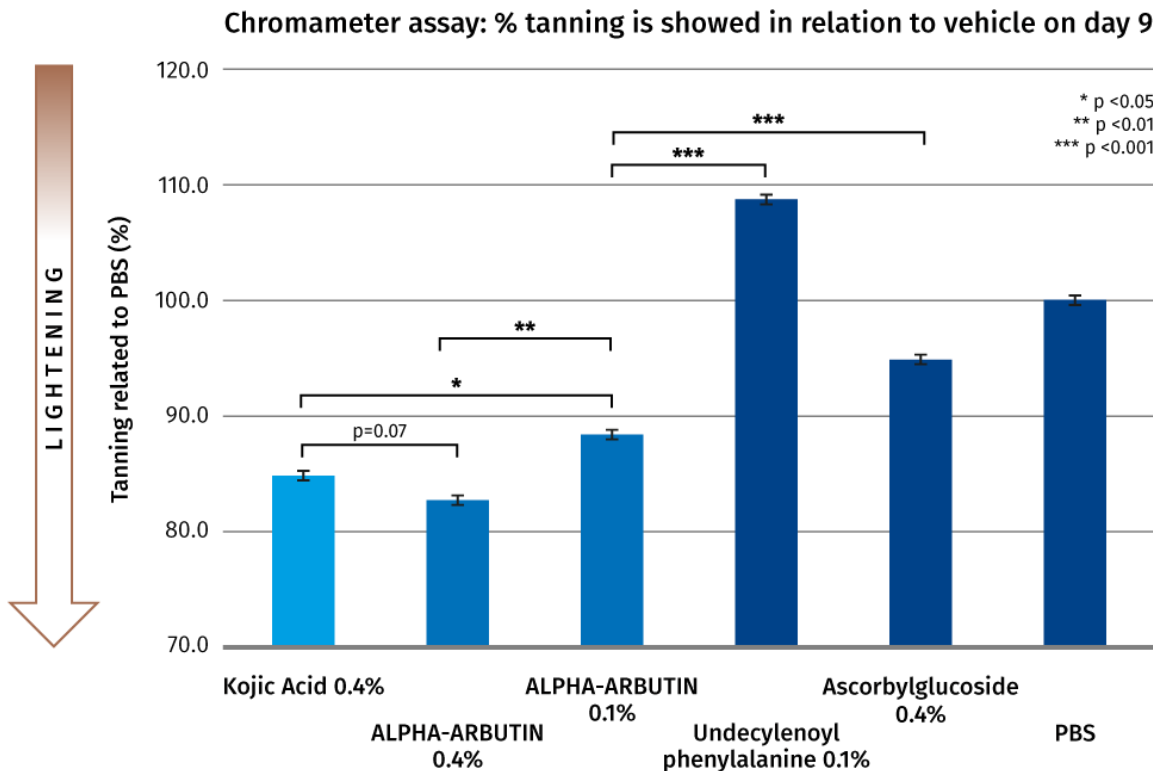
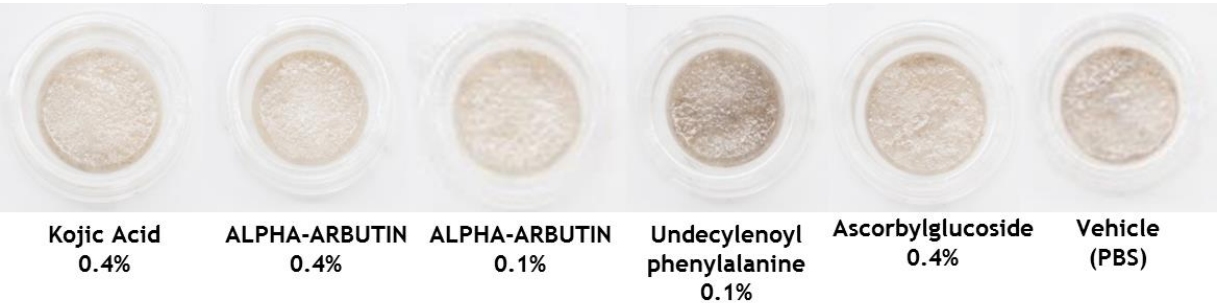
Tested on human abdominal
skin, 35 years old female donor.
Comparison of treatments
versus untreated at day 6

ALPHA-ARBUTIN demonstrated superior brightening efficacy compared to Ascorbyl Glucoside

Study design

- Reconstituted tanned human skin model (epiCS-M, Fitzpatrick skin type V)
- Topical application every second day over a 9-day study period
- Chromameter measurements

Results



ALPHA-ARBUTIN is significant more efficient than Ascorbylglucoside

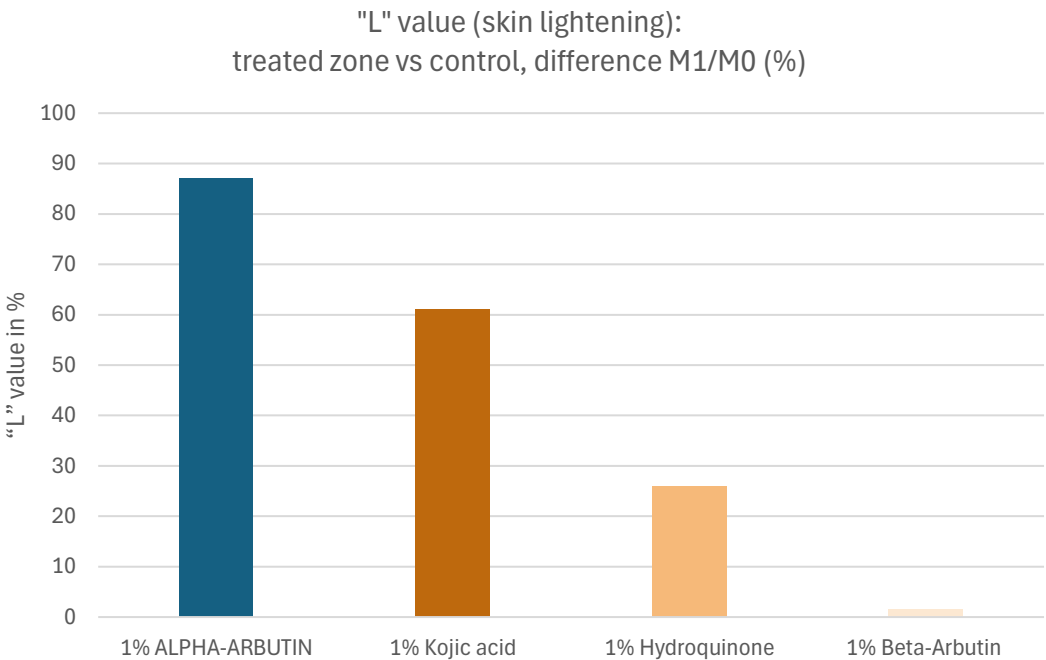
ALPHA-ARBUTIN Outperforms Hydroquinone and Beta-Arbutin in a One-Month Clinical Study

Study Design

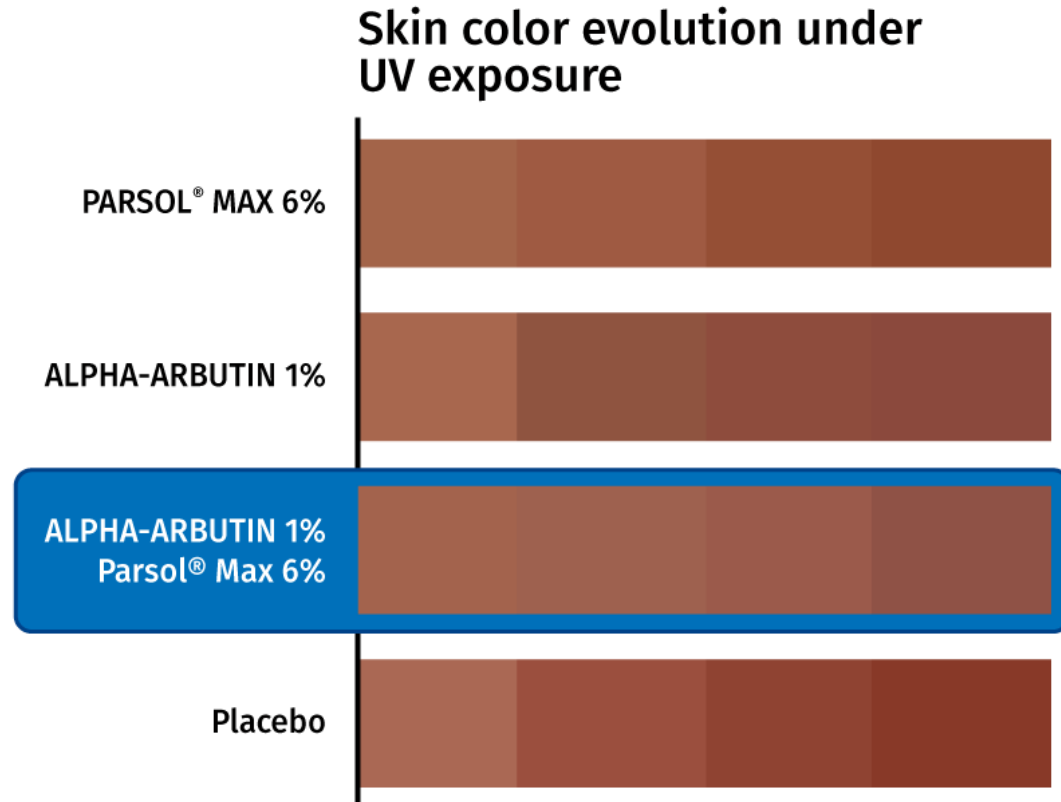
- 80 Chinese female volunteers (25-40 years)
- 1% ALPHA-ARBUTIN, Kojic Acid, Hydroquinone, and Beta-Arbutin evaluated side-by-side
- Twice-daily forearm application for 1 month
- Skin lightness assessed using a chromameter (L* value)

Key Results

- >3× greater skin-lightening efficacy vs. 1% Hydroquinone
- Outperformed Beta-Arbutin



Even skin tone with ALPHA-ARBUTIN and UV-filter *in vivo* dsm-firmenich study



*The figure shows a simulation of the skin colour based on the L*a*b* values.*

- 20 female Asian volunteers, mean age 35 years
- The formulations were applied twice on each volunteer in a dose of 2 mg/cm² once a day 60 minutes before UV stress
- Sun light exposition (< 1 MED) three times each week
- Evaluation time 12 weeks
- Skin Colour was assessed according to the L*a*b* system (CIELAB) with a Minolta spectrophotometer 508i

- ALPHA-ARBUTIN reduces the degree of skin tanning after UV exposure
- Even skin tone with ALPHA-ARBUTIN (1%) and PARSOL® MAX (6%)

*H. Moser, Personal Care July 2005

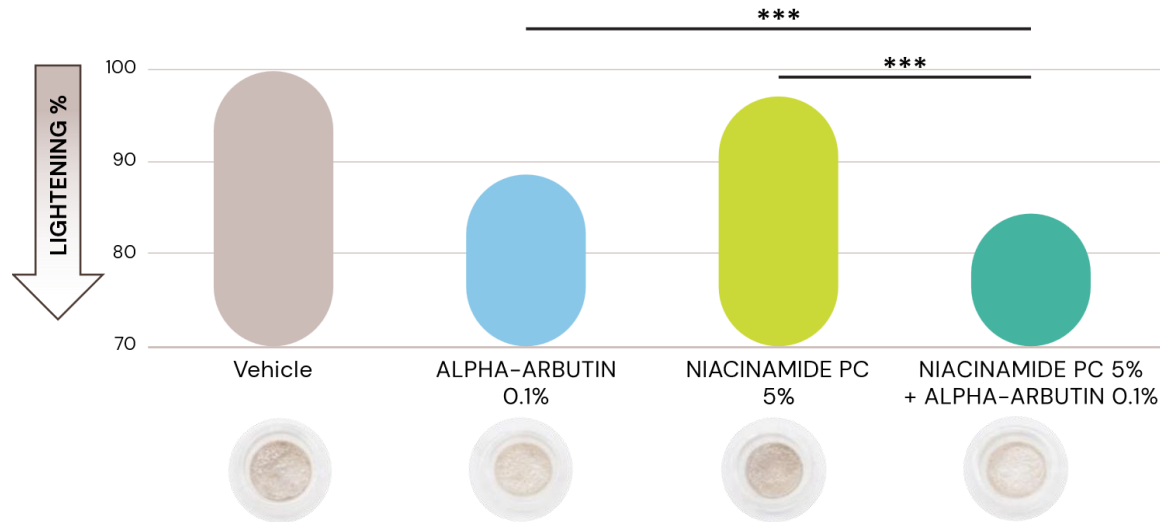
Even better with NIACINAMIDE PC *in vitro* dsm-firmenich study

... due to 2 different levels of actions:

- ALPHA-ARBUTIN directly inhibits the tyrosinase enzyme
- NIACINAMIDE PC inhibits melanosome transfer from melanocytes to surrounding keratinocytes

Tested on reconstituted tanned human skin (Fitzpatrick skin type V)

- Skin lightening was measured with Chromameter



- Visible results
- Significant skin lightening improvement
- **Patented in India**



TRIPLE ACTIVE for lighter dark spots *in vivo*

ALPHA-ARBUTIN + NIACINAMIDE PC + REGU®-FADE

dsm-firmenich study

5 different levels of action for lighter dark spots

- Help to minimize redness^{1,3}
- Act as a strong antioxidant^{1,3}
- Intervening in the pre-melanin synthesis processes³
- Directly inhibiting the tyrosinase enzyme^{2,3}
- Inhibits melanosome transfer from melanocytes to surrounding keratinocytes^{1,3}
- **Dermatologically tested in China**
According NMPA (National Medical Products Administration)
skin whitening standard test (II) in China

¹ NIACINAMIDE PC, ² ALPHA-ARBUTIN, ³ REGU®-FADE



TRIPLE ACTIVE: ALPHA-ARBUTIN + NIACINAMIDE PC + REGU®-FADE

Study design

Study design
according NMPA China⁴ skin whitening standard test (II)

 Single-blind, placebo controlled, randomized clinical study performed in China



- 30 Chinese subjects (test product group)
- 30 Chinese subjects (placebo group) aged from 23 – 58 years old
- Test area: facial age spot areas



- Formulation placebo
- Formulation with 3% NIACINAMIDE PC 0.3% ALPHA-ARBUTIN 0.05% REGU®-FADE

Measuring time points:
DO, Week 2, Week 4, Week 8

	DO	Week 2	Week 4	Week 8
Product application ¹	-	X	X	X
Skin ITA° measurement ²	X	X	X	X
Melanin index (MI) measurement ³	X	X	X	X

¹Product application: twice a day

²Skin ITA° (lightening) characterizes human skin color by measuring skin L*a*b* data with a skin colorimeter

³Melanin index (MI) is an optical skin parameter related to the melanin content in the tissue. It can be measured by spectrophotometry (Melanin meter)

⁴NMPA (National Medical Products Administration) China

TRIPLE ACTIVE: ALPHA-ARBUTIN + NIACINAMIDE PC + REGU®-FADE

Significant lighter age spots*

After 2 week

- +6% lighter age spots
- -3% melanin

After 4 weeks

- +23% lighter age spots
- -5% melanin

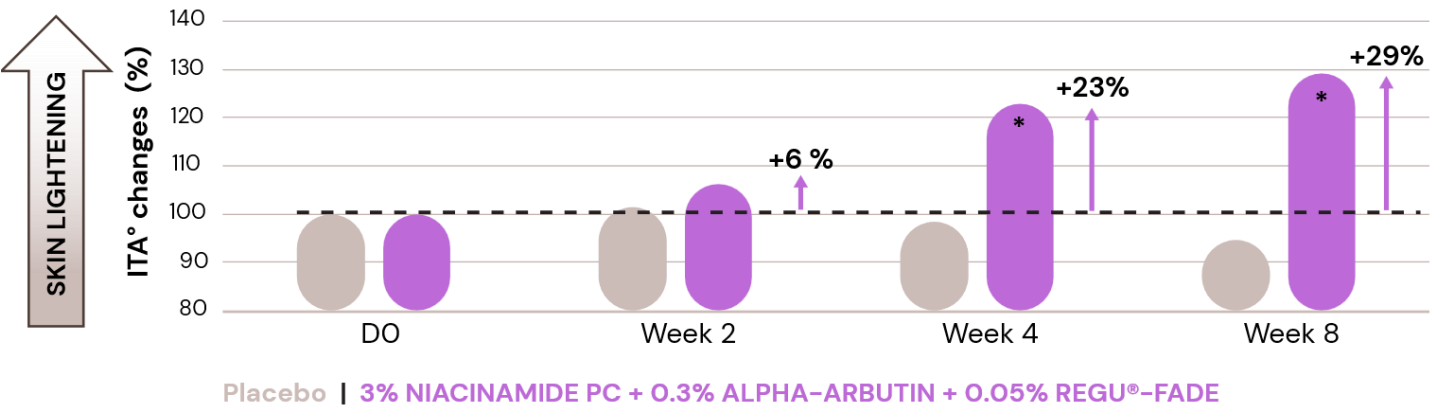
After 8 weeks

- +29% lighter age spots
- -9% melanin

Significant results

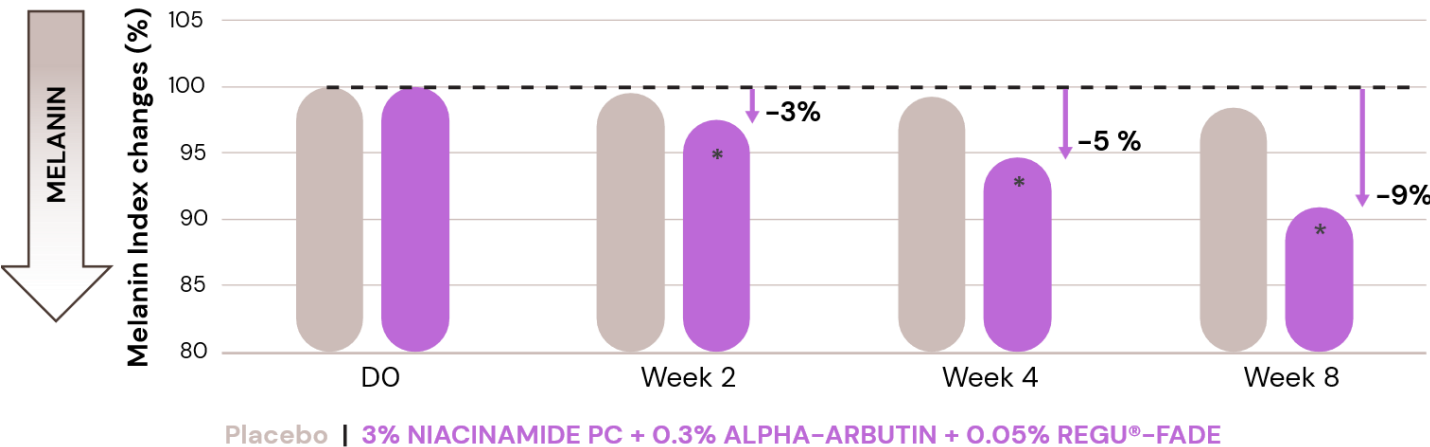
Evolution of ITA°changes (%)

* P < 0.05 compared to control



Melanin Index changes (%)

* P < 0.05 compared to control



* in-vivo

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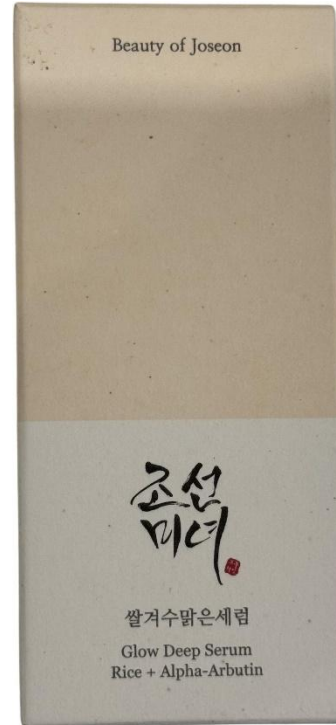
We bring progress to life

Innovative approaches with ALPHA-ARBUTIN to combat dark spots ...



Target dark spots and uneven skin tone

- Visible results with **Alpha Arbutin 2% + Hyaluronic acid**
- Highly concentrated formula
- Support absorption into the skin.



Fade dark spots & skin barrier strengthening

- Top Korean skincare brand, that **combines traditional with modern ingredients.**
- **Featuring 68.6% Rice Bran Water**, long known for its skin beautifying effect throughout Korean history, it will help to nourish and **strengthen the skin barrier**, while **brightening and clarifying.**
- **2% ALPHA-ARBUTIN** included in this serum **helps to fade dark spots and prevent hyperpigmentation.**