

STAY-C® 50

*The all-round naturally
derived beauty solution for
skin perfection*

November 2022



Agenda

Revealing the power of vitamins for beauty care



Click on the number to get redirected to the chapter

1

DSM in the sustainable vitamin c journey

2

Consumers & customers insights

3

STAY-C® 50 in formulation

4

Scientific evidence

5

Comparison among different forms of vitamin C



DSM in the Sustainable Vitamin C Journey

Our promise

DSM in the sustainable Vitamin C journey

The vitamin pioneer & leader

DSM – A leader in the vitamins journey

- As the longest-standing producer of vitamins in the world
- First to explore the beauty of potential of vitamins
- **1936** - It was at today's DSM's site in Grenzach, Germany, that vitamin C has been first industrially produced



Vitamin C industrial production, Grenzach, 1936



Today, DSM remains fully committed to explore the beauty potential of our vitamins further.

- **Comprehensive portfolio:** Full range of 13 vitamins, including the most demanded forms for cosmetics
- **Leading production capabilities:** DSM high commitment to keep technology leadership at best value for money



Sustainability Imp'Act Card™

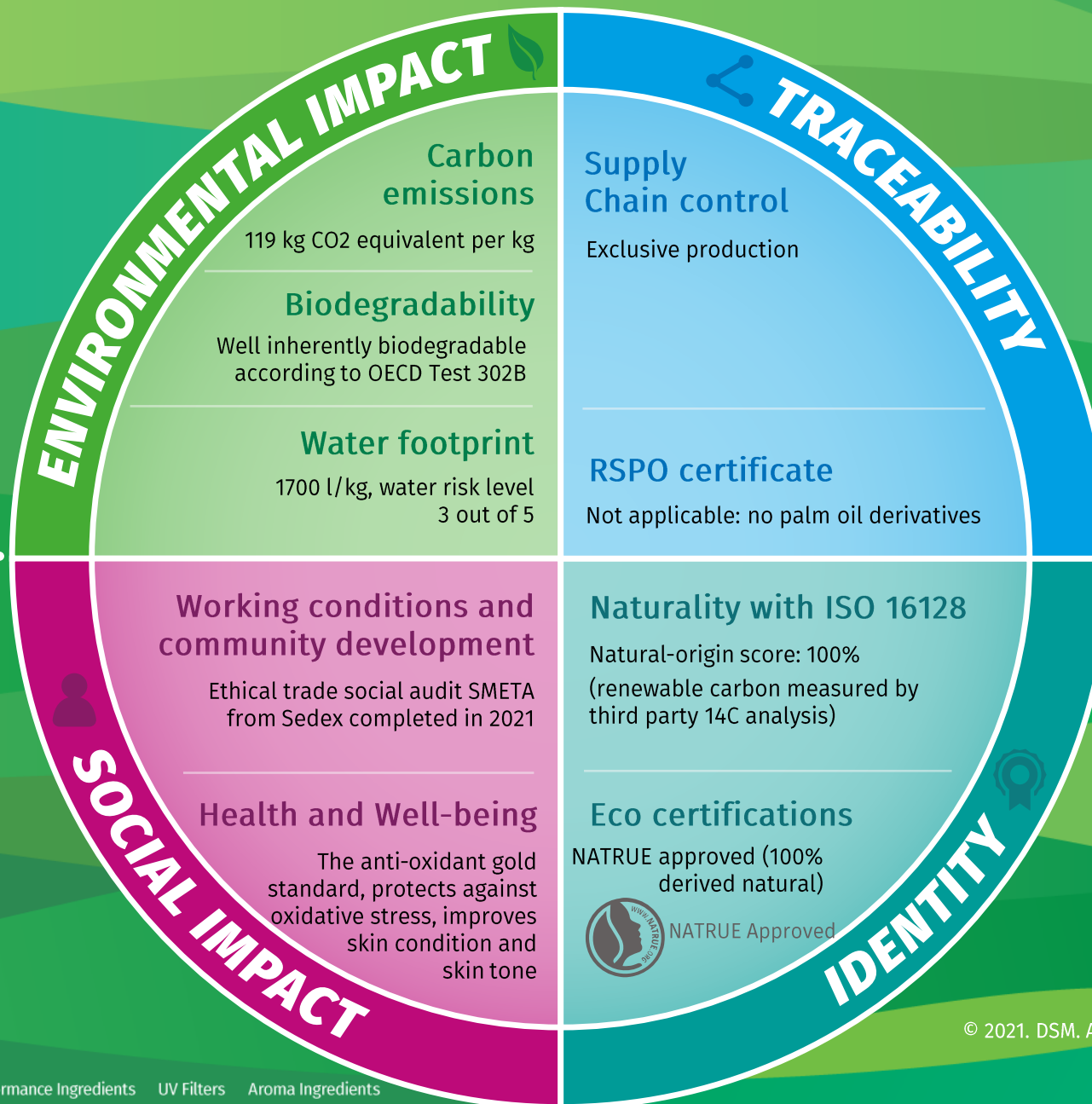
STAY-C® 50

STAY-C® 50

The stabilized form of vitamin C,
anti-oxidant gold standard

Vitamin of natural origin

INCI name: Sodium Ascorbyl
phosphate
Product Code: 5016285
card version1



Aligned with and contributing to the
SUSTAINABLE DEVELOPMENT GOALS

3 GOOD HEALTH AND WELL-BEING



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Personal Care & Aroma Bioactives Technical & Performance Ingredients UV Filters Aroma Ingredients





Consumer & customer insights

Vitamin C: the eternal hero ingredient in beauty

Magazines and blogs are giving full visibility to Vitamin C still in 2022

allure

The Best Vitamin C Serums, Moisturizers, and More For Brighter Skin

The experts have spoken, and this list of vitamin C-spiked serums, face masks, and moisturizers is sure to leave your skin happy and bright.

BY KALEIGH FASANELLA, LORI KEONG, AND ANGELA TRAKOSHIS
September 18, 2022



VOGUE

BEAUTY

How to Build Vitamin C Into Your Skin-Care Regimen

BY LAUREN VALENTI
August 13, 2021

For brightening up a dull complexion and erasing sun spots, vitamin C is the gold standard of ingredients, especially as the years go on. As such, getting familiar with the powerhouse antioxidant is essential for any robust skincare strategy. “Vitamin C is perhaps the most potent topical antioxidant we have,” explains dermatologist Joshua Zeichner, M.D., of the

Vitamin C serums are one of the most talked-about beauty buys at the moment.



INDEPENDENT

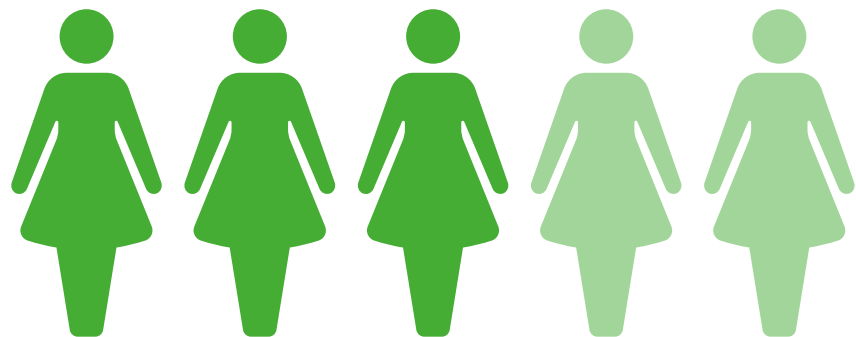
14 best vitamin C serums promising to brighten skin, reduce wrinkles and prevent sun damage



Vit C: the most googled skin care ingredient of all time

Vitamins are associated with good health and trusted by consumers*

3 out of every 5



women know that vitamins are in cosmetic products*



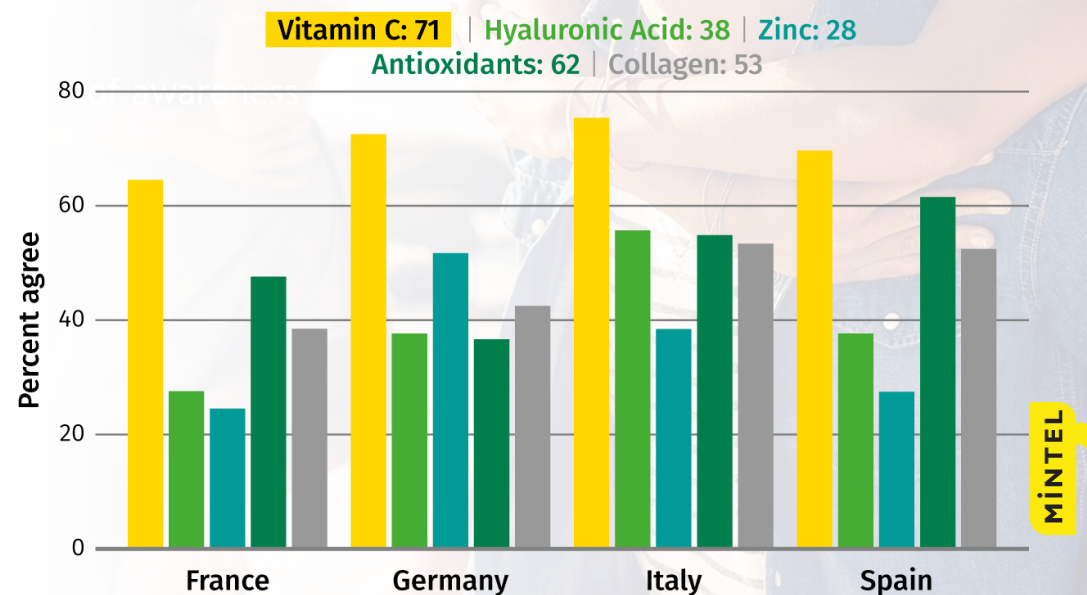
In the past years, there was an increase of 32% (to 52%) of women being aware of Vitamin C being used in cosmetic products*

* DSM PCA Vits study, Jan 2016. Global – N=1600, USA – N=400, France – N=400, China – N=400, Japan – N=400 – All females, National representation of age

..and awareness of vitamin C is much higher than other beauty-boosting actives (European consumers)!



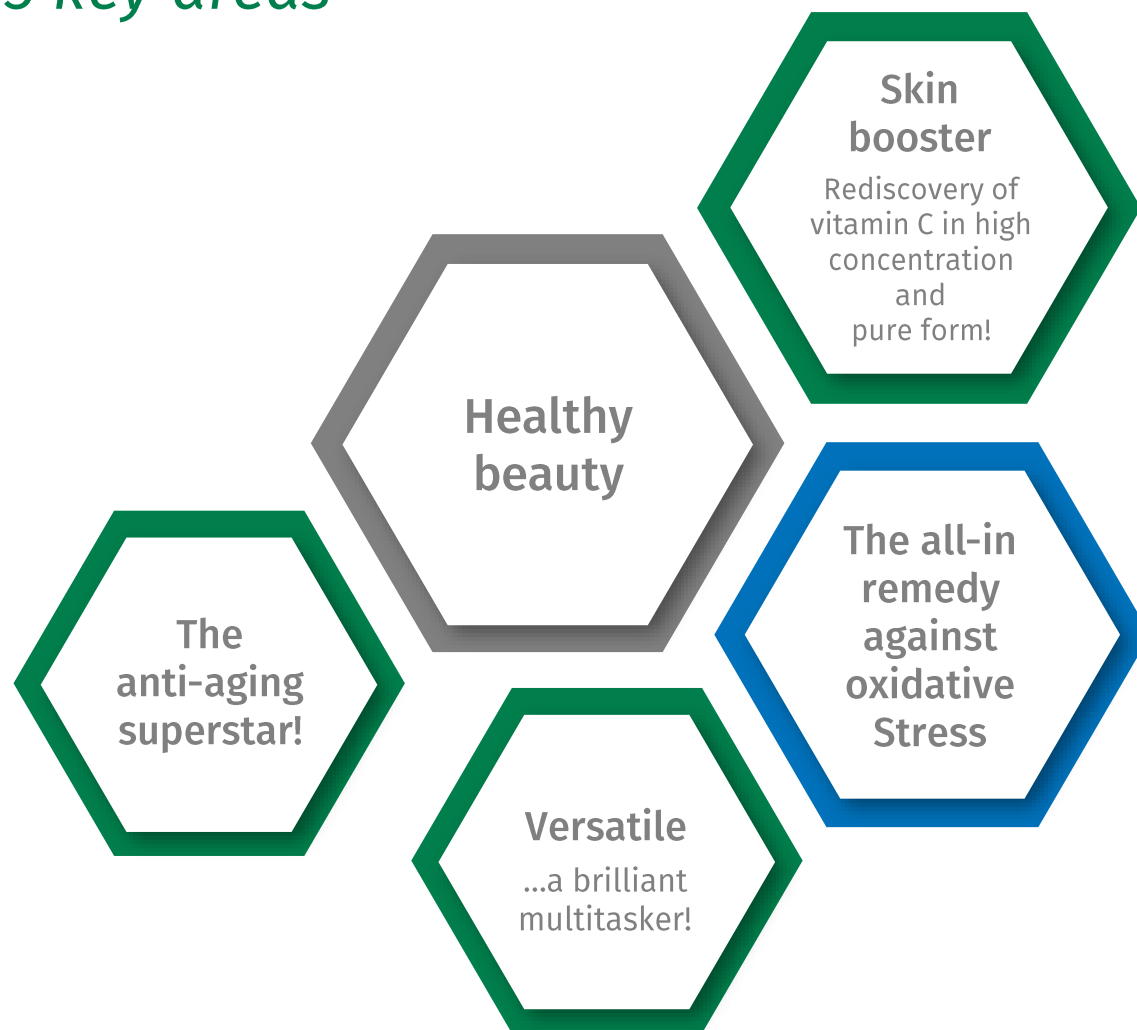
Of consumers aware that vitamin C promotes the appearance of skin, hair and nails, in selected country, 2015



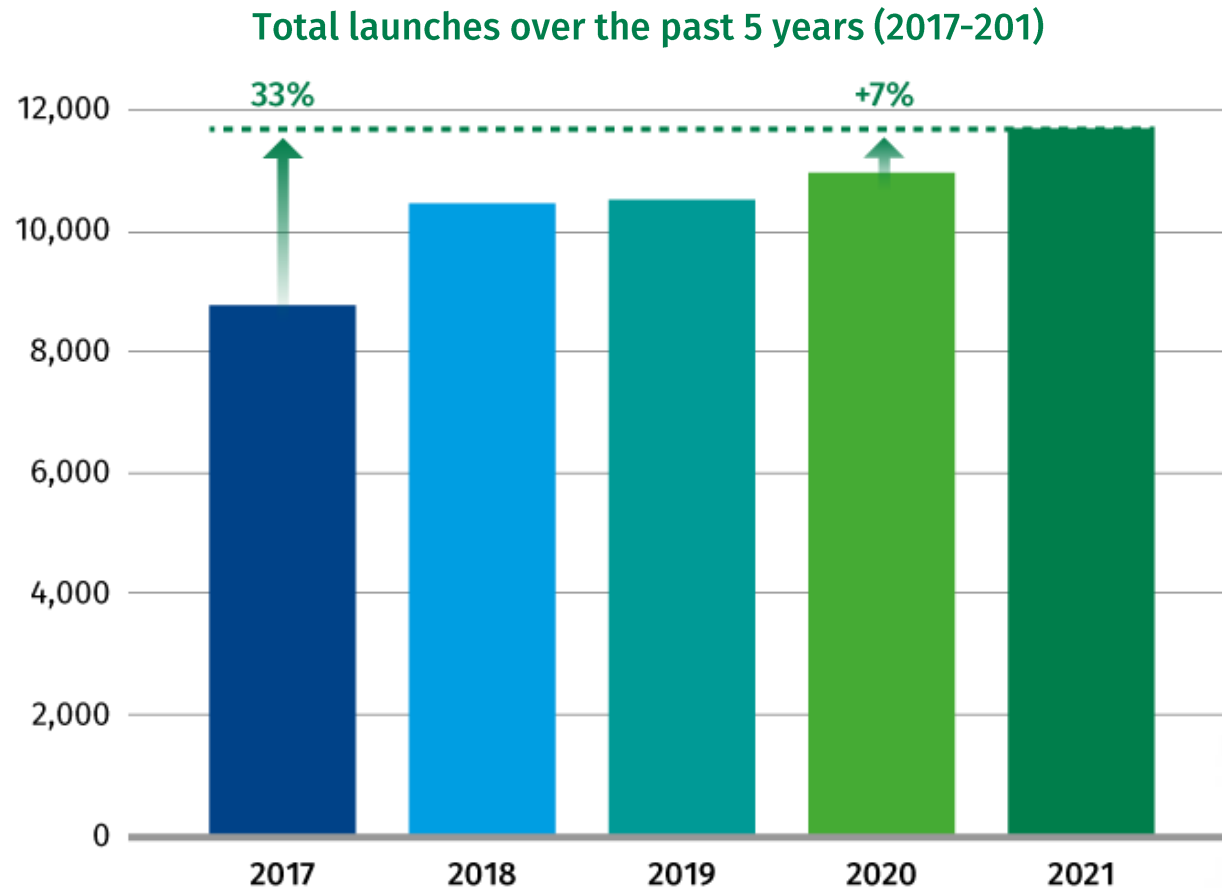
Base: 1000 internet users aged 16+ in each country. Source: Lightspeed/Mintel

Consumers perception of Vitamin C benefits on the skin

5 key areas



Launches with Vitamin C derivatives for Beauty and Personal care increased by 33% in 2021 compared to 2017



Worldwide, 1 product over 15 contains Vitamin C

Latest launches:

high concentration of Vitamin C in serum is still very trendy!

**Cetaphil: healthy radiance
antioxidant-c serum**



10% Sodium Ascorbyl Phosphate

**Nivea: Instant recharge
sheet mask**



Sodium Ascorbyl Phosphate

**Dr Pierre Ricaud: Glow
cream with Vitamin C
and Niacinamide**

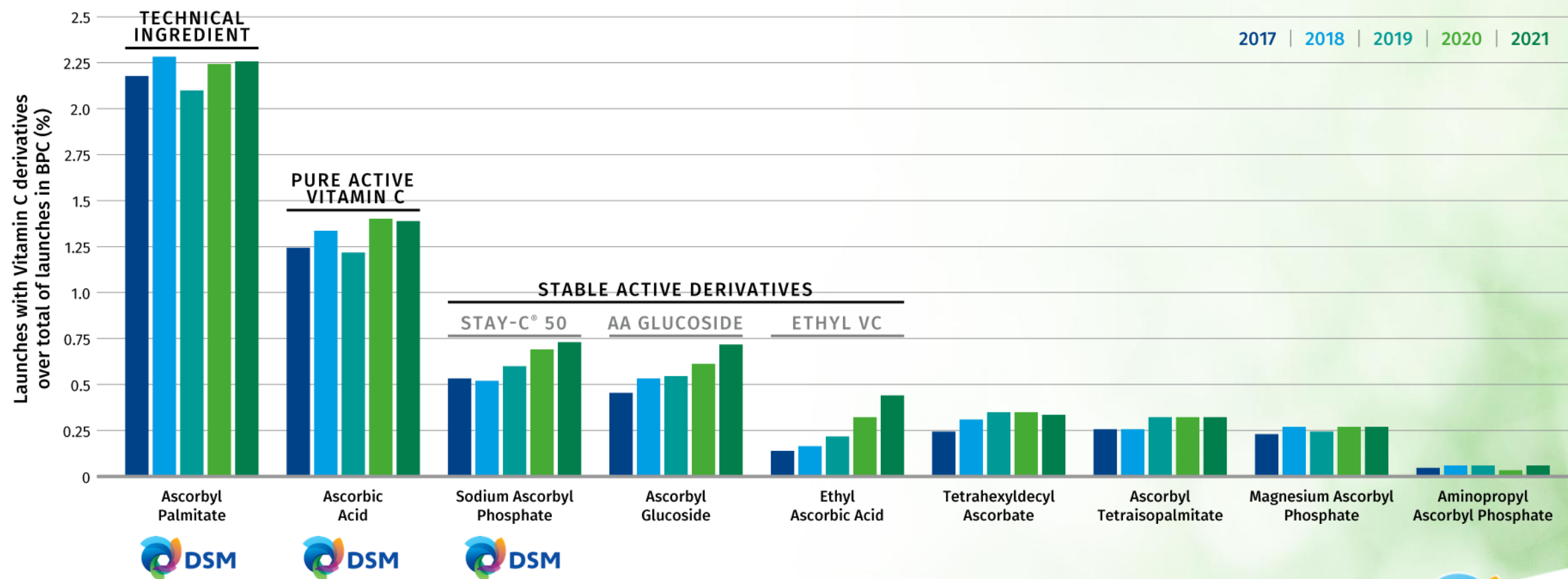


Sodium Ascorbyl Phosphate

The number of launches with Vitamin C is growing

Continuous growth between 2017–2021, with a total penetration rate of 6.2%!

Strong growth for stable forms such as Sodium Ascorbyl Phosphate, Ascorbyl Glucoside and Ethyl Ascorbic Acid





STAY-C® 50

DSM naturally derived active ingredient to deliver vitamin C efficiently into the skin

Formulation tips

Vitamin C at a glance

Our body needs Vitamin C from external source

- Vitamin C is Ascorbic Acid in different forms
- **Vital functions** for life
- Humans are **unable to synthesize** Vitamin C and therefore rely entirely on **external supplementation** such as topical application
- Vitamin C is the **most abundant anti-oxidant in the skin**
- Exposure to oxidative stress via pollutants or UV irradiation provokes Vitamin C depletion in the epidermis
- **Even high dose oral supplementation does not provide the sufficient amount of Vitamin C into the skin**

➔ We need topical application with Vitamin C to afford skin benefits!

Juliet M. Pullar. *Nutrients* 2017, 9(8), 866

To ensure better stability of Vitamin C, DSM developed STAY-C® 50

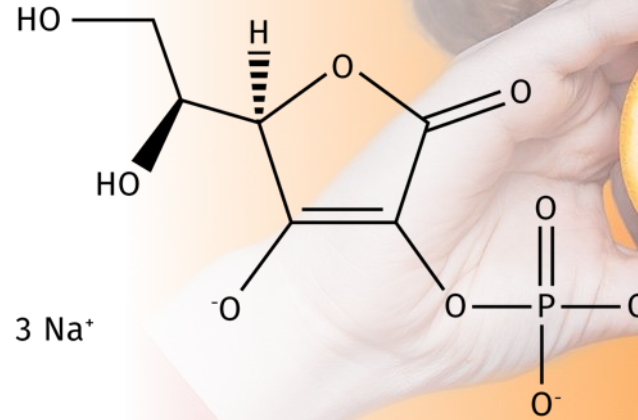
SODIUM ASCORBYL 2-PHOSPHATE: STAY-C® 50

Stable, water soluble cosmetic Vitamin C specialty

100% naturally derived (based on renewable carbon)

Fully bio-converted into ascorbic acid in the skin

Powerful antioxidant and multi-talented active



Vitamin C grades	Product code	Form	 NATRUE Approved	ISO 16128 natural origin index	DSM House of Naturals				
STAY-C® 50*	50 0858	Stable, water-soluble form Powerful antioxidant and multi-talented active	•			•	•	•	•

STAY-C® 50 – Benefits vs other derivatives

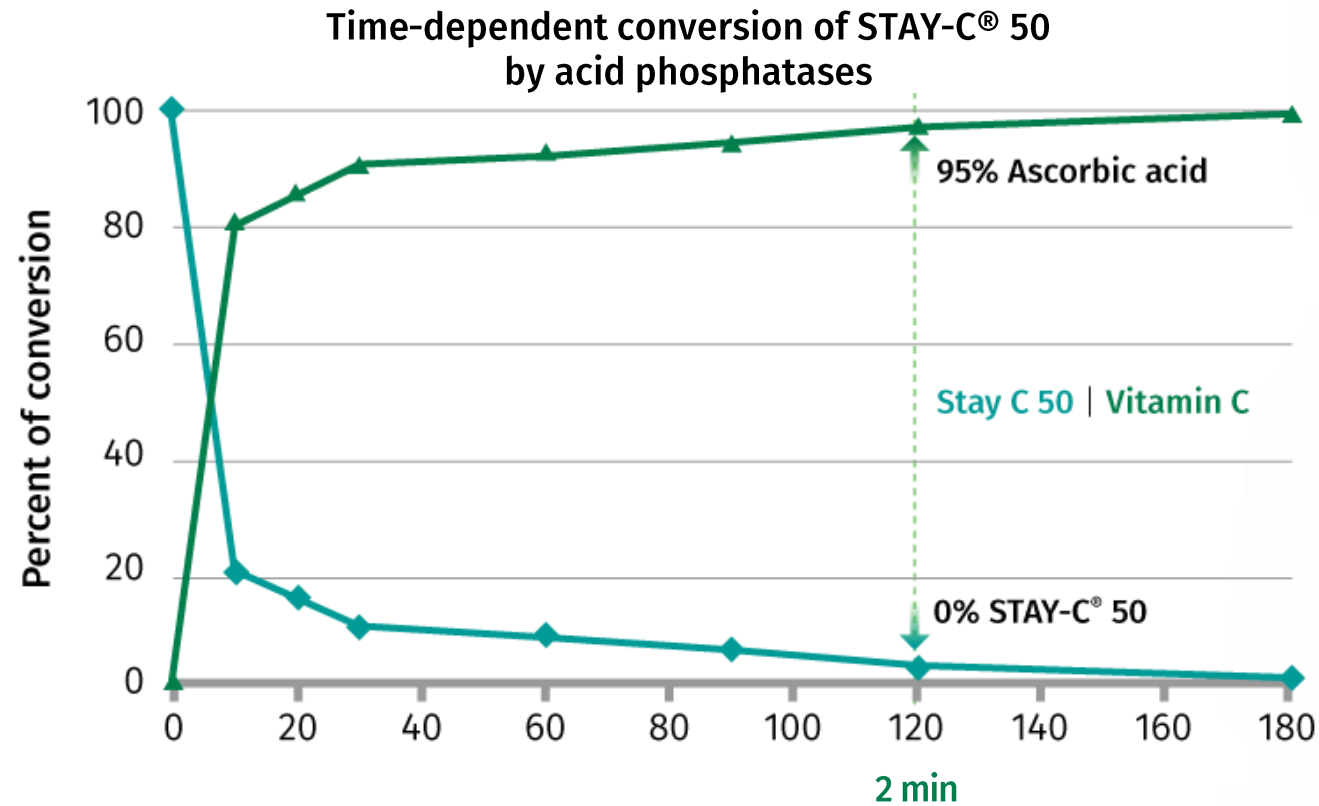
Our stable cosmetic Vitamin C specialty

- Good **skin penetration**
- **Proven conversion** into the active form ascorbic acid
- **A multi-talent beauty remedy** addressing almost every skin concern from acne to UV damage...and its **activity is proven!**
- **Overperformance in melanin synthesis inhibition and antioxidant properties** vs other derivatives
- **Stable in aqueous** environment
- Easy to formulate
- Only derivative with use level **up to 15%**
- Approved quasi-drug active ingredient for whitening products in Japan

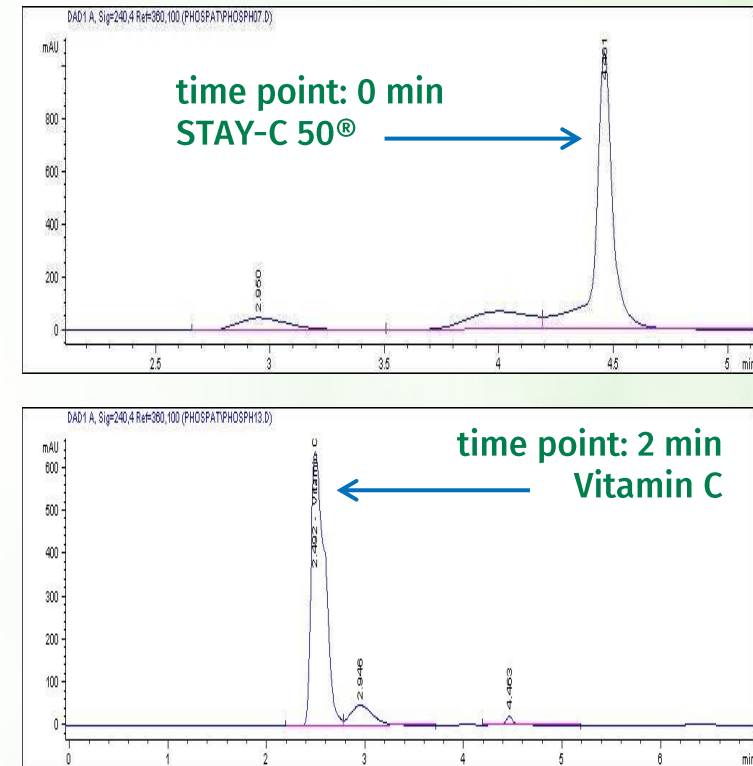
STAY-C® 50 – Two steps to be active

1) *bio-activation*

Acid phosphatases are able to bioactivate about 95% of STAY-C® 50 into ascorbic acid within 2 minutes



HPLC chromatogram



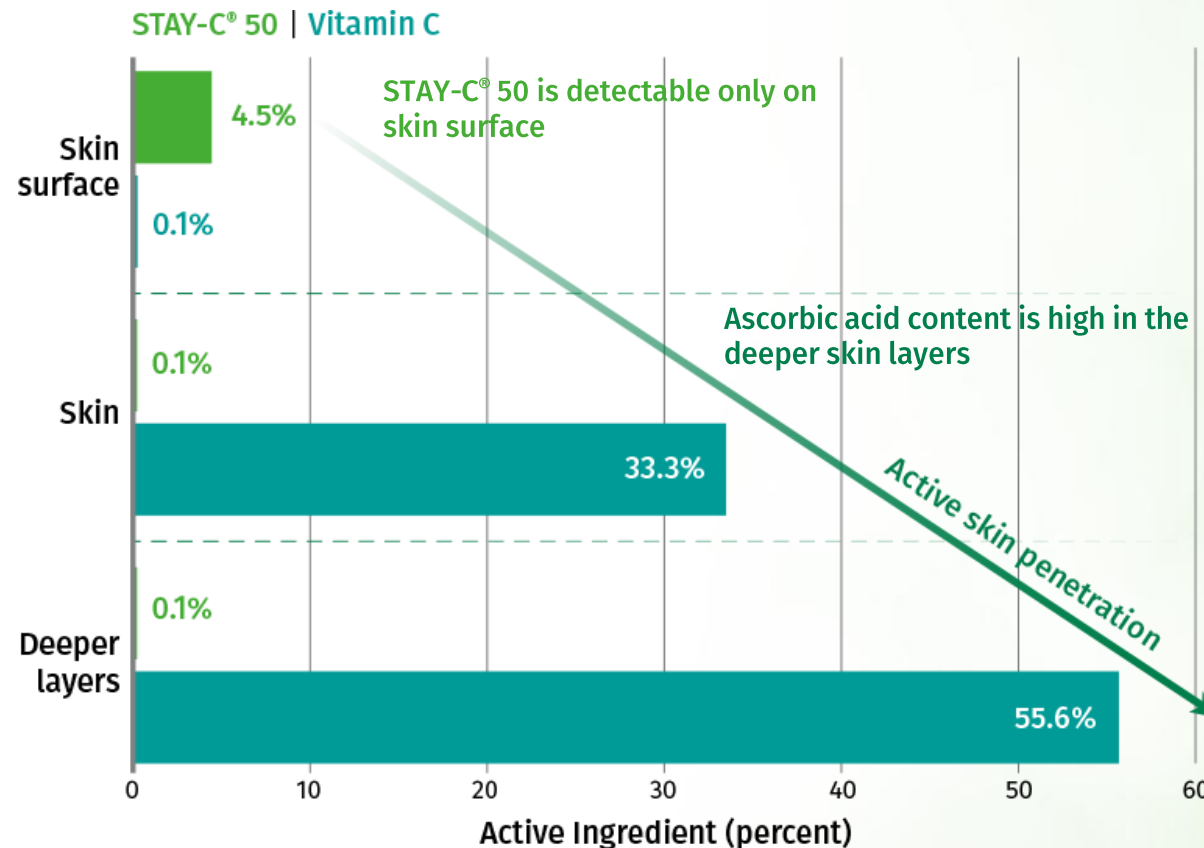
DSM Internal study

STAY-C® 50 – Two steps to be active

2) Skin Penetration

STAY-C® 50 is bio-converted in the upper skin layer into the active ascorbic acid, which easily penetrates into deeper skin layers

STAY-C® 50 and ascorbic acid concentration on each skin layers by HPLC



Any STAY-C® 50 which crosses the stratum corneum is metabolized to ascorbic acid, which further penetrates into deeper skin layers within 2h

- 0.5% STAY-C® 50 in w/o lotion
- 2h on ex vivo skin (Franz-type diffusion cell testing)

Guide formulation

STAY-C® 50

Stability

For a better performance

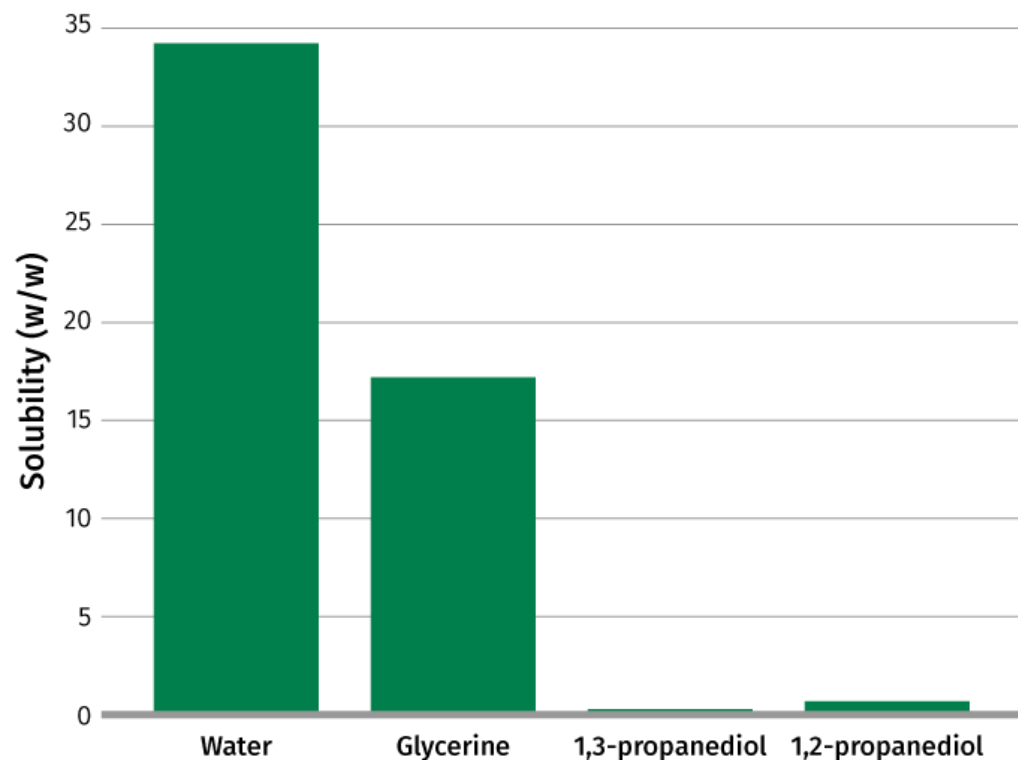
- pH $\geq$ 6
- Add 0.05-0.1% Sodium Metabisulfite to improve color stability
- Add chelating agents (EDTA, phytic acid, etc..) to prevent degradation by heavy metal ions
- Check stability with acrylic acid thickeners and some ionic emulsifiers

Note: STAY-C® 50 is able to improve the stability of Retinol in formulation at room temperature (but also at 40°C after 6 weeks where the recovery rate of retinol is above 70% with 0.5% STAY-C® 50 in formulation)



Guide formulation

STAY-C® 50

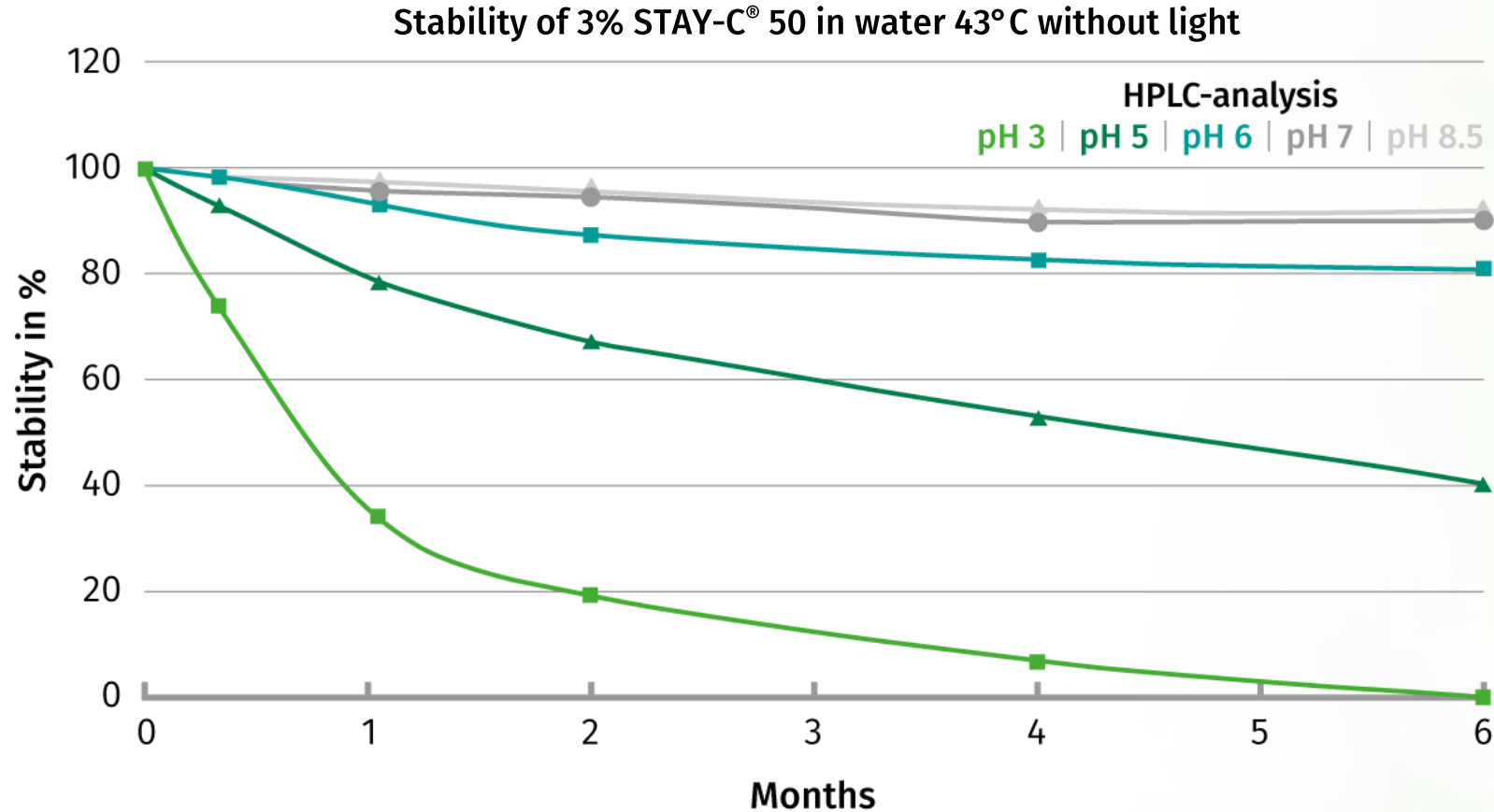


Solubility

- Readily soluble in water (nearly 35%) and in glycerin (up to 18%)
- Insoluble in lipophilic components or alcohols
- Dissolve STAY-C® 50 in water and add it to an emulsion as an aqueous solution below 35-40°C

STAY-C® 50 – Stability in formulation

STAY-C® 50 is 80 to 100% stable after 6 months in solution at pH ≥ 6



STAY-C® 50 is highly stable at a pH of 6 and higher

Even at 43°C 90% of the STAY-C® 50 initial concentration has been detected after 6 months

DSM Internal study

DSM innovation with high content of Vitamin C

Water C Whitening Ampoule

Vitamin C (STAY-C® 50) 12%

SK-A-101389-1

	Ingredients	Function	% w/w
A	Aqua	Solvent	68.63
	Disodium EDTA, Aqua	Chelating agent	0.05
	Betaine	Humectant	2.00
	TILAMAR® PDO with NØØVISTA™ (Propanediol)	Hydration, Sensory, Active carrier and Preservative booster	6.00
	Glycerin	Humectant	2.00
	Biosaccharide Gum-1	Sensory enhancer	3.00
	PEG/PPG/Polybutylene Glycol-8/5/3 Glycerin	Humectant	1.00
	Phenoxyethanol, Ethylhexylglycerin	Preservative	0.50
	HYALURONIC ACID-BT (Sodium Hyaluronate)	Active	0.02
	STAY-C® 50 (Sodium Ascorbyl Phosphate)	Active	12.00
	Sodium Metabisulfite	Antioxidant	0.05
	BIS-PEG-18 Methyl Ether Dimethyl Silane	Emollient	1.00
	Diethoxyethyl Succinate	Emollient	2.00

	Ingredients	Function	% w/w
B	Cellulose Gum	Thickener	0.10
	Xanthan Gum	Thickener	0.40
C	Peg-60 Hydrogenated Castor Oil	Solubilizer	0.30
	Cyclopentasiloxane, Cyclohexasiloxane	Emollient	0.50
	Parfum	Parfum	0.05
	Polysorbate 20	Solubilizer	0.40

Technical data:

pH: 7.32

Viscosity (Brookfield RV3/12rpm):
1 760 mPa.s

Formulation 94.2% of natural origin according to ISO 16128 by including formulation water

DSM innovation with high content of Vitamin C

Fresh Energizing Mist C

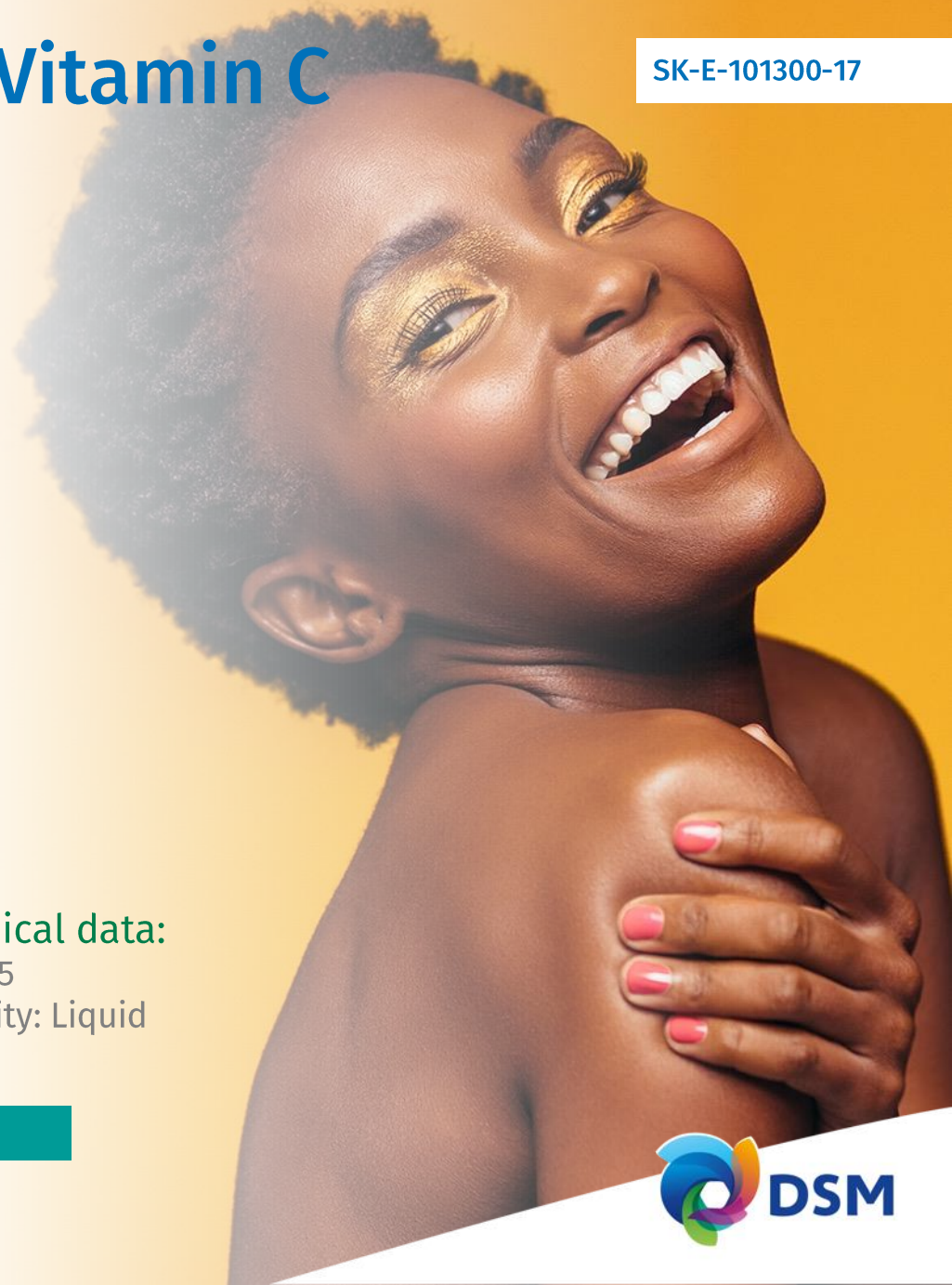
Vitamin C (STAY-C® 50) 10%

SK-E-101300-17

	Ingredients	Function	% w/w
A	Aqua	Water	60.52
	Disodium EDTA, Aqua	Chelating agent	0.20
	Pentylene Glycol	Multifunctional	3.00
	TILAMAR® PDO with NØØVISTA™ (Propanediol)	Hydration, Sensory, Active carrier and Preservative booster	2.00
	Chlorphenesin	Preservative	0.20
	Bis-PEG 18 Methyl Ether Dimethyl Silane	Humectant	1.00
B	Parfum	Parfum	0.20
	PEG-40 Hydrogenated Castor Oil	Solubilizer	1.00
C	STAY-C® 50 (Sodium Ascorbyl Phosphate)	Active	0.50
	Aqua	Water	20.00
D	Citric acid, Aqua	Buffer	1.88

Technical data:
pH: 7.75
Viscosity: Liquid

Formulation 94.4% of natural origin according to ISO 16128 by including formulation water



Formulation with Retinol and STAY-C® 50 as stabilizer

Cocooning Vitamins Mask Soap

SK-E-102144-10

STAY-C® 50 0.5% - Retinol CB 50 0.2%

	Ingredients	Function	% w/w
A	Prunus Amygdalus Dulcis Oil	Emollient	14.60
	Passiflora Incarnata Seed Oil	Emollient	14.60
	Persea Gratissima Oil	Emollient	6.10
	ARGAN OIL (Argania Spinosa Kernel Oil)	Emollient	3.00
	Theobroma cacao Seed Butter	Emollient	3.70
	Macadamia Integrifolia Seed Oil	Emollient	14.60
	Life's GLATM '10' n-6 Oil (Oenothera Biennis Oil, Ascorbyl Palmitate, Tocopherol)	Emollient, Active	2.00
	Ricinus Communis Seed Oil	Emollient	2.00
B	Kaolin	Absorbing agent	10.00
	VALVANCE® Look 100 (Silica, Titanium Dioxide)	Sensory Modifier, Whitener	3.00
	CI 77891, Polyglyceryl-2 Tetraisostearate	Pigment	2.00

Technical data:

pH: 10.79

Viscosity: Solid

	Ingredients	Function	% w/w
C	Sodium Hydroxide	Buffer	7.60
	Aqua	Solvent	14.20
D	RETINOL CB 50 (Retinol, Undecane, Tridecane, Tocopherol)	Active	0.20
	STAY-C® 50 (Sodium Ascorbyl Phosphate)	Active	0.50
	Tocopherol, Helianthus Annuus Seed Oil	Active	0.20
	PENTAVITIN® (Saccharide Isomerate, Aqua, Citric acid, Sodium Citrate)	Active	1.00
	Parfum	Parfum	0.70

Formulation 99.89% of natural origin according to ISO 16128 by including formulation water



Scientific Evidence –STAY-C® 50

Mode of action & efficacy

STAY-C® 50 – The all-round beauty solution for skin perfection



Anti-oxidant and photoprotective

- Neutralizes the oxidative stress acting as radical scavenger
- Protects against UV- and ozone- induced oxidative damage



Skin lightening activity

- Decreases melanin synthesis



Cosmetic improvement of acne-prone skin

- Reduces the appearance of acne



Anti-ageing activities

- Stimulates collagen synthesis
- Improves skin firmness



Hair care activity

- Promotes hair growth



Support of healthy teeth and gum

- Inactivates harmful oral bacteria

Deodorant activity

- Reduces malodor

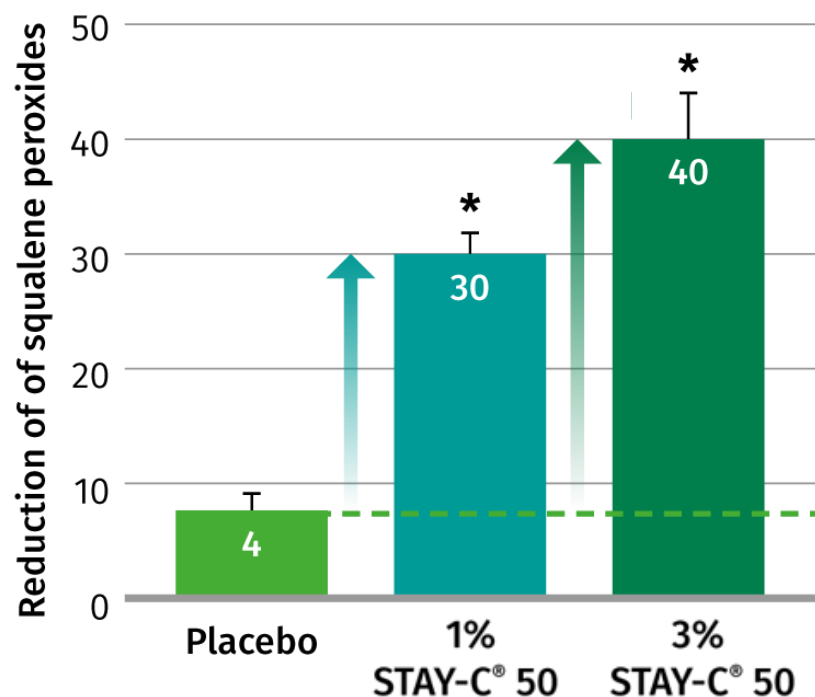
Scientific evidence that explains why
STAY-C® 50 is so popular

DSM Nutritional Products
OWN STUDY

STAY-C® 50 – in photoprotection

STAY-C® 50 reduces the UV-induced lipid peroxides up to 40%

Reduction of lipid peroxides formation (%)



* $p < 0.05$ versus placebo

STAY-C® 50 significantly protects against the UV-induced formation of oxidized molecules in human skin in a dose-dependent way

- 20 volunteers
- 7 days prior UV-irradiation, twice daily
- 1% STAY-C® 50 or 3% STAY-C® 50 vs placebo

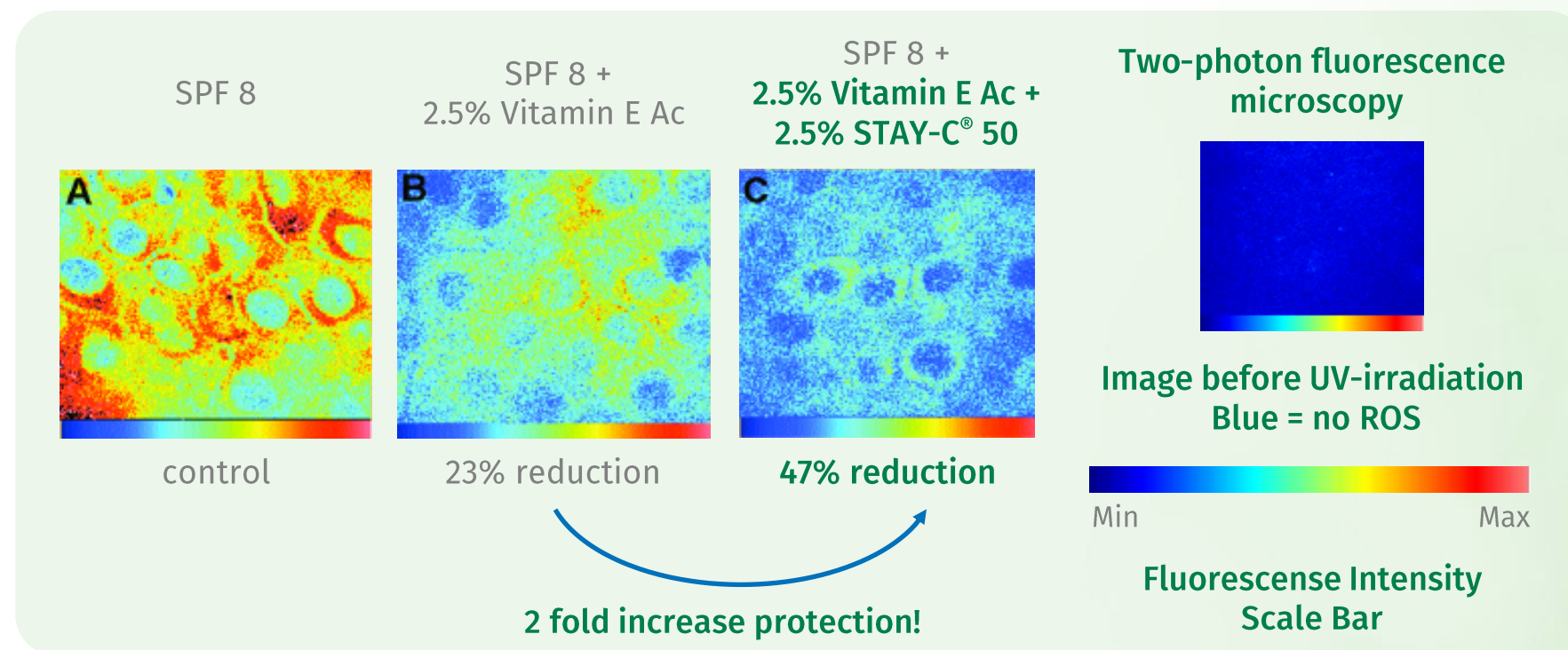
Klock J et al. International Journal of Cosmetic Science, 2005, 27,171–176

STAY-C® 50 – in photoprotection

STAY-C® 50 doubles the UVA/UVB protection of sun filters and Vitamin E



Image of live human skin showing the effect of three products on reduction of ROS after UV irradiation (1600J/m²)



- Ex vivo human skin (breast and facial), 2 individuals
- Formulations applied for 3h

Hanson et al. J Cosmet Sci. 2003 Nov-Dec;54(6):589-98.

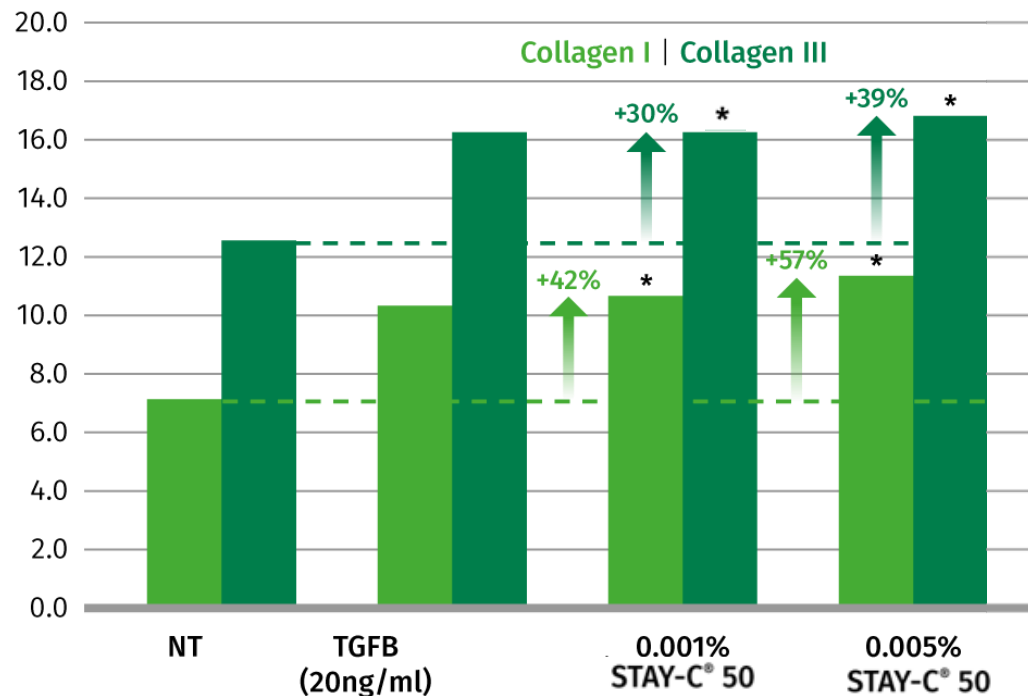
STAY-C® 50 – in anti-ageing – dermis

STAY-C® 50 promotes collagen I (+57%) and collagen III (+39%) synthesis in human fibroblasts



DSM Nutritional Products
OWN STUDY

Collagen production (ratio collagen / total protein)



* $p < 0.05$ versus non treated (NT)

STAY-C® 50 significantly stimulates both Collagen I and Collagen III production

- Human dermal fibroblasts
- STAY-C® 50 at different concentrations
- 72h

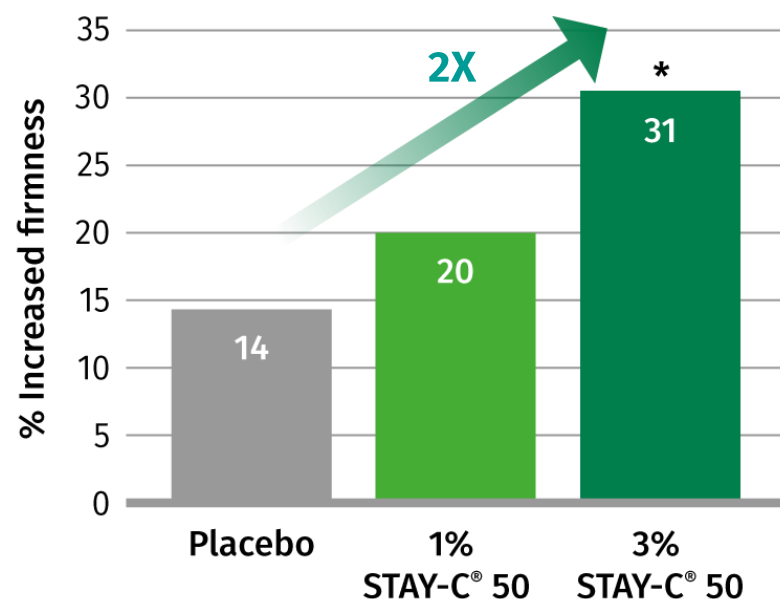
R Jermann & AA Gripp. Cosmetics and Toiletries Manufacture
Worldwide 153-157 (2004)



STAY-C® 50 – in anti-ageing

Skin firmness increase doubles with 3% STAY-C® 50 vs placebo

Measurement of firmness by cutometer on inner forearm



* $p < 0.05$ versus placebo

Regular application of STAY-C® 50 containing cream leads to a significantly firmer skin

- 20 volunteers
- Products twice daily applied over 42 days
- 1% STAY-C® 50
- 3% STAY-C® 50

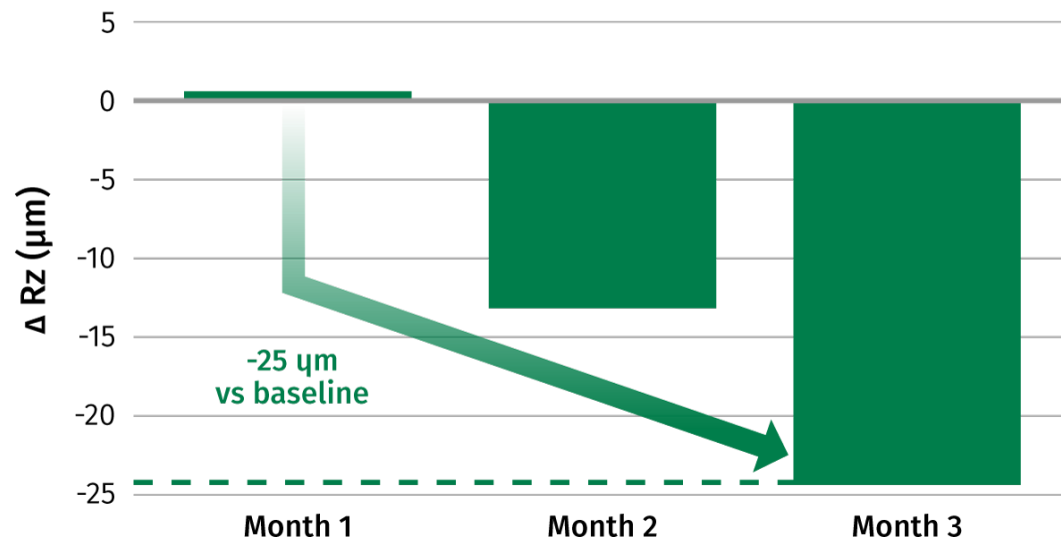
STAY-C® 50 + Biotin – combination in anti-ageing

A topical mixture containing STAY-C® 50 and Biotin reduces wrinkles by 25 µm in 12 weeks



DSM Nutritional Products
OWN STUDY

Skin roughness measurement of eye region



Significantly smoothens fine wrinkles around the eye in 3 months

- Double blind study
- 39 Volunteers
- 2 applications daily, 12 weeks around the eye
- 3% STAY-C® 50 + 0.1% Biotin formulation vs placebo

STAY-C® 50 – skin lightening activities

STAY-C® 50 visibly evens the skin tone and reduces the color intensity of age spots by 25% in 3 month

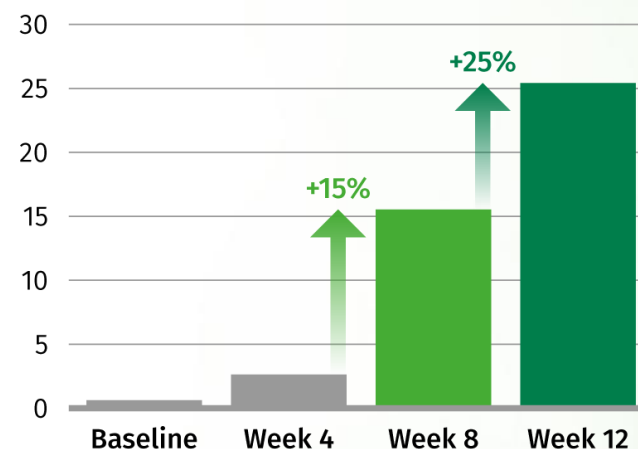


DSM Nutritional Products
OWN STUDY

Photographic evidence of spot reduction



Quantification of improvement by visual assessment (dermatological evaluation)



- Double blind study with half face treatment
- 39 female volunteers
- Test cream with 3% STAY-C® 50 and 1% Vitamin E acetate
- 12 weeks, twice daily application

J. Klock. SÖFW-Journal | 130 | 9-2004 (no data report available)

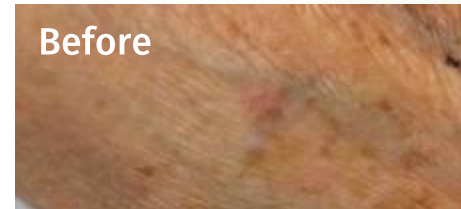
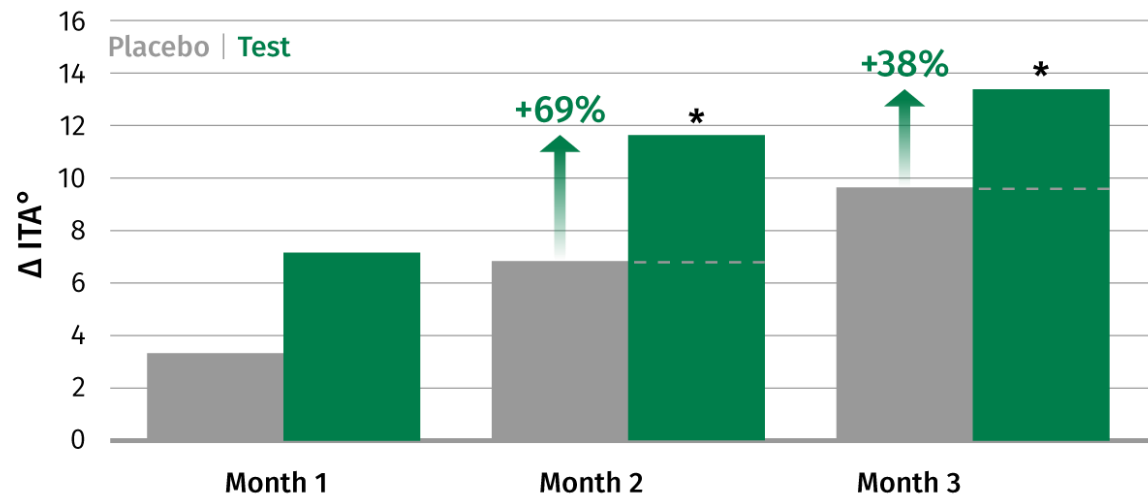
STAY-C® 50 + Biotin – combination in skin lightening

A topical mixture containing STAY-C® 50 and biotin lightens the skin up to 69% in 2 months

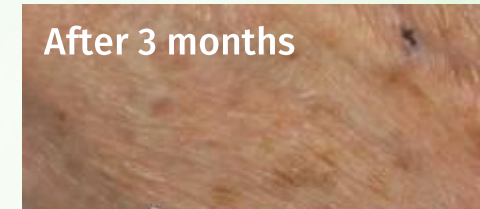


DSM Nutritional Products
OWN STUDY

Measurement of skin lightening vs baseline (Δ ITA°)



Before



After 3 months

- Double blind study
- 39 volunteers
- 2 applications daily, 12 weeks on back of hands
- 3% STAY-C® 50 + 0.1% Biotin formulation vs placebo



Strong lightening effect with increase of 13 ITA° after 3 months!

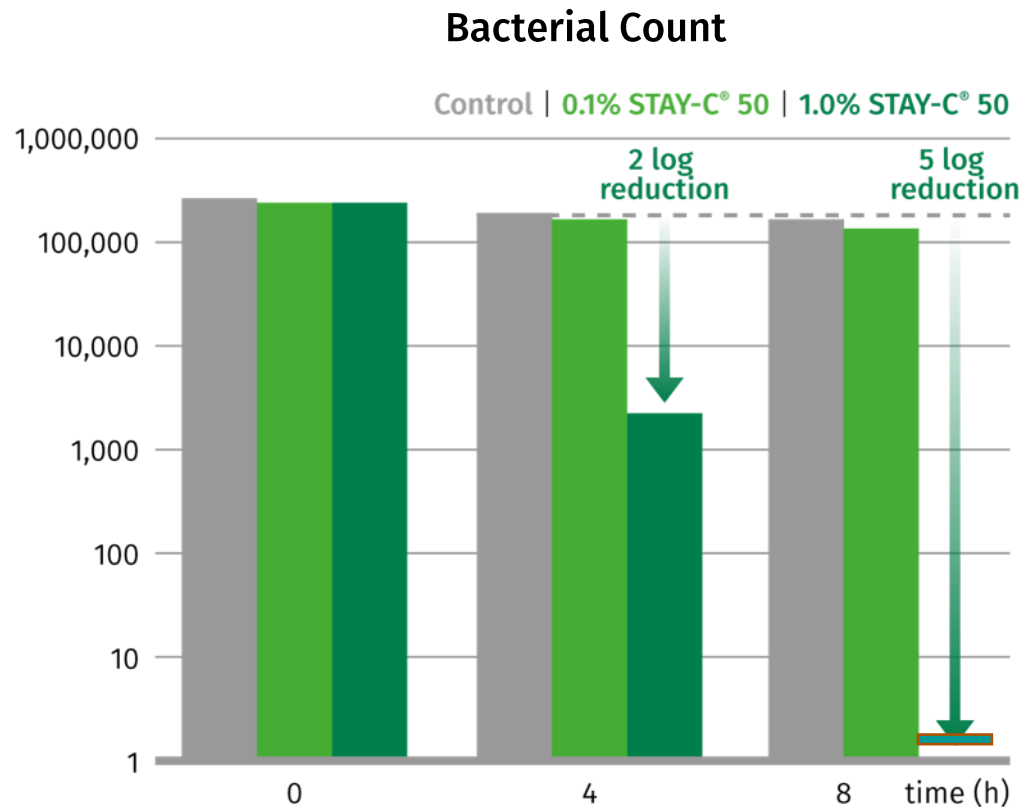
Images taken with digital camera Canon EOS D30

STAY-C® 50 – reduces the appearance of acne

*STAY-C® 50 inactivates *Cutibacterium acnes* by 5 log after 8 hours of incubation*



DSM Nutritional Products
OWN STUDY



1% STAY-C® 50 is effective against *Cutibacterium acnes* already after 4h

After 8h the log reduction of bacterial count is 5, which means that most bacteria are killed

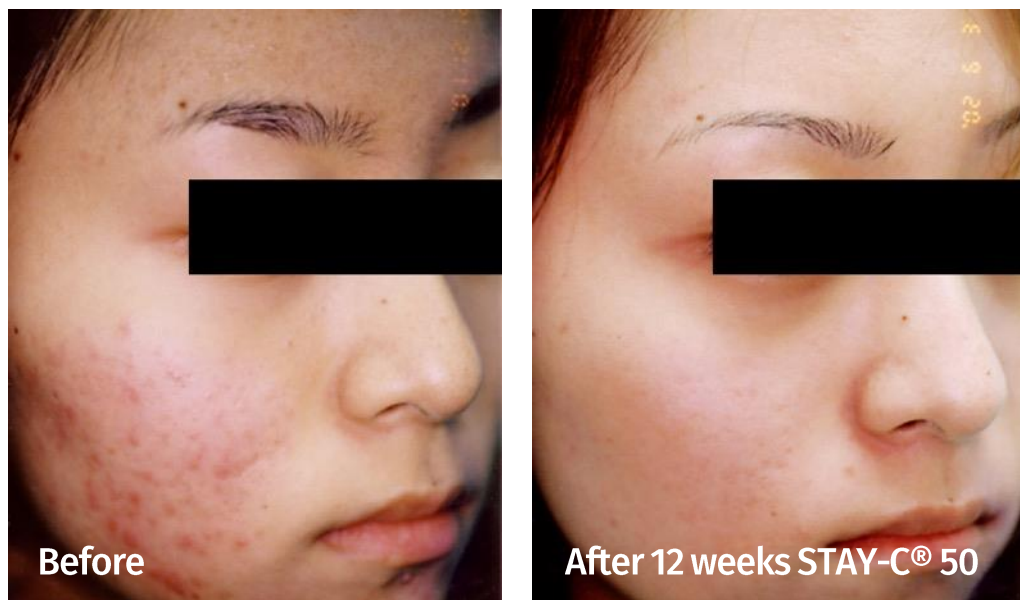
- Cultivation of bacterium *Cutibacterium acnes*
- Addition of different concentrations of STAY-C® 50 to the media

STAY-C® 50 – reduces the appearance of acne

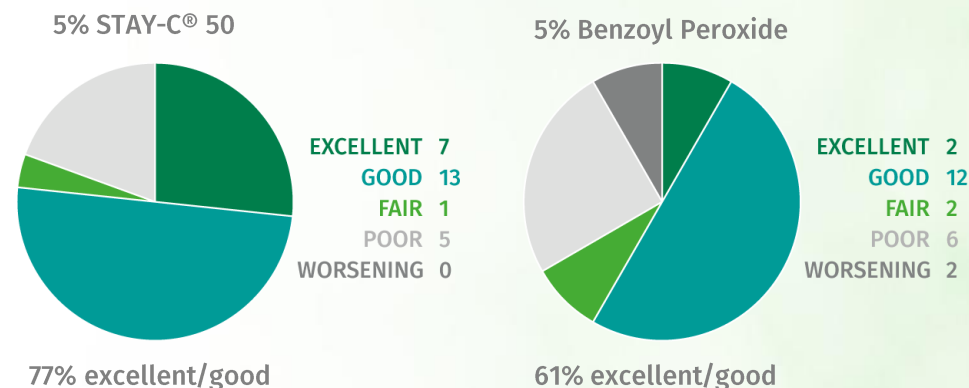
STAY-C® 50 visibly improves skin condition of acne vulgaris by 77 % in 12 weeks



DSM Nutritional Products
OWN STUDY



Improvement of skin conditions after treatment



STAY-C® 50 visibly reduces the appearance of acne lesions in 12 weeks and outperforms Benzoyl Peroxide[#]

- 2x30 patients with acne vulgaris
- 5% STAY-C® 50 or 5% Benzoyl Peroxide
- 12 week treatment, twice daily application

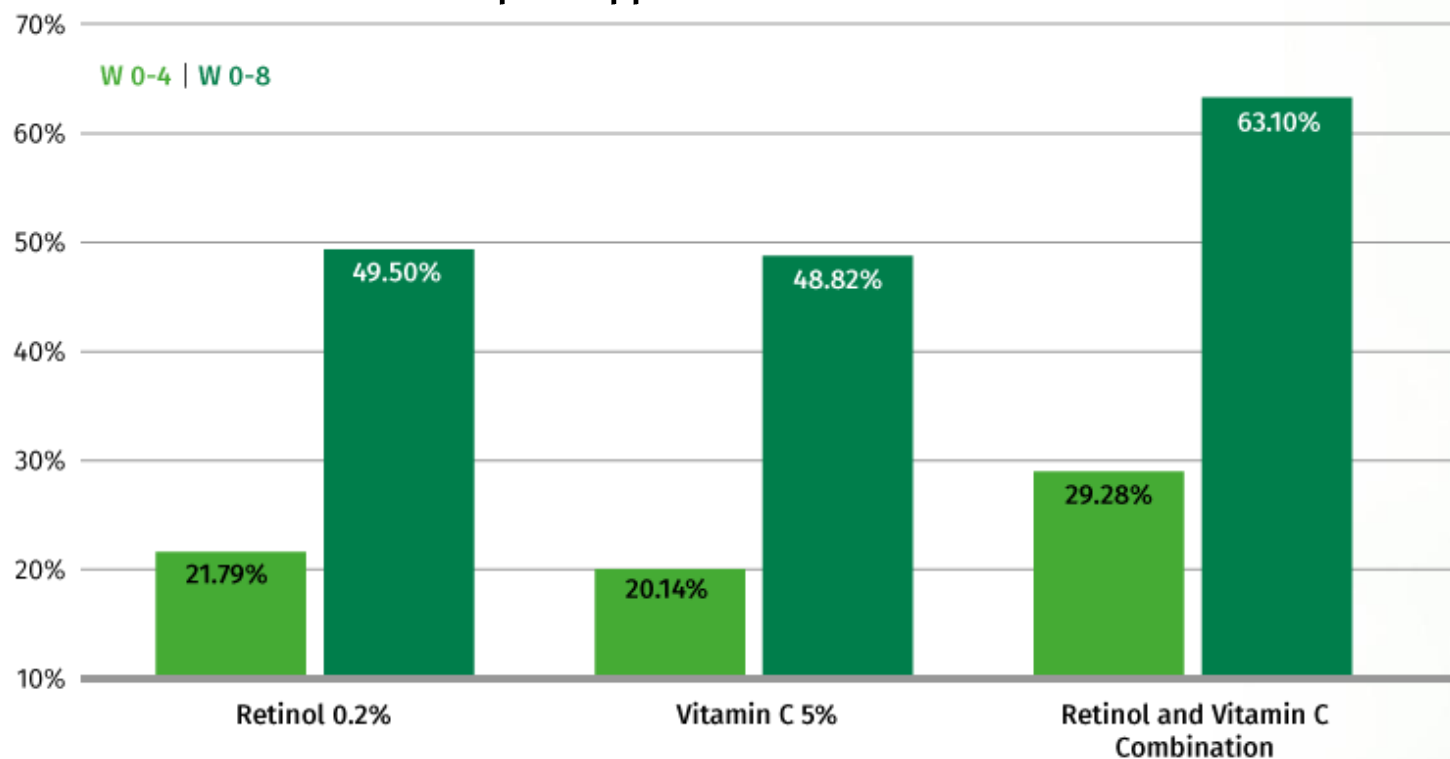
Klock J et al. Int J Cosmet Sci 2005;27:171-176

[#] Benzoyl peroxide is a bactericidal powerful ingredient against acne

STAY-C® 50 + Retinol – synergy in anti-acne

Combination of STAY-C® 50 and Retinol reduced the inflammatory lesions up to 63% in 8 weeks

Reduction of inflammatory lesions (%) after 4 and 8 weeks of topical application vs baseline



STAY-C® 50 reduces the inflammatory lesions by 20.14% and 48.82% (4 and 8 weeks). Addition of retinol improved the treatment efficacy by 30%.

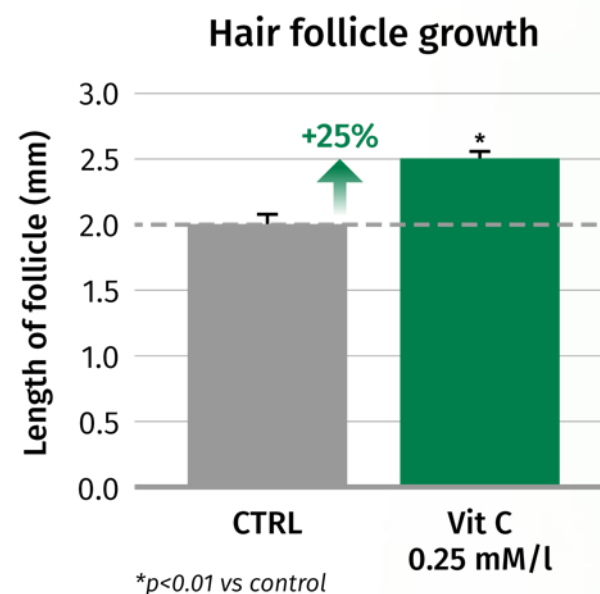
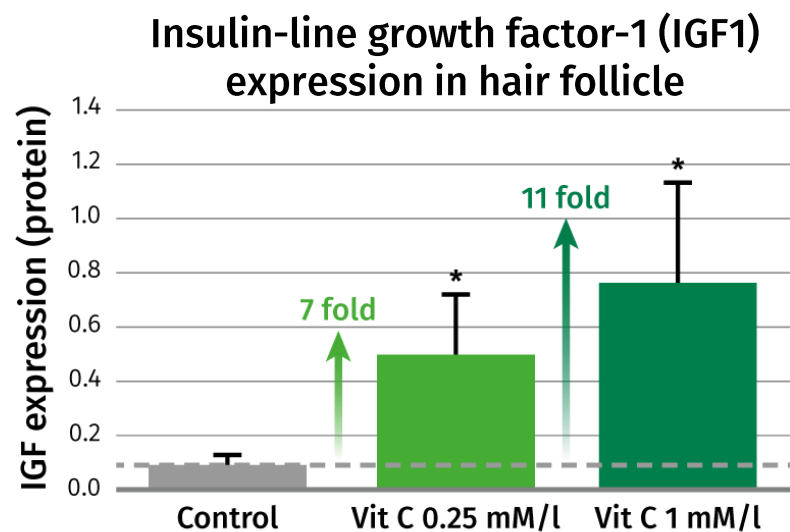
- 45 volunteers
- 4- and 8-weeks study
- 5% STAY-C® 50 (twice daily) and 0.2% Retinol (once daily), separately or in combination vs baseline

C. Ruamrak, N. Lourith, S. Natakankitkul. Comparison of clinical efficacies of SAP, retinol and their combination in acne treatment. *Int J Cosmet Sci*, 2009, 31: 41-46



STAY-C® 50 – in hair care

STAY-C® 50 induces hair follicle growth up to 25%



STAY-C® 50 stimulated the growth of cultured human hair follicle by upregulating IGF-1 up to 11 fold

- Human hair follicles obtained from scalp biopsies
- Vitamin C #, 0.25 and 1 mM/l, 9 days



Kwack MH et al. Br J Dermatol. 2009 Jun;160(6):1157-62.

L-Ascorbic acid 2-phosphate

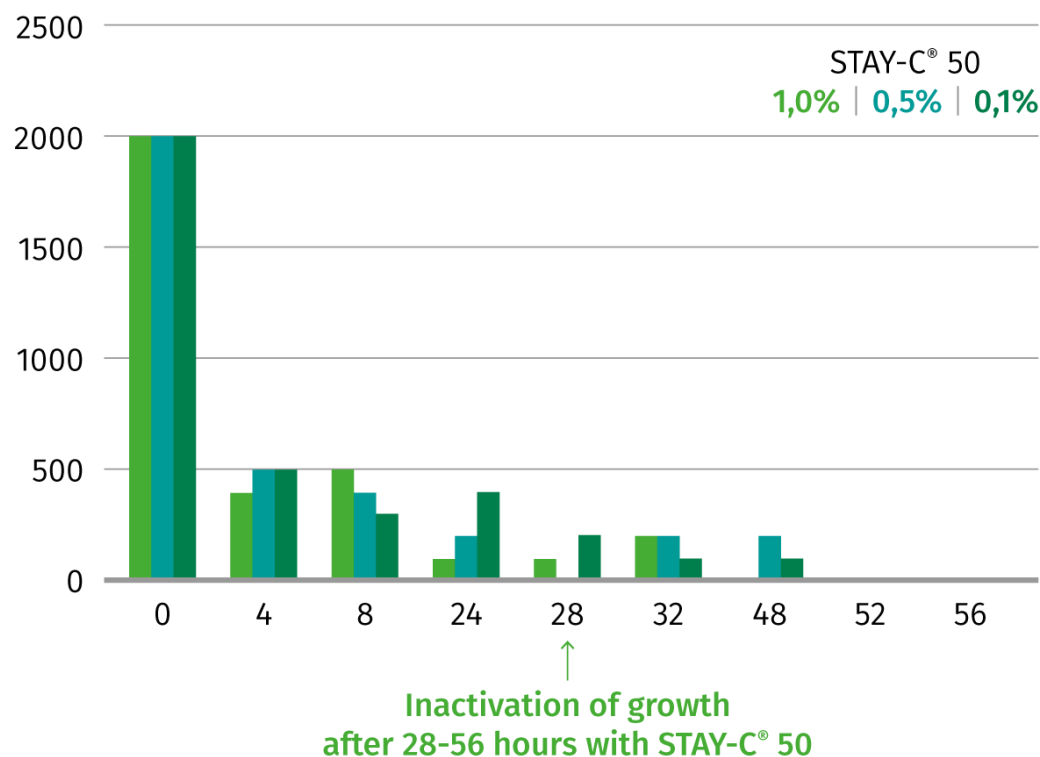


DSM Nutritional Products
OWN STUDY

STAY-C® 50 – in oral care

STAY-C® 50 inhibits growth of oral bacteria Streptococcus mutants, key bacteria for caries

Streptococcus mutants growth



STAY-C® 50 effectively inactivates *in vitro* *Streptococcus mutants*, the main bacteria responsible for caries

Similar efficiency against key bacteria for gingivitis, *Actinobacillus actinomycetemcomitans* and periodontitis, *Porphyromonas gingivalis* (back up slides)

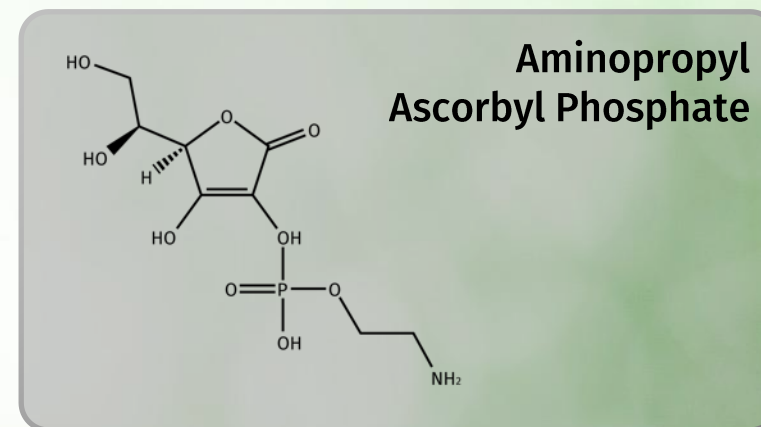
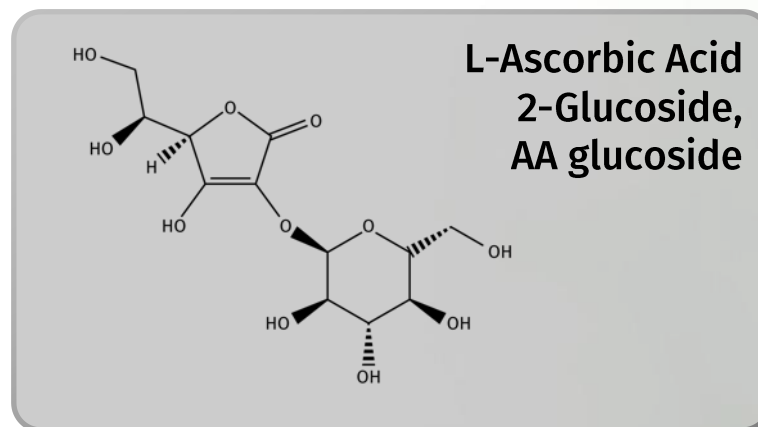
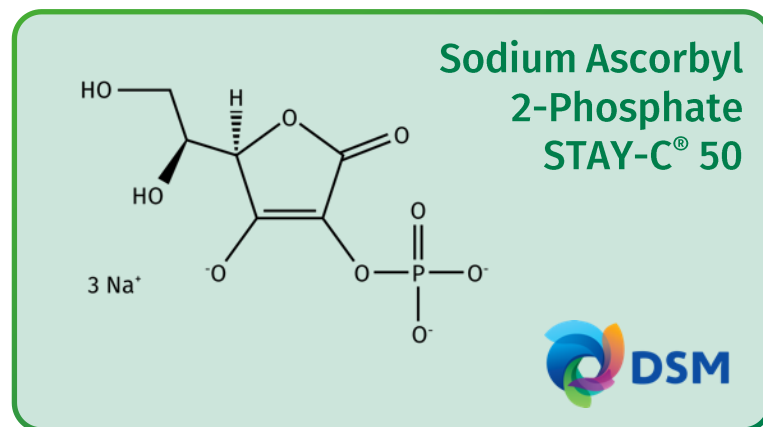
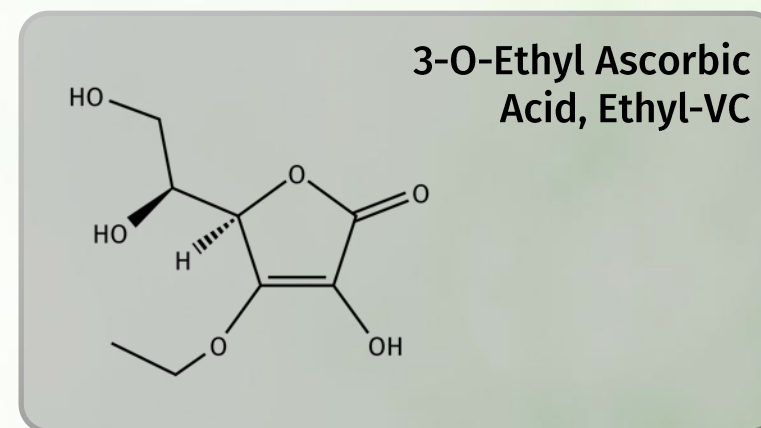
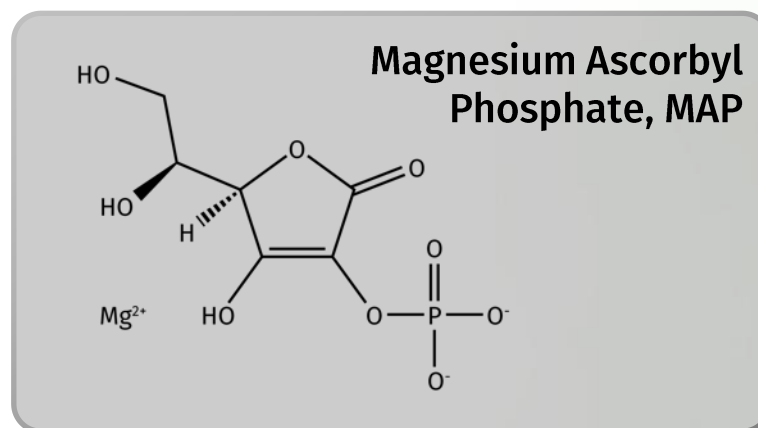
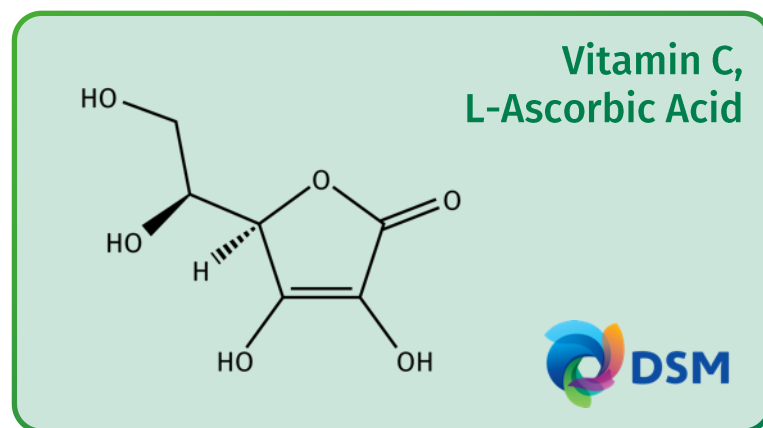
- STAY-C® 50 incubated with the bacteria up to 56 hours
- STAY-C® 50 1%
STAY-C® 50 0.5%
STAY-C® 50 0.1%

R Jermann & AA Gripp. Cosmetics and Toiletries Manufacture Worldwide 153-157 (2004)



Comparison among Different Forms of Vitamin C

A closer look at the main water-soluble derivatives of Vitamin C used in cosmetics



Stamford et al. *Journal of Cosmetic Dermatology*, 11, 310–317 (2012)
Juliet M. Pullar. *Nutrients* 2017, 9(8), 866

Use properties

Comparison



Parameter	L-Ascorbic Acid 2-Glucoside (AA Glucoside)	3-O-Ethyl Ascorbic Acid (Ethyl-VC)	Aminopropyl Ascorbyl Phosphate	Magnesium Ascorbyl Phosphate (MAP) [#]	Sodium Ascorbyl 2-Phosphate (STAY-C [®] 50)	L-Ascorbic Acid
Optimum pH range	pH 5.5-7	pH 4-5.5	pH 1-10	pH 6-7.5	pH 6-8.5	pH 3-4
Solubility	Water soluble (up to 71.4g/100mL)	Water soluble	Water soluble (up to 20.0g/100mL)	Slightly water soluble (up to 8.0g/100mL)	Water soluble (up to 78.9g/mL)	Water soluble (up to 30.0g/100ml)
Ascorbic acid equivalents (MW)	52.0%	86.3%	56.2%	46.4%	50.0%	100.0%
Resistance to discoloration	RT + HT(40-45°C) +	RT + HT(40-45°C) +	Claimed, not shown	RT + HT(40-45°C) -	RT + HT(40-45°C) -	RT - HT(40-45°C) --
Stability in solution (% of active)	Yes (≥90%, 3 months)	Yes (≥90%, 3 months)	Yes, shown for 4h	Yes (≥90%, 3 months)	Yes (≥90%, 3 months)	Slightly (60%, 3 months)
Conversion to AA	Claimed	NA	Claimed	Claimed	Yes	NA
Recommended use level	≤2.0%	0.1-3.0%	0.1-2.0%	0.1-3.0%	0.1-15%	0.1-15%

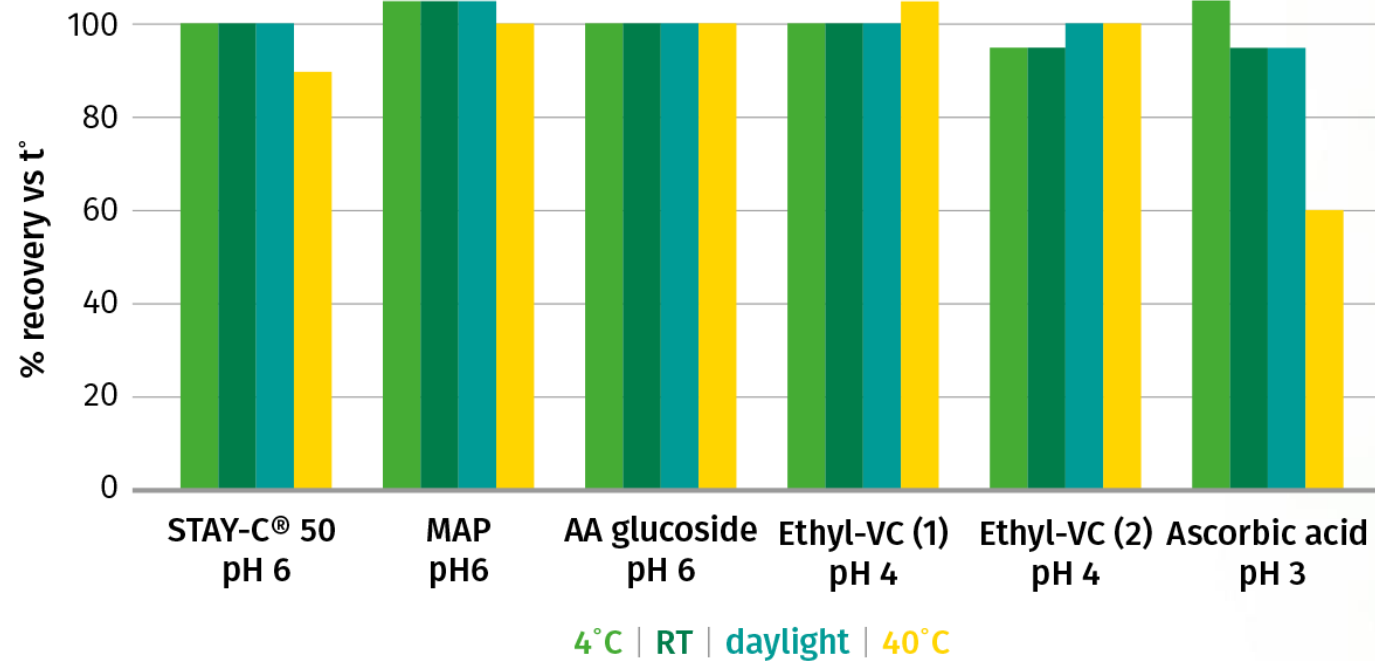
Parameters as reported on the available documentation (RT= room temperature: HT= 40-45°C)
 Parameter was tested internally



Comparison – stability in formulation

STAY-C® 50 is $\geq 90\%$ stable at all temperature conditions after 3 months, comparable to other stable derivatives #

Recovery of the active by HPLC after 3 months storage at different temperatures



The recovery rate of pure Ascorbic acid is $\geq 80\%$ when stored at 4°C, RT and daylight. At 40°C the recovery is 50-60%

DSM Internal study

Tests were performed at 2 different recommended pH for each grade, results at the lowest tested pH for each grade are shown in emulsion-based formula

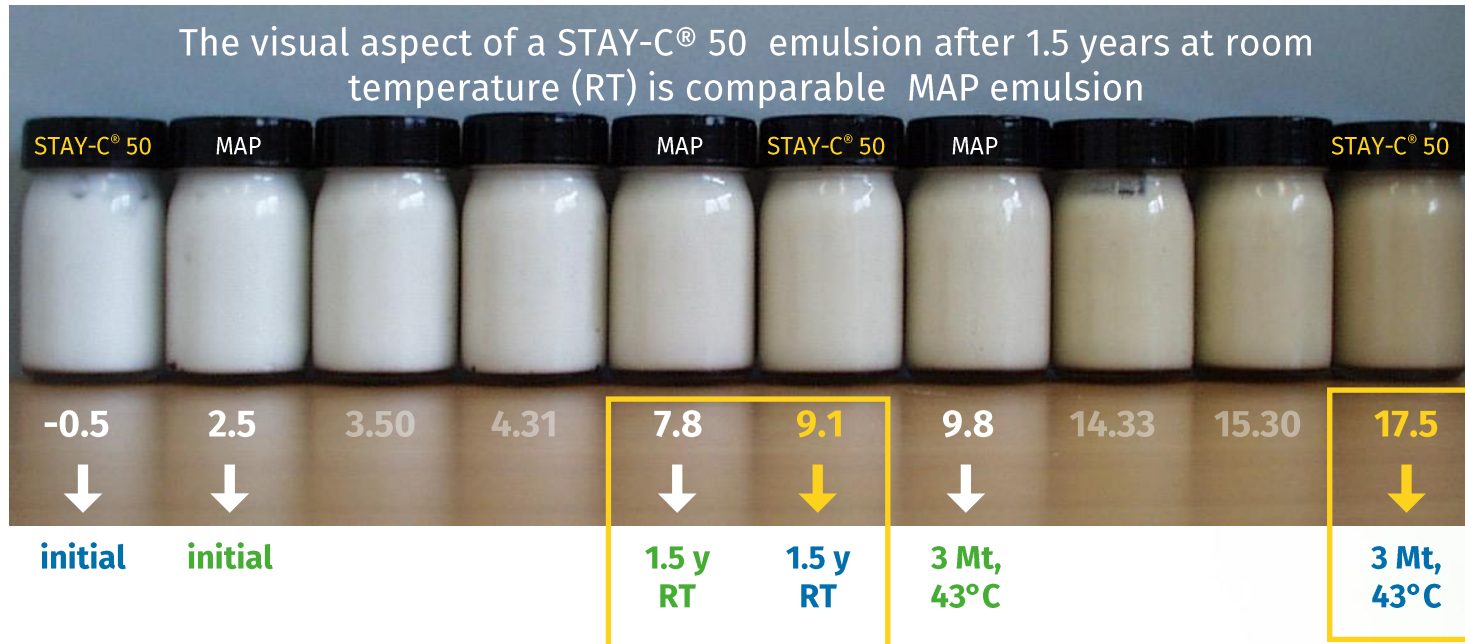
From left to right: Sodium Ascorbyl 2-Phosphate (STAY-C® 50), Magnesium ascorbyl phosphate (MAP), ascorbyl 2-glucoside (AA glucoside), 3-O-ethyl ascorbic acid (Ethyl-VC 1 and 2), Ascorbic Acid Ultra Fine Powder (Ascorbic Acid). All grades were tested at 2%

STAY-C® 50 – Color stability in formulation

STAY-C® 50 is color-stable when stored at RT for 18 months.

Accelerated stability test at 40°C does not reflect the long-term color-stability

Long-term color-stability of 3% STAY-C® 50 or MAP
in Brij-emulsion formulation (b* value)

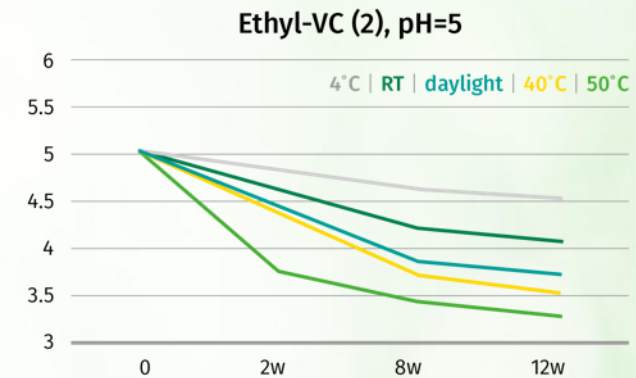
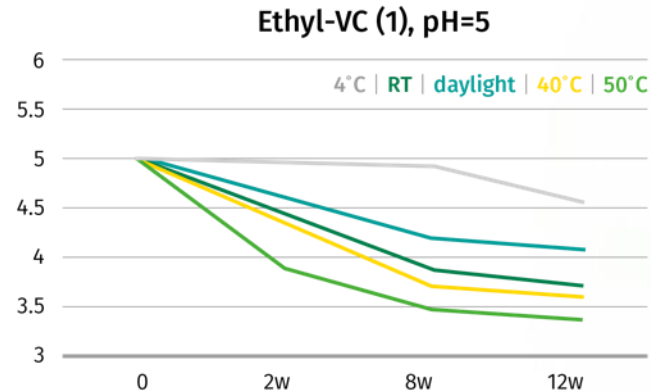
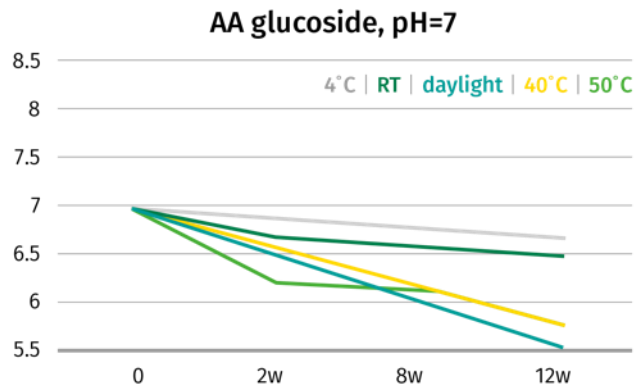
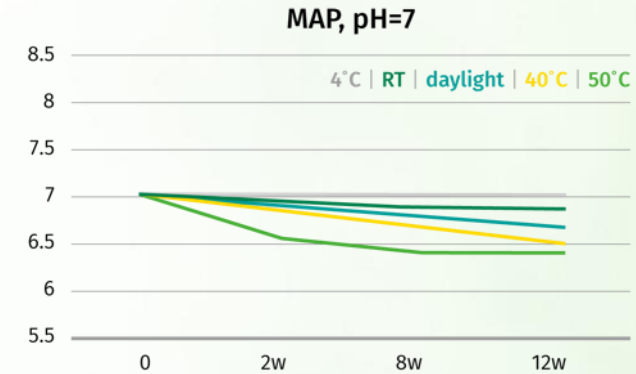
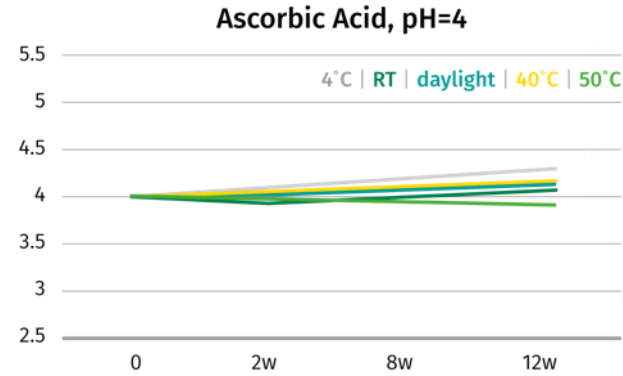
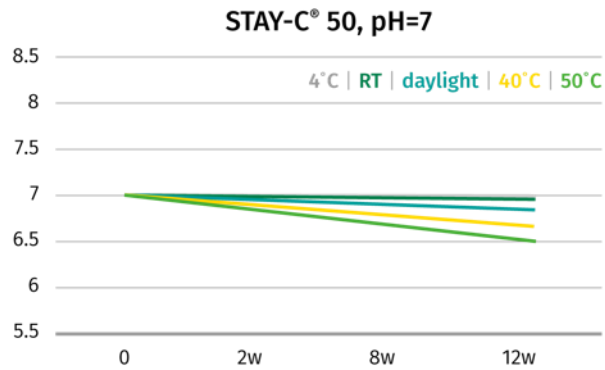


STAY-C® 50 is color-stable when stored at RT for 18 months.

Even though some slight discoloration occurs at 40°C, it does not impact the long-term color stability.

Comparison – pH stability in formulation

pH is more stable with STAY-C® 50 and Ascorbic Acid than with AA glucoside and Ethyl-VC#



DSM Internal study

Tests were performed at 2 different recommended pH for each grade, results at the highest tested pH for each grade are shown in emulsion-based formula

From left to right: Sodium Ascorbyl 2-Phosphate (STAY-C® 50), Ascorbic Acid Ultra Fine Powder (Ascorbic acid), Magnesium ascorbyl phosphate (MAP), ascorbyl 2-glucoside (AA glucoside), 3-O-ethyl ascorbic acid (Ethyl-VC 1 and 2), All grades were tested at 2%

Activity claims based on published documentation

Comparison

Parameter	L-Ascorbic Acid 2-glucoside (AA glucoside) [#]	3-O-ethyl ascorbic acid (Ethyl-VC) [#]	Aminopropyl Ascorbyl Phosphate	Magnesium Ascorbyl Phosphate (MAP) [#]	Sodium Ascorbyl 2-Phosphate (STAY-C® 50) [#]
Antioxidant	<i>In vitro</i>	<i>In vitro</i>	•	<i>In vitro</i>	<i>In vivo</i>
Protection from UV-induced damage	<i>In vitro</i> !	<i>In vitro</i> / <i>Ex vivo</i>	-	<i>In vitro</i>	<i>Ex vivo</i>
Collagen stimulation	<i>In vitro</i>	<i>In vitro</i>	<i>In vitro</i>	<i>In vitro</i>	<i>In vitro</i>
Skin lightening/Age spots fading	<i>In vitro</i> / <i>In vivo</i> !	<i>In vitro</i> / <i>In vivo</i> !	<i>In vivo</i>	<i>In vitro</i> !	<i>In vitro</i> / <i>In vivo</i>
Anti-ageing	<i>In vitro</i> / <i>In vivo</i>	•	<i>In vivo</i>	•	<i>In vivo</i>
Reduces the appearance of acne	•	-	-	<i>In vivo</i>	<i>In vitro</i> / <i>In vivo</i>
Promotes hair growth	-	-	-	•	<i>In vitro</i>
Deodorant activity	-	-	-	-	<i>In vivo</i>
Support of healthy gum and teeth	-	-	-	-	<i>In vitro</i>

SUBSTANTIATED CLAIM: a direct experimental evidence is showed to the brochure/documentation to support the claim

CLAIM NOT SUBSTANTIATED: there is no direct evidence to support the claim on the brochure/documentation, the claim comes from an indirect interpretation

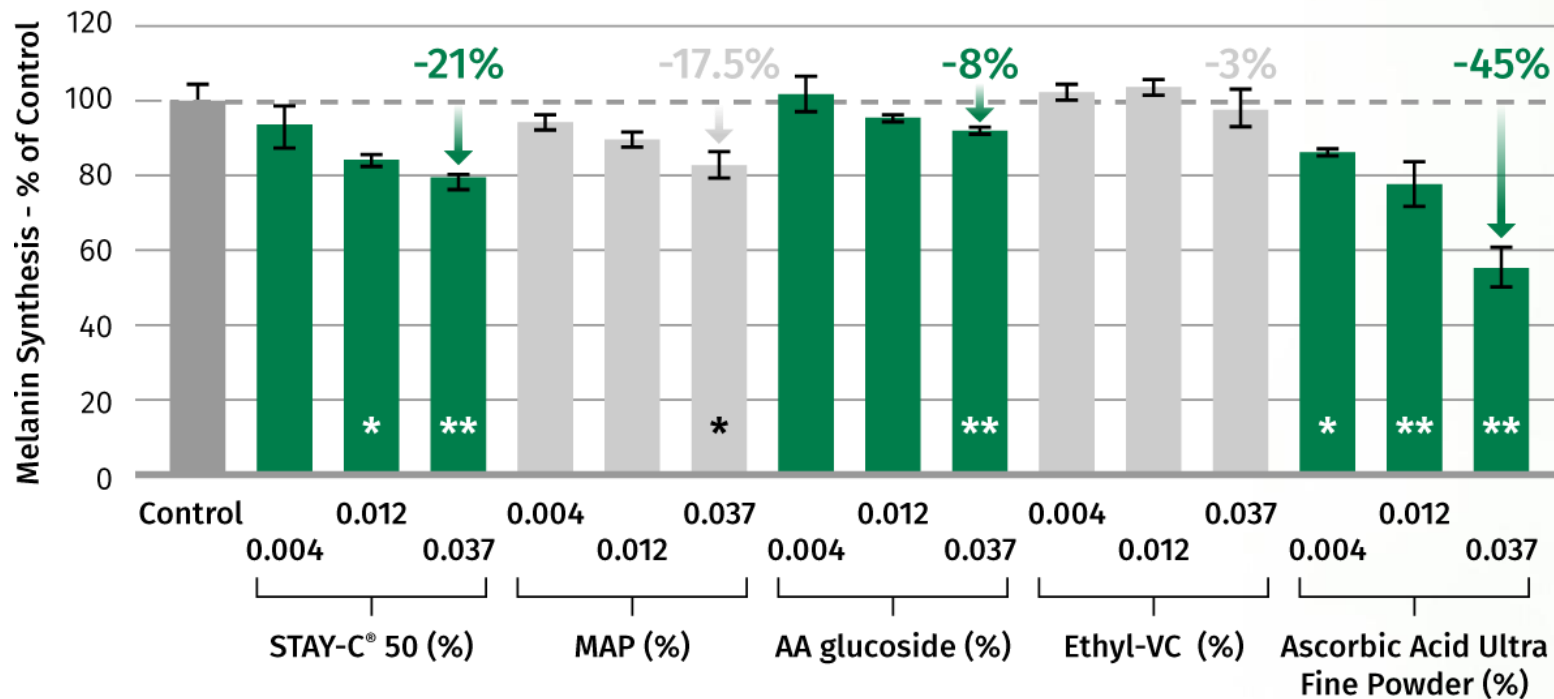
! : Controversial results comparing competitor documentation and internal know-how/scientific published results

[#] used as whitening active ingredient for Quasi Drugs in Japan

Comparison – skin lightening activities

STAY-C® 50 and ascorbic acid show superior skin lightening activity as compared to MAP, AA Glucoside and Ethyl-VC#

Inhibition of melanin synthesis



* $p < 0.05$ ** $p < 0.01$ vs control

STAY-C® 50 dose-dependently decreases melanin content up to -22%

Ascorbic acid dose-dependently decreases melanin content up to -40%

DSM Internal study

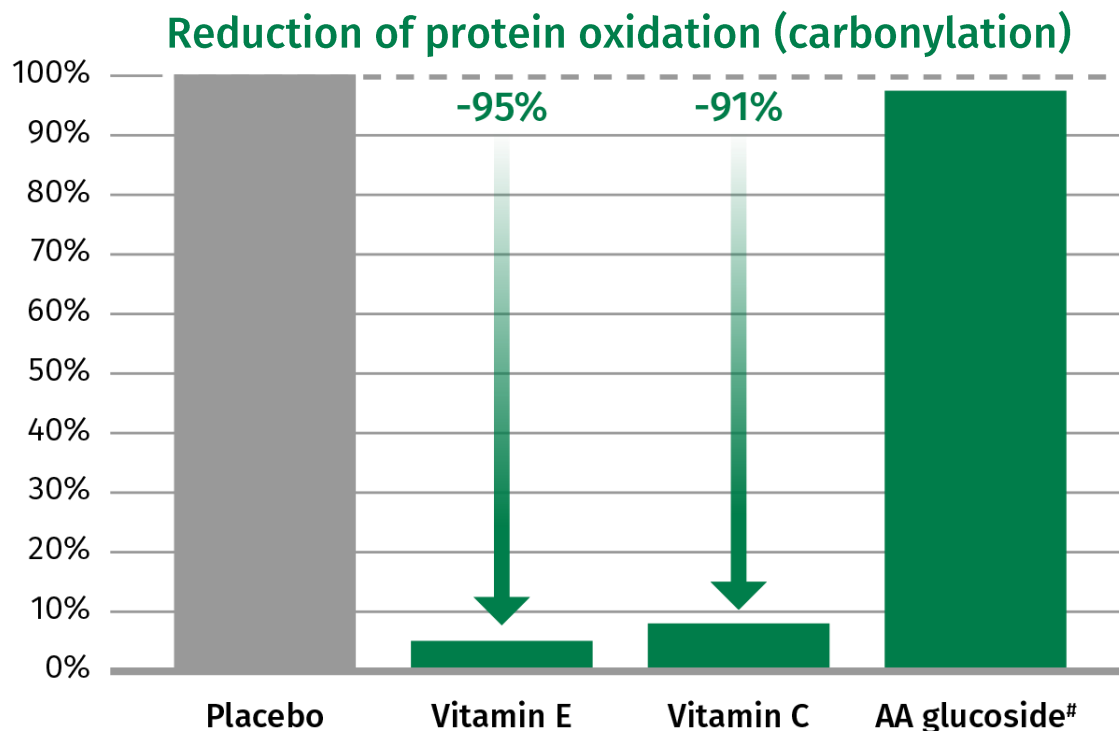
- NHEM-LP Melanocytes
- Different Vitamin C forms, 10 days

DSM Internal study

From left to right: STAY-C® 50, Magnesium Ascorbyl Phosphate (MAP), ascorbyl 2-glucoside (AA glucoside), 3-O-ethyl ascorbic acid (Ethyl-VC), Ascorbic Acid Ultra Fine Powder

Comparison – antioxidant activity

Vitamin C reduces protein oxidation by 91%, while AA Glucoside[#] does not show any activity



Vitamin C shows excellent antioxidant capability in the stratum corneum, similar to Vitamin E

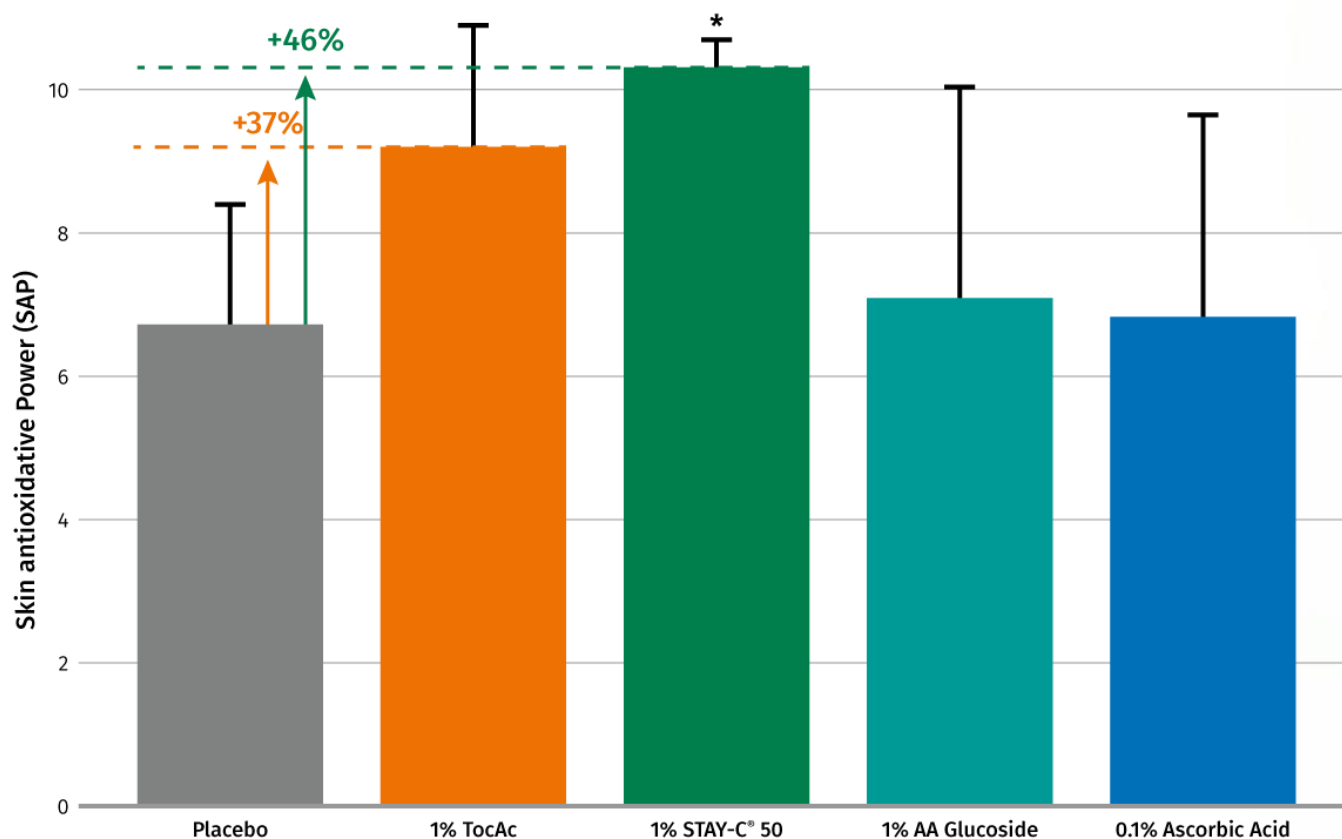
- Single-blind test
- 8 volunteers, forehead
- 0.5% Vitamin C or Vitamin E or AA Glucoside[#] emulsion vs placebo
- 4 weeks, twice daily

F.J.Tsai et al. J Photochem Photobiol B. 2012 Jul 2;112:7-15

[#] AA Glucoside is ascorbyl 2-glucoside

Comparison – antioxidant properties *ex vivo*

Skin Antioxidative Power (SAP): STAY-C® 50 shows superior anti-oxidant activities than Tocopherol and Ascorbyl glucoside (up to 46%) after 5 hours



- Skin Antioxidative Power performed using Electron Spin Resonance spectroscopy on skin explant labelled with semi-stable free radical that is reduced by the antioxidant system inside the epidermis and dermis
- Actives applied on the epidermal side, 5h experiment allowing the skin penetration, done in triplicate
- Ascorbic acid has a much higher SAP after 10 min (SAP at 10.9, +46% vs placebo) because Ascorbic acid is quickly absorbed by the skin

STAY-C® 50 is the sole ingredient showing a significant increase of SAP compared to placebo after 5 hours

DSM Internal study

* Statistically significant at $p < 0.05$ (ANOVA)

The all-round beauty solution for skin perfection

STAY-C® 50

Biological Concepts

Counteracts skin oxidation:

- Neutralization of UV-induced ROS
- Reduction of peroxides formation

Promotes collagen production (dermis)
Strengthens skin's barrier (epidermis)

Decreases melanin synthesis and reduces age spot

Improves the appearance of acne inflammatory lesions

Limits the growth of oral bacteria

Promotes elongation of hair follicle

Consumer Benefits



Photoprotection from UVA & UVB
Reduction of photodamage



Anti-ageing
Improvement of skin firmness and texture



Evens the skin tone and skin lightening



Cosmetic treatment of acne-prone skin



Support of healthy teeth and gum



Stimulation of hair growth

STAY-C® 50 – benefits vs other derivatives

Our stable cosmetic Vitamin C specialty

- Good **skin penetration**
- **Proven conversion** into the active form ascorbic acid
- **A multi-talent beauty remedy** addressing almost every skin concern from acne to UV damage...and its **activity is proven!**
- **Overperformance in melanin synthesis inhibition and antioxidant properties** vs other derivatives
- **Stable in aqueous** environment
- Easy to formulate
- Only derivative with use level **up to 15%**
- Approved quasi-drug active ingredient for whitening products in Japan
- Use in Daycare, Suncare, anti-aging product, anti-acne and Oral and body care

STAY-C® 50 – Regulatory Status

Allows development of global products

US status: Full cosmetic registration
*Cosmetic Ingredient Review: safe as used

EU status: Full chemical and cosmetic registration
Chemical REACH registration ✓
Cosmetic registration ✓

China status: Full chemical and cosmetic registration
Chemical REACH registration ✓
Chinese INCI name ✓
Cosmetic registration ✓

Japan Status: Full cosmetic registration

**Used as whitening active ingredient for Quasi Drugs in Japan*

Product free for sales as cosmetic ingredient for the application and use level recommended by DSM!



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Back-up

Additional slides, with partly more comprehensive data than in main presentation



STAY-C® 50: the all-round naturally derived beauty solution for skin perfection

Biological Concepts

Counteracts skin oxidation:

- Neutralization of UV-induced ROS
- Reduction of peroxides formation

Promotes collagen production (dermis)
Strengthens skin's barrier (epidermis)

Decreases melanin synthesis and reduces age spot

Improves the appearance of acne inflammatory lesions

Limits the growth of oral bacteria

Promotes elongation of hair follicle

Consumer Benefits



Photoprotection from UVA & UVB
Reduction of photodamage



Anti-ageing
Improvement of skin firmness and texture



Evens the skin tone and skin lightening



Cosmetic treatment of acne-prone skin



Support of healthy teeth and gum



Stimulation of hair growth

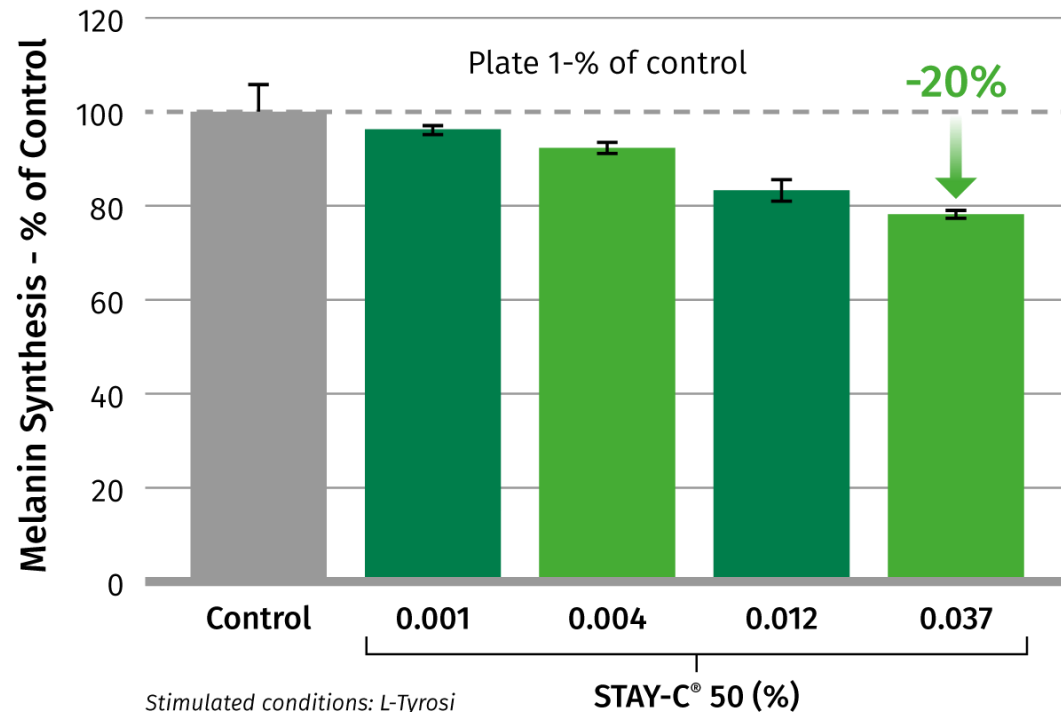
STAY-C® 50 – skin lightening activities

STAY-C® 50 dose-dependently inhibits melanin synthesis by 20% in L-tyrosine stimulated human melanocytes



DSM Nutritional Products
OWN STUDY

Inhibition of melanin synthesis after treatment with STAY-C® 50

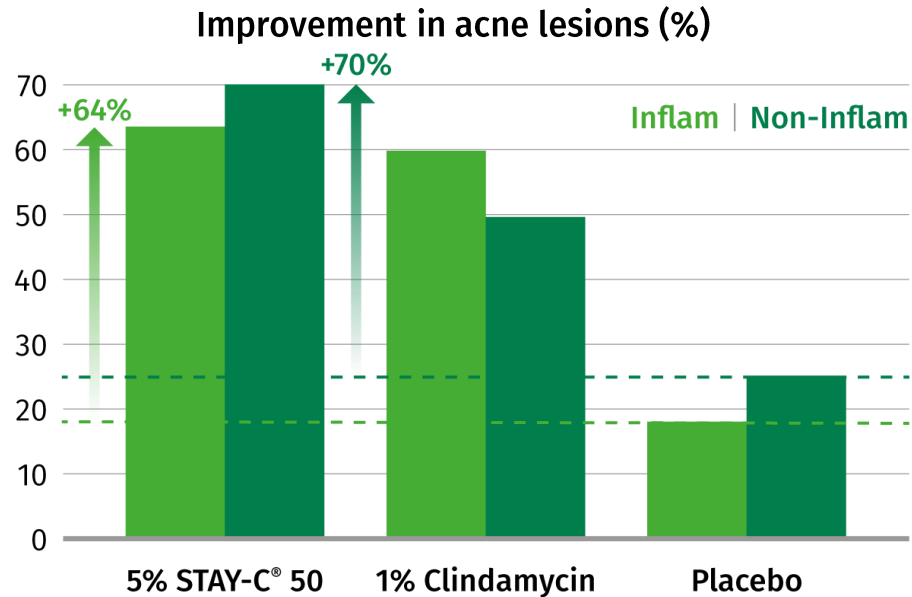


STAY-C® 50 reduces the melanin content in human melanocytes in a dose-dependent way

- NHEM-LP Melanocytes
- 10 days incubation with different concentration of STAY-C® 50

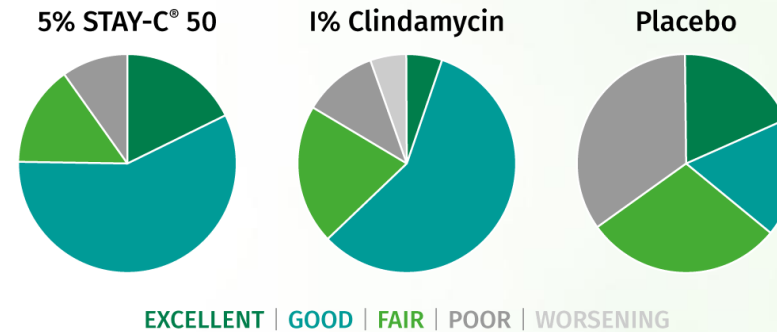
STAY-C® 50 – reduces the appearance of acne

STAY-C® 50 improves the appearance of inflammatory and non-inflammatory lesions by 64% to 70% vs placebo in 12 weeks



STAY-C® 50 outperforms clindamycin[#] in cosmetic treatment of acne prone skin

Improvement of skin conditions after treatment



- 89 volunteers
- Lotion with 5% STAY-C® 50 or 1% Clindamycin vs placebo
- 12 weeks, twice daily
- Measuring acne index and comparison to day=0

Hiroshi Ikeno et al, 2003, IID, Poster #0324

[#]topical clindamycin is an antibiotic commonly used to treat inflammatory acne

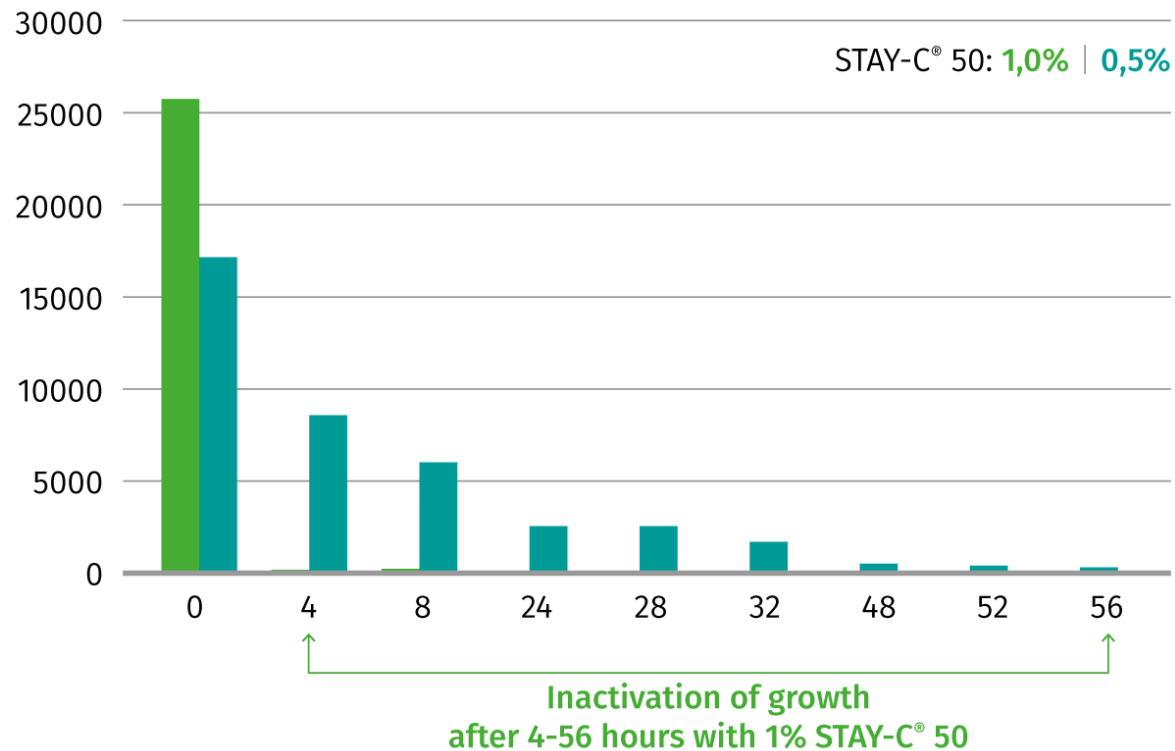
STAY-C® 50 – in oral care

1 % STAY-C® 50 inhibits growth of oral bacteria *Actinobacillus actinomycetemcomitans*, key bacteria for gingivitis



DSM Nutritional Products
OWN STUDY

Actinobacillus actinomycetemcomitans growth



STAY-C® 50 at 1% and 0.5% strongly decreases the bacterial count of *Actinobacillus actinomycetemcomitans*, the main bacteria responsible for gingivitis

- STAY-C® 50 incubated with the bacteria up to 56 hours
- STAY-C® 50 1%
STAY-C® 50 0.5%

DSM Internal study

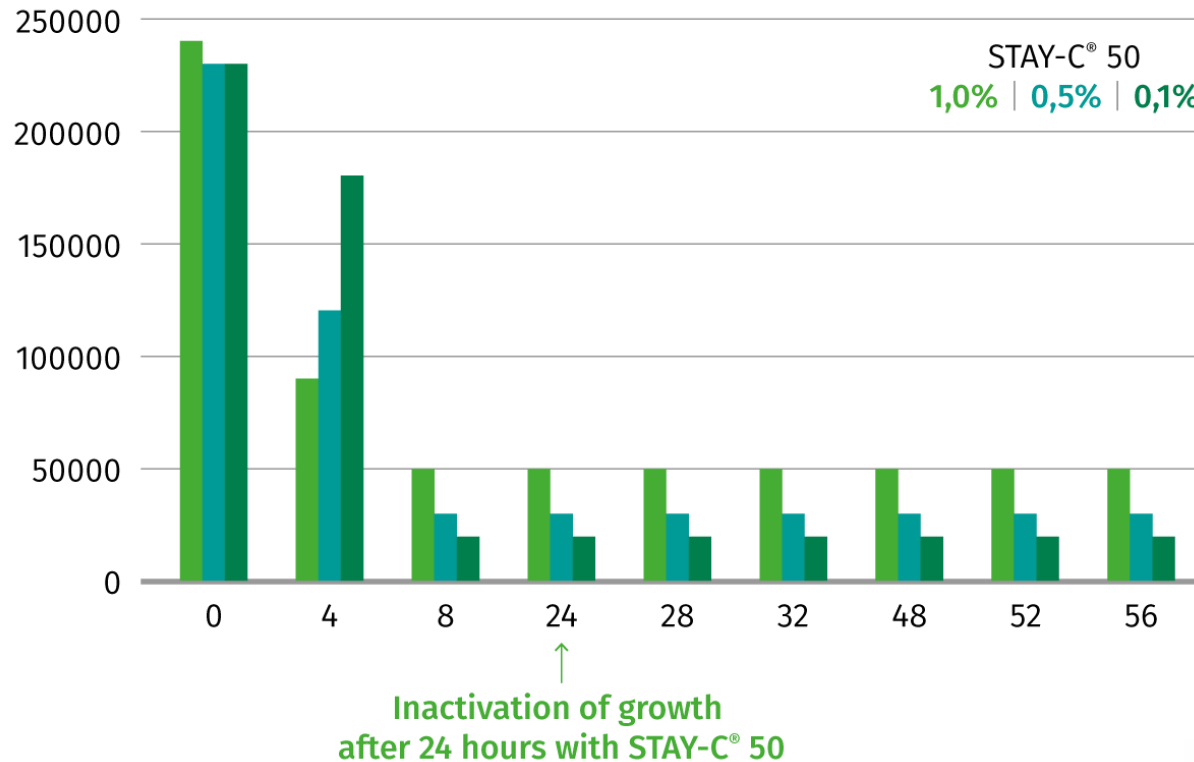
STAY-C® 50 – in oral care

STAY-C® 50 strongly inactivates growth of oral bacteria *Porphyromonas gingivalis*, key bacteria for periodontitis



DSM Nutritional Products
OWN STUDY

Porphyromonas gingivalis growth



STAY-C® 50 rapidly decreases the growth of *Porphyromonas gingivalis* at all tested concentrations

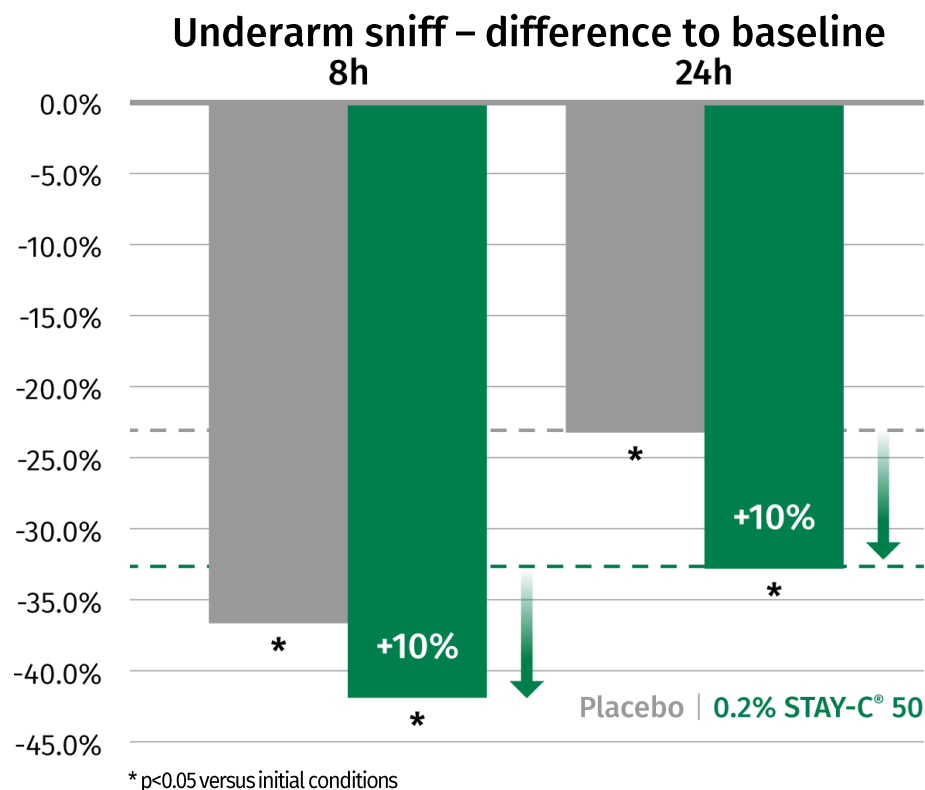
- STAY-C® 50 incubated with the bacteria up to 56 hours
- STAY-C® 50 1%
STAY-C® 50 0.5%
STAY-C® 50 0.1%



DSM Nutritional Products
OWN STUDY

STAY-C® 50 – in deodorants

STAY-C® 50 reduces malodor by more than 40% 8 hours post-application and performs 10% better than placebo



24 hours after the application, the STAY-C® 50 formulation performed an additional 10% better than the placebo

- 10 female volunteers, underarm
- 2 weeks washout period prior test start
- 0.2% STAY-C® 50 in a water base containing 12% EtOH
- Single application

R Jermann & AA Gripp. *Cosmetics and Toiletries Manufacture Worldwide* 153-157 (2004)

STAY-C® 50 + Biotin – combination in skin lightening

Specific claims and combinations with additional ingredients

STAY-C® 50 + Biotin + Niacinamide

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 September 2008 (18.09.2008)

PCT

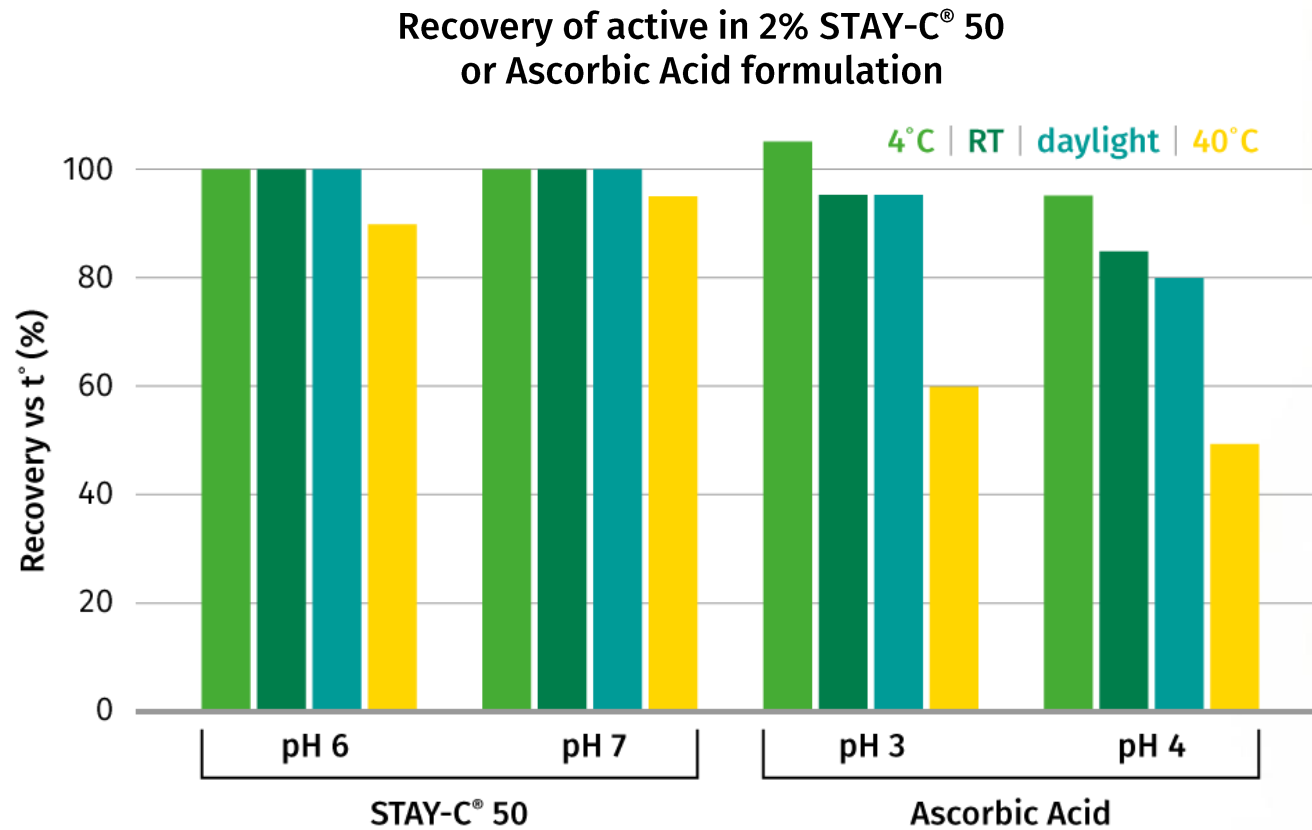
(10) International Publication Number
WO 2008/110268 A1

The present invention relates to the use of ascorbyl phosphate and niacinamide to suppress the crystallization of biotin in cosmetic or dermatological compositions. Furthermore, the invention relates to cosmetic or dermatological compositions comprising ascorbyl phosphate, niacinamide, biotin and a cosmetically acceptable carrier.



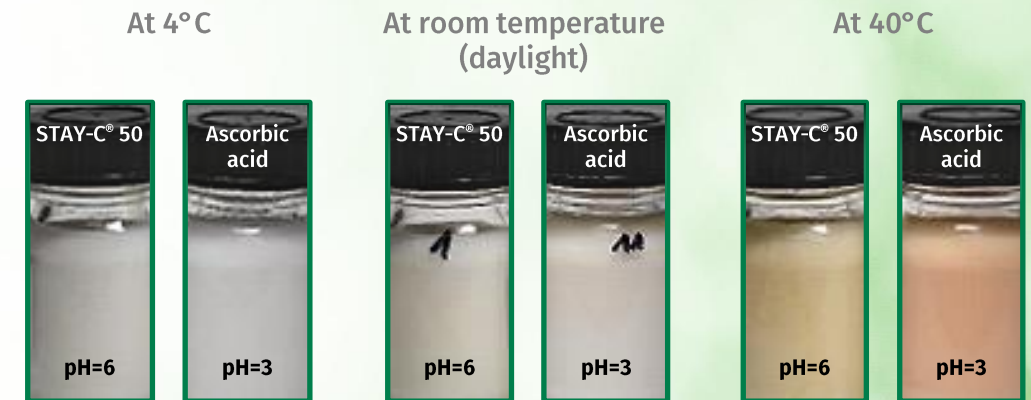
STAY-C® 50 – stability in formulation

STAY-C® 50 is highly stable over 3 months. Even the slight discoloration at 40°C does not impact the content of the active



With STAY-C® 50, the recovery of active is $\geq 90\%$ at all conditions

With Ascorbic acid the recovery is $\geq 80\%$ when stored at 4°C, RT and daylight. At 40°C the recovery is 50-60%

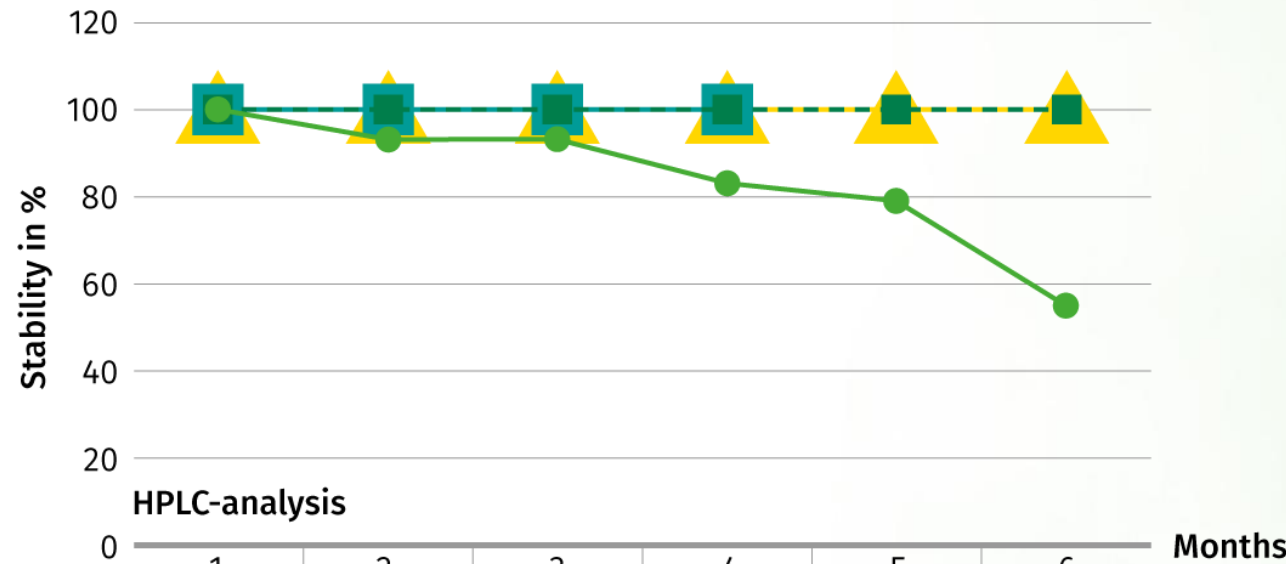


DSM Internal study
Tests were performed at 2 different recommended pH for each grade. All grades were tested at 2%

Comparison – stability in formulation

STAY-C® 50 is 100% stable at room temperature even after 6 months, comparable to other stable Vitamin C derivatives

Stability of 3% aqueous solution
at room temperature without light at pH 7



HPLC-analysis

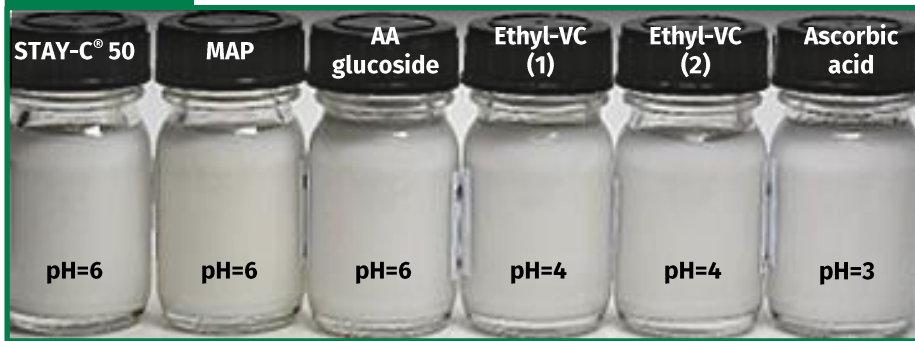
	1	2	3	4	5	6
STAY-C® 50	100	100	100	100	100	100
Magnesium Ascorbyl Phosphate	100	100	99.3	100		
Ascorbyl Glucoside	100	100	99.8	100	100	100
Ascorbic Acid	100	93	93	83	79	55

DSM Internal study

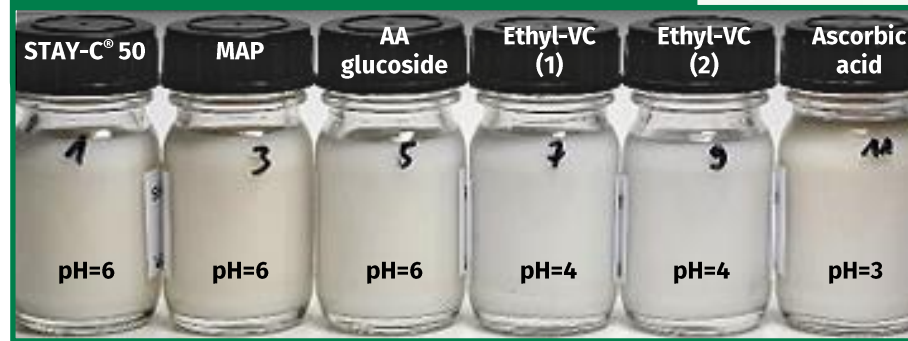
Comparison – color stability in emulsion formulation

STAY-C® 50 and MAP show coloration at elevated temperature, while AA glucoside and Ethyl-VC# have good color stability after 3 months

At 4°C

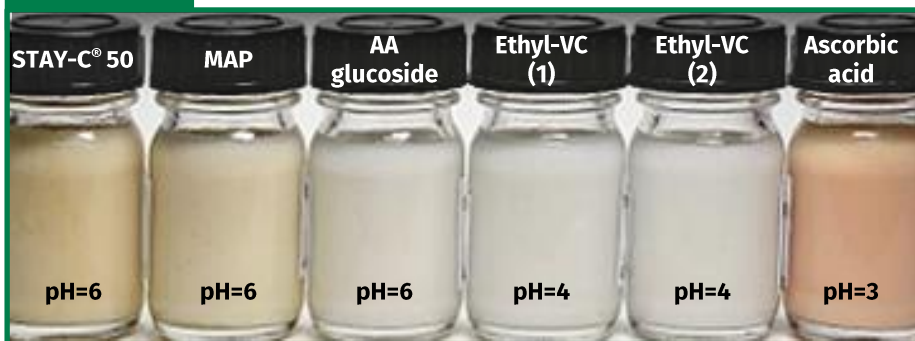


At room temperature (daylight)



At 40°C, AA glucoside and Ethyl-VC have a lower impact on the color stability of finished formulas

At 40°C



DSM Internal study

Tests were performed at 2 different recommended pH for each grade, results at the lowest tested pH for each grade are shown in emulsion-based formula

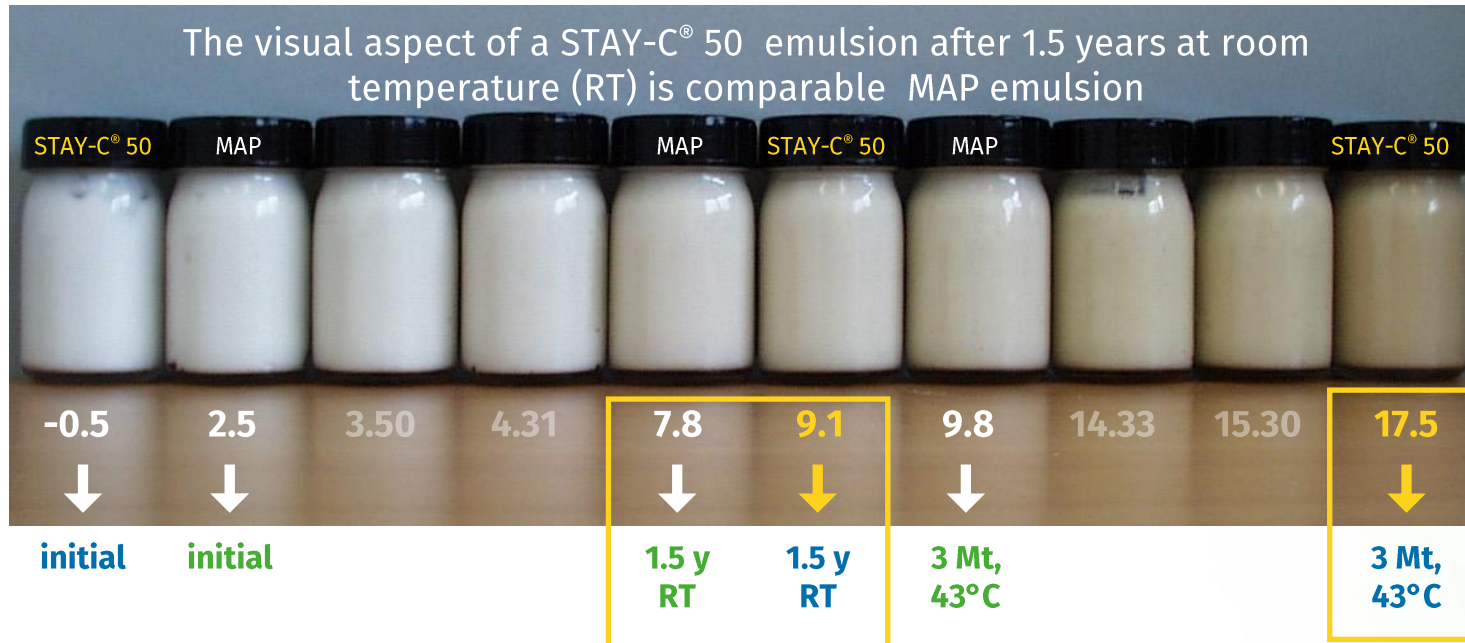
From left to right: Sodium Ascorbyl 2-Phosphate (STAY-C® 50), Magnesium ascorbyl phosphate (MAP), ascorbyl 2-glucoside (AA glucoside), 3-O-ethyl ascorbic acid (Ethyl-VC 1 and 2), Ascorbic Acid Ultra Fine Powder (Ascorbic Acid). All grades were tested at 2%

STAY-C® 50 – color stability in formulation

STAY-C® 50 is color-stable when stored at RT for 18 months.

Accelerated stability test at 40°C does not reflect the long-term color-stability

Long-term color-stability of 3% STAY-C® 50 or MAP
in Brij-emulsion formulation (b* value)



STAY-C® 50 is color-stable when stored at RT for 18 months.

Even though some slight discoloration occurs at 40°C, it does not impact the long-term color stability.