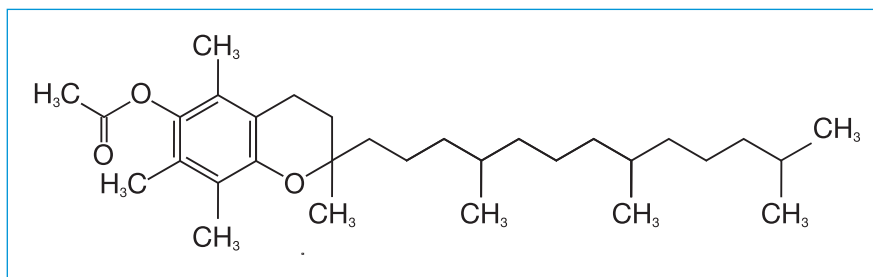


Structural formula**INCI name**

Tocopheryl Acetate

Synonyms

DL-alpha-tocopheryl acetate, DL-alpha-tocopherol acetate, all-rac-alpha-tocopherol acetate, racemic 5,7,8-trimethyltolcol acetate

Molecular formula $C_{31}H_{52}O_3$ **Molar mass**

472.8 g/mol

CAS-No.

7695-91-2

PRD-No.

30499500

EINECS-No.

231-710-0

Description

Light yellow, viscous oil with practically no odor.

Solubility

Miscible with hydrocarbons, alcohols, fats and oils; insoluble in water.

Monographs

The product complies with the current Ph.Eur., USP and FCC monographs and with the German regulations for food additives.

Application

Vitamin E Acetate is an active ingredient for use in cosmetic products for the skin and the hair. As an in-vivo antioxidant, it protects the cells against free radicals and prevents the peroxidation of body fats. It is also an effective moisturizing agent and improves the elasticity and smoothness of the skin. It is particularly suitable for use in sun-protection products and products for daily personal care.

Stability and storage

Vitamin E Acetate is stable towards heat and oxygen, in contrast to Vitamin E alcohol (Tocopherol).

It is not resistant towards alkalis, as it undergoes saponification, or to strong oxidizing agents.

When it is stored in the unopened original container at room temperature the product is stable for at least 36 months.

Synergy with Vitamin C

Results of in-vitro study

Introduction

This study is able to show the synergistic action of Vitamin E and Vitamin C working together as anti-oxidants in the human skin.

Living human keratinocytes (HaCaT cells) were chosen as an in-vitro model. Due to the reduced stability of Tocopherol (Vitamin E) and Ascorbic Acid (Vitamin C) in cosmetic formulations pro-drugs are used, typically Vitamin E Acetate and Sodium Ascorbyl Phosphate, respectively. They were therefore used in this in-vitro cell test. The HaCaT-cell system contains the esterases and phosphatases needed to convert the pro-drugs into the active form.

Sodium Ascorbyl Phosphate is water soluble and can be used as such in this aqueous cell system. Vitamin E Acetate is insoluble in water and has to be brought into solution with a vehicle. To keep the conditions as simple as possible, ethanol was used as vehicle. Vitamin E Acetate was dissolved in 0.1% ethanol. A control experiment ensured that the vehicle (0.1% ethanol solution in water) has no disturbing effect.

Due to different kinetics of the cleavage of the prodrug into the active form, the optimum reaction time had to be determined empirically in preliminary experiments. It could be shown that a reaction time of 48 hrs. for Sodium Ascorbyl Phosphate and 7 days for Vitamin E Acetate are the ideal conditions. (The compounds are stable in water during this time.) If a combination was tested, Vitamin E Acetate supplementation started 5 days before adding Sodium Ascorbyl Phosphate.

Results

Human keratinocytes (HaCaT-cells) were supplemented with Vitamin E Acetate (VEA) diss. In 0.1% ethanol for seven days and/or Sodium Ascorbyl Phosphate (SAP) for 48 hrs.

The following concentrations were tested alone and in combination with the other active ingredient.

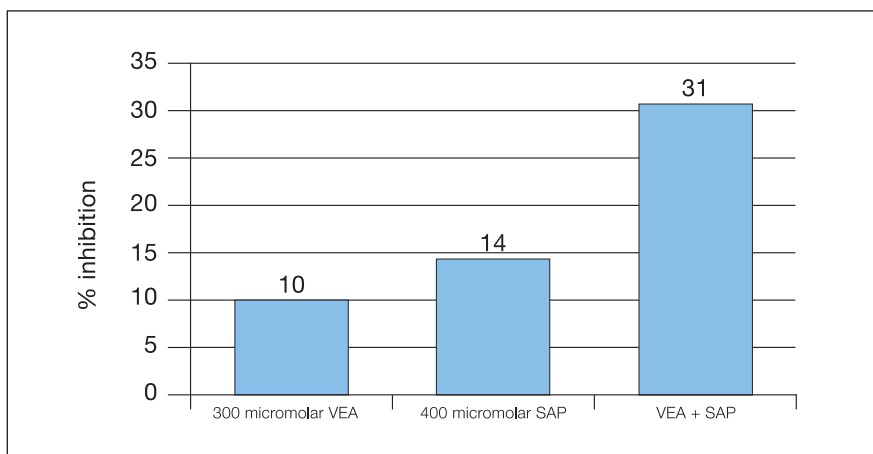
VEA: 3, 10, 30, 100, 300 micromolar

SAP: 50, 100, 200, 400 micromolar

The anti-oxidant effect was determined in measuring the ability to inhibit hydrogen-peroxide induced oxidation.

The cells were incubated with the fluorescence label DCFH. The oxidative stress was induced with 200 micromolar hydrogen peroxide. (These are very harsh conditions.)

The capability of VEA and SAP to inhibit oxidation was measured in determining the resulting fluorescence.



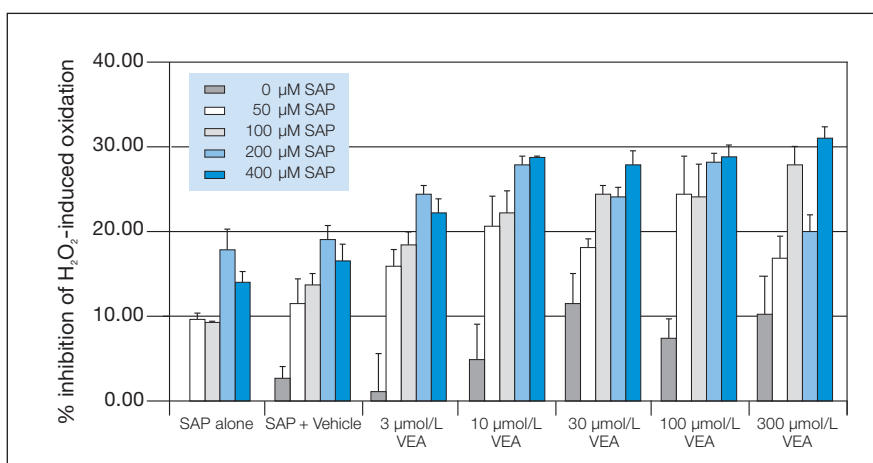
Result: 400 $\mu\text{mol/L}$ SAP and 300 $\mu\text{mol/L}$ VEA

The chart above shows an example with both SAP and VEA at high concentrations. With VEA alone in a concentration of 300 micromolar the inhibition of oxidation is 10%. With SAP alone in a concentration of 400 micromolar the inhibition of oxidation is 14%.

If VEA and SAP are used together in the above mentioned concentration, the inhibition of oxidation is over 30%. This is a synergistic effect, because the theoretical addition of the two ingredients results only 24%.

The effect is much higher than with the single compounds alone and even higher than the theoretical addition.

The following chart shows all the results together.



Overview of results

First column is SAP alone at different concentrations. The effect is dose dependant, because it increases with the concentration. However, a saturation occurs. From a certain concentration level on, an increase in concentration does not lead to a higher effect. The fact, that 200 $\mu\text{mol/L}$ gives the highest effect with 18% while the concentration of 400 $\mu\text{mol/L}$ is a bit lower should not be overrated. This will be due to margin of error.

The second column is the control experiment. The cells are in an aqueous environment. SAP is soluble in water, so not a problem. Vitamin E Acetate (VEA) is oil-soluble, so it has to be brought into solution with a vehicle. This vehicle is 0.1% Ethanol, so a simple dispersion. The results shown in this column are the same as in the first column without the vehicle (within margin of error). Therefore the vehicle does not have an effect. The results for VEA in this test-system are trustworthy.

The columns 3-7 show the results with VEA alone and the results of the experiments with the combination of VEA and SAP.

The results of VEA alone are always the first column in one group. The concentration increases to the right. The effect is similar to the one of SAP, however lower in value. Increase of concentration leads to a higher effect and again there is a saturation effect. At a certain point an increase of concentration does not lead to a higher effect. Maximum effect is 10% inhibition.

All the other columns represent combinations of SAP and VEA. It becomes clearly visible that much higher effects can be obtained if a combination of SAP and VEA is used compared to the values where only one ingredient is used.

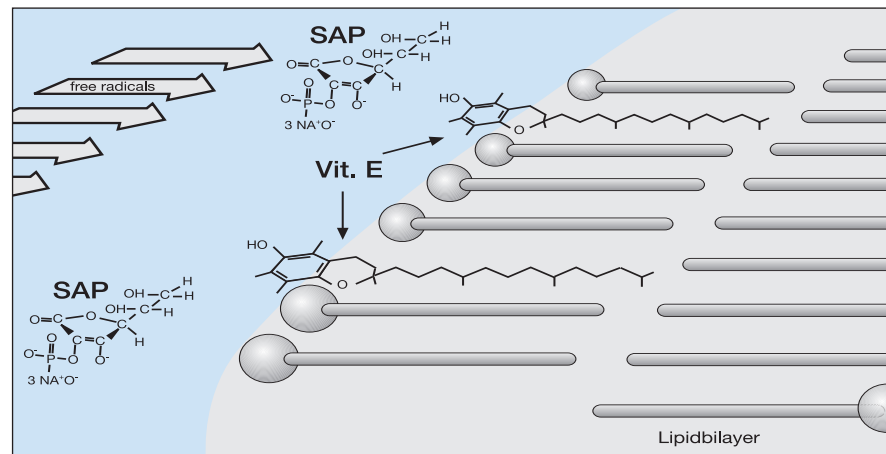
Summary of in-vitro study and conclusions

The maximum inhibition of hydrogen peroxide-induced oxidation with Sodium Ascorbyl Phosphate (SAP) and Vitamin E Acetate (VEA) alone are 18% and 10%, respectively.

Higher values of inhibition can be obtained only if a combination of SAP and VEA is used.

Due to their different solubilities SAP protects the aqueous cytosol part of the system, while VEA is incorporated into the oil-soluble cell-membranes.

The synergistic effect of SAP and VEA is therefore due to the fact that only a combination of a watersoluble with a fatsoluble anti-oxidant offers integral protection.



Typical formulations

After shave balm

No. 07/00040

	%	Ingredients	Supplier	INCI name
A	0.25	Pemulen TR-1	(6)	Acrylates/C10-30 Alkyl Acrylate Crosspolymer
	1.50	Vitamine E Acetate	(1)	Tocopheryl Acetate
	0.20	Bisabolol rac	(1)	Bisabolol
	10.00	Miglyol 812	(11)	Carpilic/Capric Triglyceride
	0.20	Perfume "Round" 250 090	(70)	Perfume
	1.00	Cremophor® CO 40	(1)	PEG-40 Hydrogenated Castor Oil
B	1.00	D-Panthenol USP	(1)	Panthenol
	15.00	Ethanol 96%		Alcohol
	5.00	Glycerin 85%	(20)	Glycerin
	0.05	Tylose H 4000	(260a)	Hydroxyethyl Cellulose
	65.72	Water dem.		Aqua
C	0.08	Sodium Hydroxide	(20)	Sodium Hydroxide

Production: Weigh out the components of phase A and mix them.
Stir phase B into phase A whilst homogenizing and continue homogenizing for a while.
Neutralize with phase C and homogenize again.

Properties: Viscosity: 6,000 mPa·s Brookfield RVD VII+
pH value: 7.0

After shave lotion

No. 07/00043

	%	Ingredients	Supplier	INCI name
A	0.40	Carbopol 1342 Polymer	(6)	Acrylates/C10-30 Alkyl Acrylate Crosspolymer
	10.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	5.00	Vitamin E Acetate	(1)	Tocopheryl Acetate
	0.10	Perfume		
B	15.00	Ethanol		Alcohol
	1.00	D-Panthenol USP	(1)	Panthenol
	3.00	Glycerin 85%	(20)	Glycerin
	0.30	Bisabolol rac.	(1)	Bisabolol
	0.20	Triethanolamine Care	(1)	Triethanolamine
	65.00	Water dem.		Aqua

Production: Weigh out the components of phase A and mix them.
Fold in phase B and homogenize.

Properties: Viscosity: 10,000 mPa·s Brookfield RVD VII+
pH value: 6.1

Shampoo with vitamins**No. 08/00596**

	%	Ingredients	Supplier	INCI name
A	10.00	Rewopol SB FA 30 B	(44)	Disodium Laureth Sulfosuccinate
	10.00	Tego Betain L 7	(44)	Cocamidopropyl Betaine
	40.00	Texapon NSO	(27)	Sodium Laureth Sulfate
	0.50	Vitamin E Acetate	(1)	Tocopheryl Acetate
	0.20	Phytantriol		Phytantriol
	q.s.	Perfume		
	2.00	Cremophor® CO 40	(1)	PEG-40 Hydrogenated Castor Oil
B	30.30	Water dem.		Aqua
	0.50	Sodium Ascorbyl Phosphate	(1)	Sodium Ascorbyl Phosphate
	3.00	Sodium Chloride	(20)	Sodium Chloride
	1.00	D-Panthenol USP	(1)	Panthenol
	2.50	Luviquat® FC 550	(1)	Polyquaternium-16

Production:

Weigh out the components of phase A and mix them. Add the components of phase B one after another and mix until a homogeneous solution is obtained. Set pH value with citric acid as desired.

Properties:

Viscosity: 2,900 mPa·s Brookfield RVD VII+
pH value: 6.1

After Sun Lotion**No. 50/00062**

	%	Ingredients	Supplier	INCI name
A	0.40	Carbopol 1342 Polymer	(6)	Acrylates/C10-30 Alkyl Acrylate Crosspolymer
	15.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	0.20	Bisabolol rac.	(1)	Bisabolol
	q.s.	Perfume		
	1.00	Vitamin E Acetate	(1)	Tocopheryl Acetate
B	1.00	D-Panthenol USP	(1)	Panthenol
	15.00	Ethanol 96%		Alcohol
	3.00	Glycerin 85%	(20)	Glycerin
	64.20	Water, dem.		Aqua dem.
C	0.20	Triethanolamine Care	(1)	Triethanolamine

Production:

Mix the components of phase A. Dissolve phase B and stir into phase A whilst homogenizing. Neutralise with phase C and homogenize again.

Properties:

Viscosity: approx. 7,500 mPa·s Haake Viscotester VT-02
pH value: approx. 6

Multivitamin emulsion**No. 51/00011**

	%	Ingredients	Supplier	INCI name
A	6.00	Cremophor® WO 7	(1)	PEG-7 Hydrogenated Castor Oil
	8.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	5.00	Isopropylmyristate	(27)	Isopropyl Myristate
	15.00	Paraffin Oil		Mineral Oil
	2.00	Elfacos ST 9	(2)	PEG-45/Dodecyl Glycol Copolymer
	0.50	Magnesium Stearate	(10)	Magnesium Stearate
	0.50	Aluminum Stearate	(10)	Aluminum Stearate
B	3.00	Glycerin 85%	(20)	Glycerin
	0.70	Magnesium Sulfate-7-hydrate	(20)	Magnesium Sulfate
	2.00	D-Panthenol USP	(1)	Panthenol
	q.s.	Preservative		
	51.30	Water dem.		Aqua
C	1.00	DL-alpha-Tocopherol	(1)	Tocopherol
	5.00	Vitamin E Acetate	(1)	Tocopheryl Acetate
	q.s.	Perfume		

Production:

Heat phases A and B separately to about 80 °C.
 Stir phase B into phase A and homogenize.
 Cool to about 40 °C, add phase C and homogenize again.

Properties:

Viscosity: 4,000 mPa·s Haake Viscotester VT-02

Vitamin lotion

No. 62/00067

	%	Ingredients	Supplier	INCI name
A	4.00	Cetiol MM	(27)	Myristyl Myristate
	3.00	Miglyol 812	(11)	Caprylic/Capric Triglyceride
	3.00	Fitoderm	(27)	Squalane
	3.00	Tegin Pellets	(44)	Glyceryl Stearate SE
	1.00	Softisan 100	(11)	Hydrogenated Coco-Glycerides
	2.00	Macadamia Nut Oil		Macadamia (Ternifolia) Nut Oil
	0.50	Abil 350	(44)	Dimethicone
	2.00	Cutina Gms	(27)	Stearic Acid
	0.50	Phytantriol		Phytantriol
B	3.00	Glycerin 85%	(20)	Glycerin
	0.20	Pemulen TR-1	(6)	Acrylates/C10-30 Alkyl Acrylate Crosspolymer
	q.s.	Preservative		
	76.72	Water dem.		Aqua
C	0.08	Sodium Hydroxide	(20)	Sodium Hydroxide
D	1.00	Vitamin E Acetate	(1)	Tocopheryl Acetate
	q.s.	Perfume		

Production:

Heat phases A and B separately to about 80 °C.
 Stir phase B into phase A whilst homogenize and continue homogenizing for a while.
 Stir in phase C and rehomogenize.
 Cool to about 40 °C, add phase D and homogenize again.

Properties:

Viscosity: 6,000 mPa·s Haake Viscotester VT-02
 pH value: 7.0

Body care lotion with vitamins

No. 62/00070

	%	Ingredients	Supplier	INCI name
A	2.00	Cremophor® A 6	(1)	Ceteareth-6, Stearyl Alcohol
	2.00	Cremophor A 25	(1)	Ceteareth-25
	3.00	Cutina GMS V	(27)	Glyceryl Stearate
	3.00	Lanette 16	(27)	Cetearyl Alcohol
	1.00	Phytantriol		Phytantriol
	10.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	10.00	Paraffin Oil		Mineral Oil
	0.50	Abil 350	(44)	Dimethicone
B	4.00	1,2-Propylene Glycol Care	(1)	Propylene Glycol
	q.s.	Preservative		
	61.40	Water dem.		Aqua
C	3.00	Vitamin E Acetate	(1)	Tocopheryl Acetate
	0.10	DL-alpha-Tocopherol	(1)	Tocopherol
	q.s.	Perfume		

Production:

Heat phases A and B separately to about 80 °C.
Stir phase B into phase A and homogenize.
Cool to about 40 °C, add phase C and homogenize again.

Properties:

Viscosity: 4,500 mPa·s Brookfield RVD VII+
pH value: 6.0

Vitamin rich body lotion

No. 62/00091

	%	Ingredients	Supplier	INCI name
A	2.00	Cremophor® A 25	(1)	Ceteareth-25
	2.00	Cremophor A 6	(1)	Ceteareth-6, Stearyl Alcohol
	0.10	Phytantriol		Phytantriol
	8.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	6.00	Grape Seed Oil		Grape (Vitis Vinifera) Seed Oil
	3.00	Imwitor 960 K	(11)	Glyceryl Stearate SE
	2.00	Lanette O	(27)	Cetearyl Alcohol
	0.50	Abil 350	(44)	Dimethicone
	0.15	Oxynex 2004	(20)	BHT, Ascorbyl Palmitate, Citric Acid, Glyceryl Stearate, Propylene Glycol
B	3.00	1,2-Propylene Glycol Care	(1)	Propylene Glycol
	1.00	D-Panthenol USP	(1)	Panthenol
	0.20	Edeta® BD	(1)	Disodium EDTA
	2.00	Glycerin 85%	(20)	Glycerin
	q.s.	Preservative		
	63.35	Water dem.		Aqua
	0.30	Carbopol 940 Polymer	(6)	Carbomer
C	0.30	Triethanolamine Care	(1)	Triethanolamine
D	0.20	Sodium Ascorbyl Phosphate	(1)	Sodium Ascorbyl Phosphate
	5.00	Water dem.		Aqua
	0.50	Thermoplex	(23)	Soluble Collagen, Glycerin
E	0.40	Vitamin E Acetate	(1)	Tocopheryl Acetate
	q.s.	Perfume		

Production:

Heat phases A and B separately to about 80 °C. Stir phase B into phase A whilst homogenize and continue homogenizing for a while. Stir in phase C and rehomogenize. Cool to about 40 °C, add phases D and E and homogenize again.

Properties:

Viscosity: 11,000 mPa·s Brookfield RVD VII+
pH value: 6.5

Hand cream with ACE

No. 62/00095

	%	Ingredients	Supplier	INCI name
A	6.00	Cremophor® WO 7	(1)	PEG-7 Hydrogenated Castor Oil
	10.00	Paraffin Oil		Mineral Oil
	3.00	Vaseline		Petrolatum
	5.00	Miglyol 812	(11)	Caprylic/Capric Triglyceride
	2.00	Elfacos ST 9	(2)	PEG-45/Dodecyl Glycol Copolymer
	5.00	Jojoba Oil		Jojoba (Buxus Chinensis) Oil
B	3.00	1,2-Propylene Glycol Care	(1)	Propylene Glycol
	0.10	Edeta® BD	(1)	Disodium EDTA
	q.s.	Preservative		
	62.40	Water dem.		Aqua
C	2.00	Retinol 10 S	(1)	Glycine Soja (Soybean) Oil, Retinol
	0.20	Sodium Ascorbyl Phosphate	(1)	Sodium Ascorbyl Phosphate
	0.20	Vitamin E Acetate	(1)	Tocopheryl Acetate
	0.10	BHT	(20)	BHT
	q.s.	Perfume		

Production:

Heat phases A and B separately to about 85 °C.
Stir phase B into phase A and homogenize.
Cool to about 40 °C, add phase C and homogenize again.

Recommendation:

Do the production of the emulsion and the filling into appropriate containers in the absence of oxygen.

Properties:

Viscosity: 20,000 mPa·s Brookfield RVD VII+

Day care cream with ACE

No. 62/00096

	%	Ingredients	Supplier	INCI name
A	2.00	Cremophor® A 6	(1)	Ceteareth-6, Stearyl Alcohol
	2.00	Cremophor A 25	(1)	Ceteareth-25
	4.00	Lanette O	(27)	Cetearyl Alcohol
	10.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	3.00	Cutina GMS V	(27)	Glyceryl Stearate
	5.00	Vaseline		Petrolatum
B	5.00	1,2-Propylene Glycol Care	(1)	Propylene Glycol
	0.10	Edeta® BD	(1)	Disodium EDTA
	q.s.	Preservative		
	68.10	Water dem.		Aqua
C	0.50	Retinol 10 S	(1)	Glycine Soja (Soybean) Oil, Retinol
	0.20	Sodium Ascorbyl Phosphate	(1)	Sodium Ascorbyl Phosphate
	0.10	Vitamin E Acetate	(1)	Tocopheryl Acetate
	q.s.	Perfume		

Production:

Heat phases A and B separately to about 80 °C.
Stir phase B into phase A and homogenize.
Cool to about 40 °C, add phase C and homogenize again.

Recommendation:

Do the production of the emulsion and the filling into appropriate containers in the absence of oxygen.

Properties:

Viscosity: 15,400 mPa·s Brookfield RVD VII+
pH value: 7.4

Night care cream with ACE**No. 62/00098**

	%	Ingredients	Supplier	INCI name
A	2.00	Cremophor® A 6	(1)	Ceteareth-6, Stearyl Alcohol
	2.00	Cremophor A 25	(1)	Ceteareth-25
	4.00	Lanette O	(27)	Cetearyl Alcohol
	10.00	Luvitol® EHO	(1)	Cetearyl Ethylhexanoate
	3.00	Cutina GMS V	(27)	Glyceryl Stearate
	5.00	Vaseline		Petrolatum
B	5.00	1,2-Propylene Glycol Care	(1)	Propylene Glycol
	0.10	Edeta® BD	(1)	Disodium EDTA
	q.s.	Preservative		
	67.40	Water dem.		Aqua
C	0.50	Retinol 10 S	(1)	Glycine, Soja (Soybean) Oil, Retinol
	0.50	Sodium Ascorbyl Phosphate	(1)	Sodium Ascorbyl Phosphate
	0.50	Vitamin E Acetate	(1)	Tocopheryl Acetate
	q.s.	Perfume		

Production: Heat phases A and B separately to about 80 °C. Stir phase B into phase A and homogenize. Cool to about 40 °C, add phase C and homogenize again.

Recommendation: Do the production of the emulsion and the filling into appropriate containers in the absence of oxygen.

Properties: Viscosity: 11,000 mPa·s Brookfield RVD VII+
pH value: 7.8

Skin conditioning gel with vitamins**No. 62/00099 V003**

	%	Ingredients	Supplier	INCI name
A	4.00	Cremophor RH 410	(1)	PEG-40 Hydrogenated Castor Oil
	15.00	Ethanol		Alcohol
	0.10	Bisabolol rac.	(1)	Bisabolol
	0.50	Vitamin E-Acetate Care	(1)	Tocopheryl Acetate
	q.s.	Perfume		
B	3.00	D-Panthenol USP	(1)	Panthenol
	0.60	Carbopol 940 Polymer	(6)	Carbomer
	76.00	Water dem.		Aqua dem.
C	0.80	Triethanolamine Care	(1)	Triethanolamine

Production: Dissolve phase A clearly. Allow phase B to swell and neutralize it with phase C. Stir phase A into the neutralized phases B + C and homogenize.

Properties: Viscosity: 57,600 mPa·s Brookfield RVD VII+
pH value: 7.7