dermofeel®
Natural Antioxidants and Chelating Agents

Evonik Dr. Straetmans

dr.straetmans®

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Leading Beyond Chemistry

Shelf life of oils

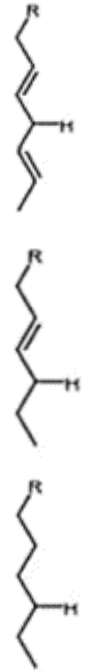
< 1 Year	1 Year	2 Year
Hazelnut Oil Hempseed Oil Grapeseed Oil Apricot Kernel Oil Primrose Oil Flax Seed Oil Sesame Oil Sweet Almond Oil Wheatgerm Oil	Avocado Oil Castor Oil Coconut Oil Emu Oil Palm Oil Palm Kernel Oil Safflower Oil Shea Butter	Canola Oil Olive Oil Tamanu Oil

unsaturated

The more unsaturated an oil, the more unstable it is.

Shelf life of oils

	Saturated	Mono-unsaturated	Poly-unsaturated
Hempseed Oil	7	9	82
Sunflower Oil	11	20	66
Apricot Kernel Oil	8	66	25
Almond Oil	10	70	20
Castor Oil	1	94	5
Olive Oil	15	72	11
Argan Oil	18	43	37
Palm Oil	49	40	9
Palm Kernel Oil	82	15	2
Coconut Oil	83	7	2



Poly-unsaturated lipids are unstable towards oxygen

Mono-unsaturated lipids are fairly stable towards oxygen

Saturated lipids are stable towards oxygen

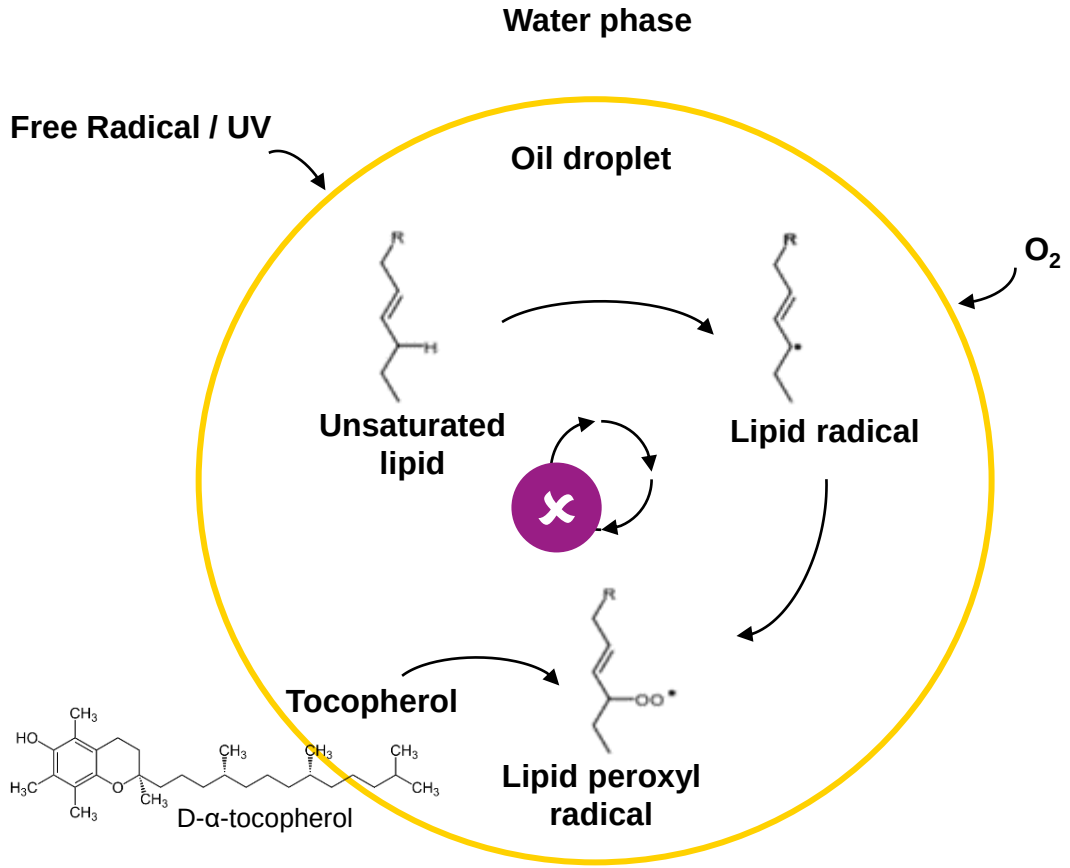
The more unsaturated an oil, the more unstable it is.

Why are natural oils used in cosmetics?

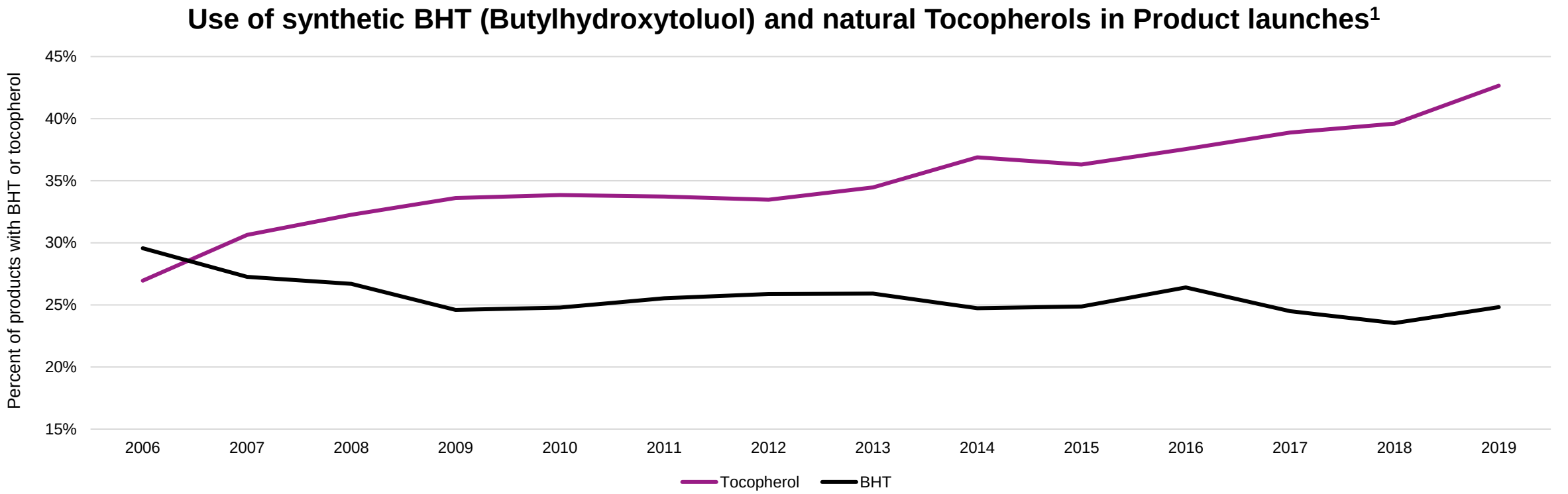
- Creating a pleasant sensory
- Perfuming, aromatherapy
- Formulating variety
- Compliant with natural standards
- Attractive INCI
- Different marketing concepts

Mode of action antioxidants

“Chain breaker”
Tocopherols intercept lipid peroxyl radicals and terminate the lipid peroxidation chain reactions.



Natural tocopherols vs. synthetic BHT



Since 2006, the number of natural tocopherols used in cosmetic products has been increasing, while the use of synthetic antioxidants (such as BHT) is decreasing.

[1] Mintel

Antioxidants in nature
Performance of different D-tocopherols

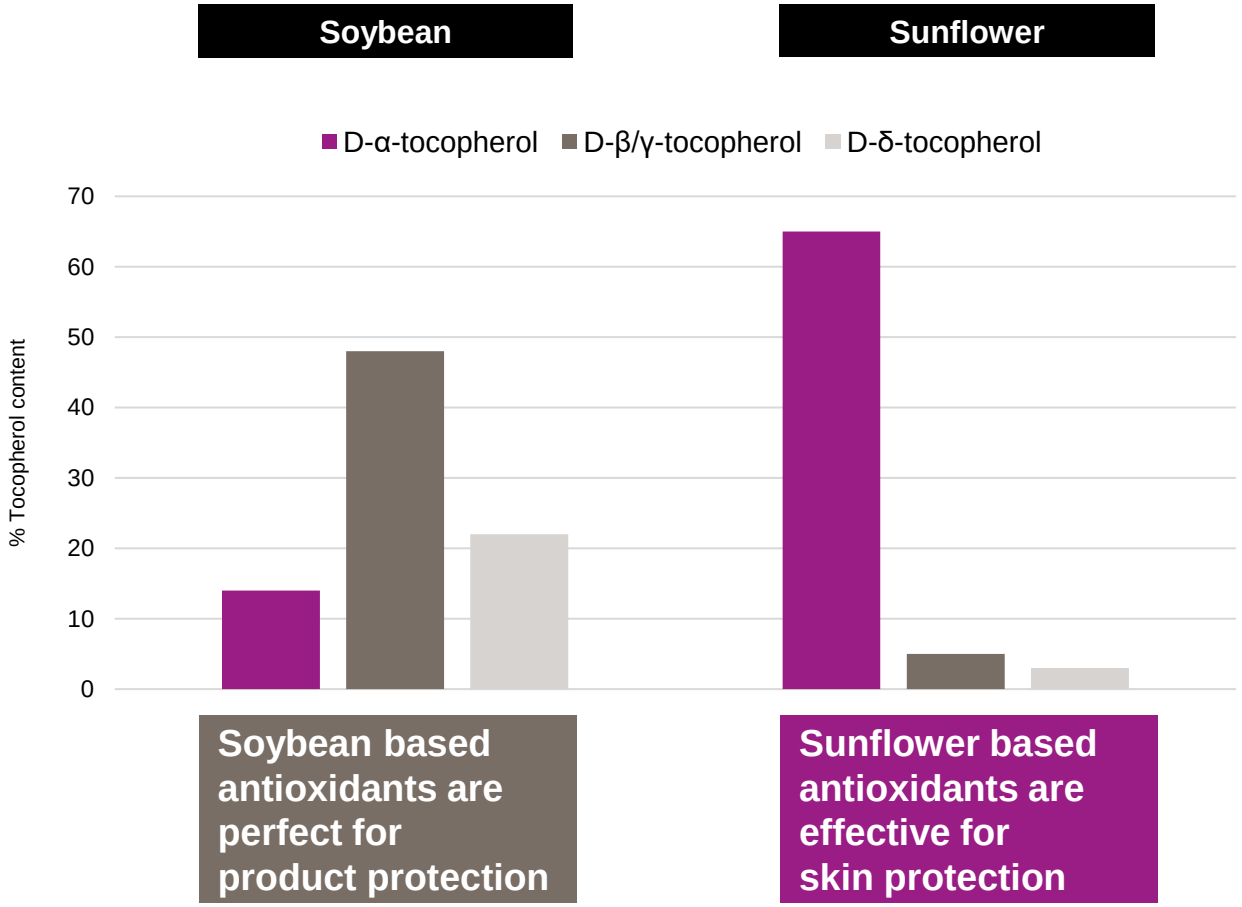
Type of Tocopherol	Biological activity (IU/mg) in the physiological environment (with D-α-tocopherol as 1)	Antioxidant activity (with D-α-tocopherol as 1) in a O/W-emulsion
D-α-tocopherol *	1.0	1.0
D-β-tocopherol	0.5	1.3
D-γ-tocopherol	0.1	2.0
D-δ-tocopherol	0.07	4.0

* Synthetic D-L-α-tocopherol has only a relative biological activity (IU/mg) of 0.67

In the physiological environment of the **skin D-α-tocopherol** has the highest antioxidant efficacy.

At the interface of an **O/W-emulsion D-γ and δ-tocopherol** have the highest antioxidant efficacy.

Antioxidants in nature
Performance of different D-tocopherols



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dermofeel® Toco 70 non GMO

Non GMO, **soy based** antioxidant for effective product protection

PROPERTIES

INCI	Tocopherol, Helianthus Annuus (Sunflower) Seed Oil
Appearance	Brown, viscous liquid, mild odor
Active matter	> 70% total tocopherol content
Dosage	0.05 – 1.5%
Certifications	COSMOS Non-GMO

APPLICATIONS

Protection against oxidation of natural ingredients, for all cosmetic products

For products with a high content of natural oils

THE PRODUCT

- Antioxidant for product protection
- Mixed tocopherol content from non-GMO sources
- Suitable for natural cosmetics
- Contains 30% organic sunflower oil

Natural sunflower based antioxidant for skin protection

dermofeel® TocoSkin

- Natural high content of D-alpha Tocopherol
- For certified natural cosmetics
- Effictive skin protection

70% of females who buy natural cosmetic products look for **Vitamin E** as ingredient (2017)[1]

[1] The Benchmarking Company

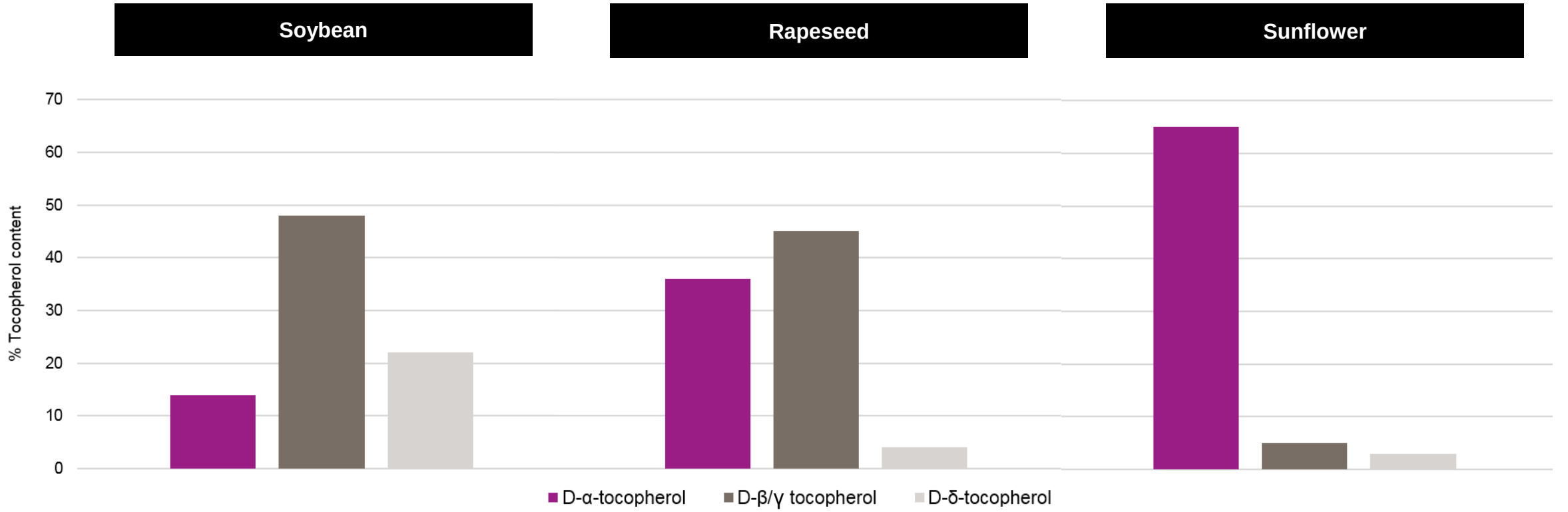
dermofeel® TocoSkin
Sunflower based antioxidant for skin protection

PROPERTIES	
INCI	Tocopherol, Helianthus Annuus (Sunflower) Seed Oil
Appearance	Clear brownish red, mild odor
Active matter	Min. 60.4% d-alpha-tocopherol content
Dosage	0.05 – 1.0%
Certifications	COSMOS

APPLICATIONS
Anti-Aging or skin protecting lotions
Sun protecting creams
Skin protecting serums

THE PRODUCT
▪ Sunflower based antioxidant with a high content of alpha-tocopherol
▪ Suitable for natural cosmetics
▪ Prevents the skin from damage caused by free radicals
▪ Anti-inflammatory effect
▪ Contains 30% organic sunflower oil

Antioxidants in nature
D-tocopherols from different sources



Rapeseed naturally contains a very balanced proportion of D-tocopherols.

dermofeel® TocoBalance

- Natural balanced content of tocopherols
- For certified natural cosmetics

Natural rapeseed based multifunctional antioxidant for product and skin protection at once

dermofeel® TocoBalance

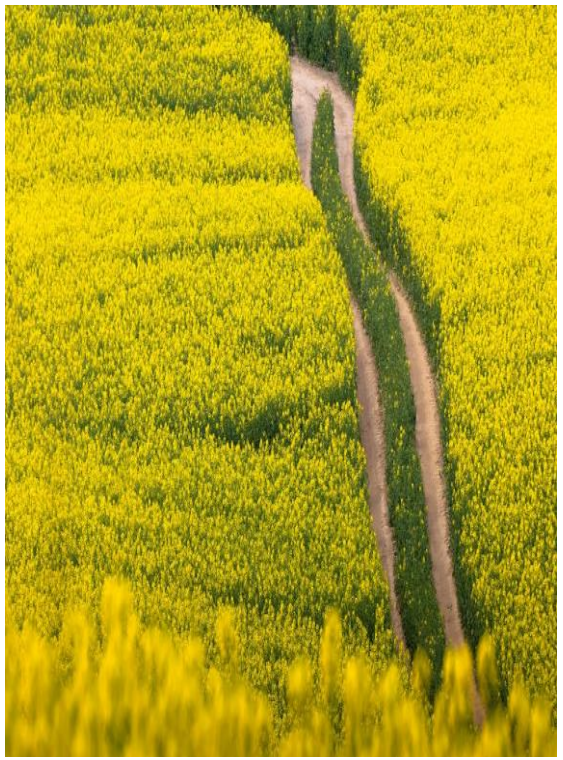
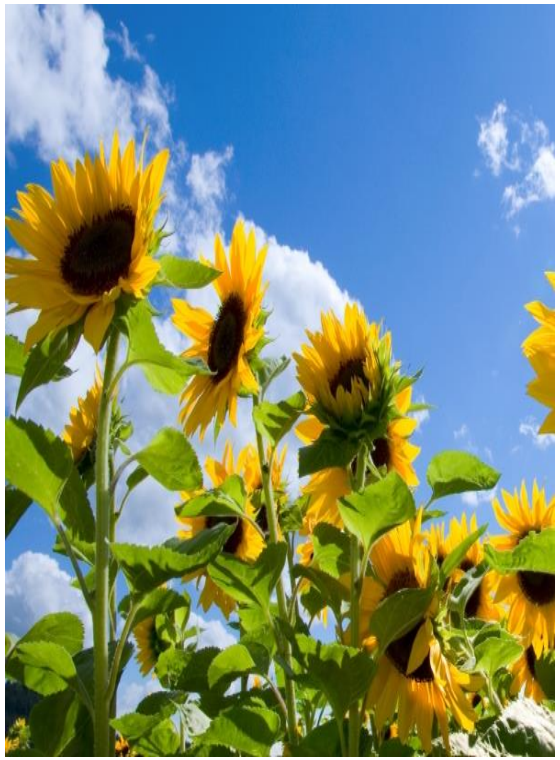
Rapeseed based multifunctional antioxidant for product and skin protection

PROPERTIES	
INCI	Tocopherol, Helianthus Annuus (Sunflower) Seed Oil
Appearance	Clear brownish red, mild odor
Active matter	> 70% total tocopherol content
Dosage	0.05 – 1.5%
Certifications	COSMOS

APPLICATIONS
Perfect for products with a high content of natural oils
Sun protecting creams
Anti-Aging and skin protecting creams

THE PRODUCT
▪ Balanced content of mixed tocopherols from non-GMO rapeseed
▪ Effectively protects valuable ingredients in cosmetics formulation from oxidation
▪ Additional benefit of antioxidative activity for the skin
▪ Suitable for natural cosmetics
▪ Contains 30% organic sunflower oil

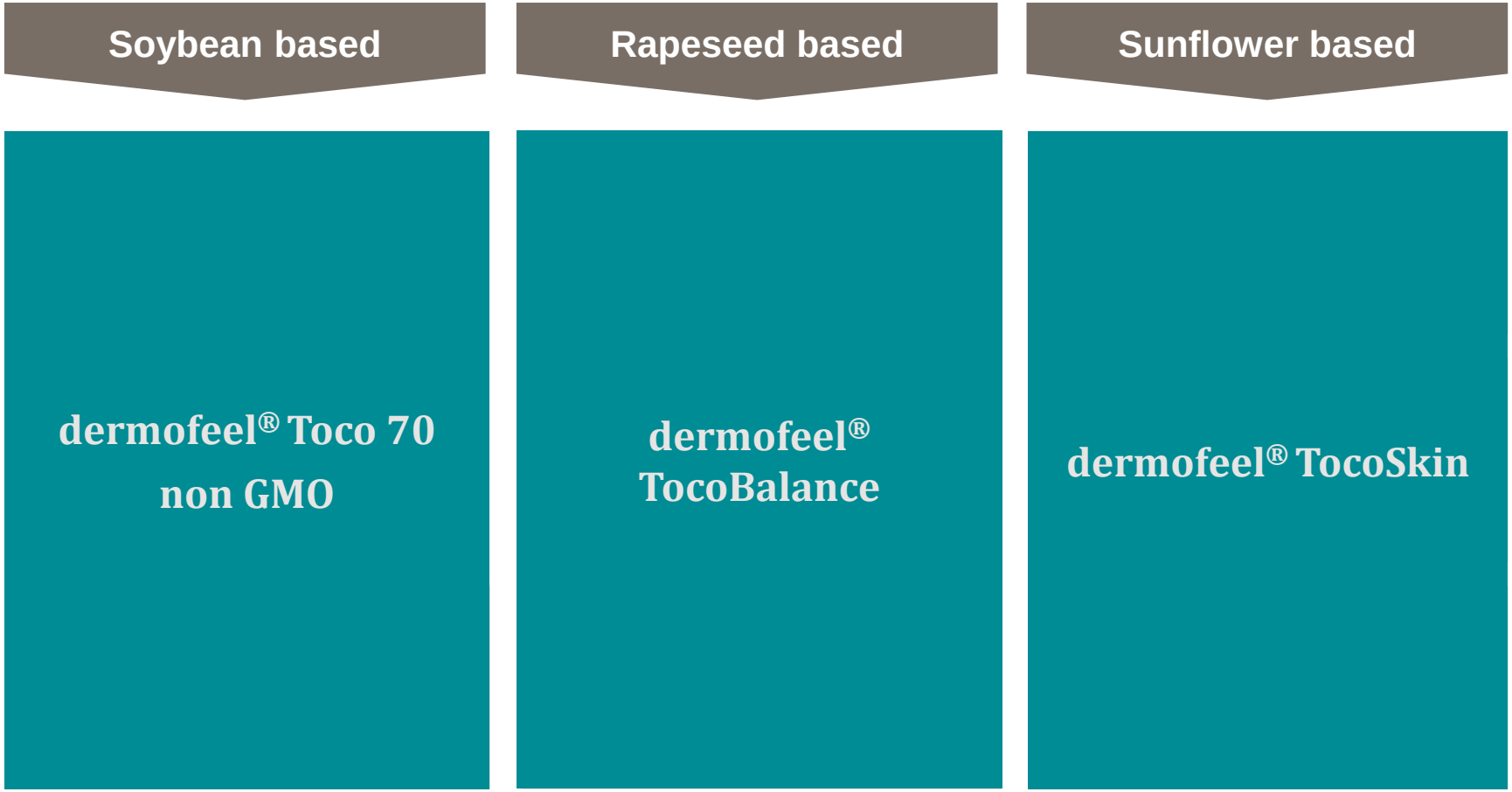
Sources of tocopherols
Comparison of the environmental impact

	Soybean based	Rapeseed based	Sunflower based
Farming (land use)			
Fuel impact (meaning consumption while planting, harvesting, drying, transporting and refining)			
Water/vapor			

Sources of tocopherols
Comparison of the environmental impact

	Soybean based	Rapeseed based	Sunflower based
Farming (land use)	**11.8** ha of land used per 1 kg of tocopherol	**4.5** ha of land used per 1 kg of tocopherol	**7.2** ha of land used per 1 kg of tocopherol
Fuel impact (meaning consumption while planting, harvesting, drying, transporting and refining)		45% lower fuel impact	45% lower fuel impact
Water/vapor	285 kg of vapor used per MT of seeds	40 – 100% lower water consumption (farming)	56% lower vapor consumption due to higher oil content

Sources of tocopherols
Comparison of the environmental impact



Further ways to increase product protection

Decreasing oxidation rate with Phytic Acid derivatives

- Oxidation can depend on many factors like
  - Ingredient
  - Packaging
  - Metal ions (catalysts for oxidation)

- Inactivating metal ions with chelators (complexing agents) slows down the rate of oxidation!

- Phytic acid is a natural chelator (and replacement for EDTA) and helps in the protection of the product

Metal ions in cosmetics

Sources of metal ions

- Equipment
- Ingredients (natural, pigments)
- Process water (hardness)

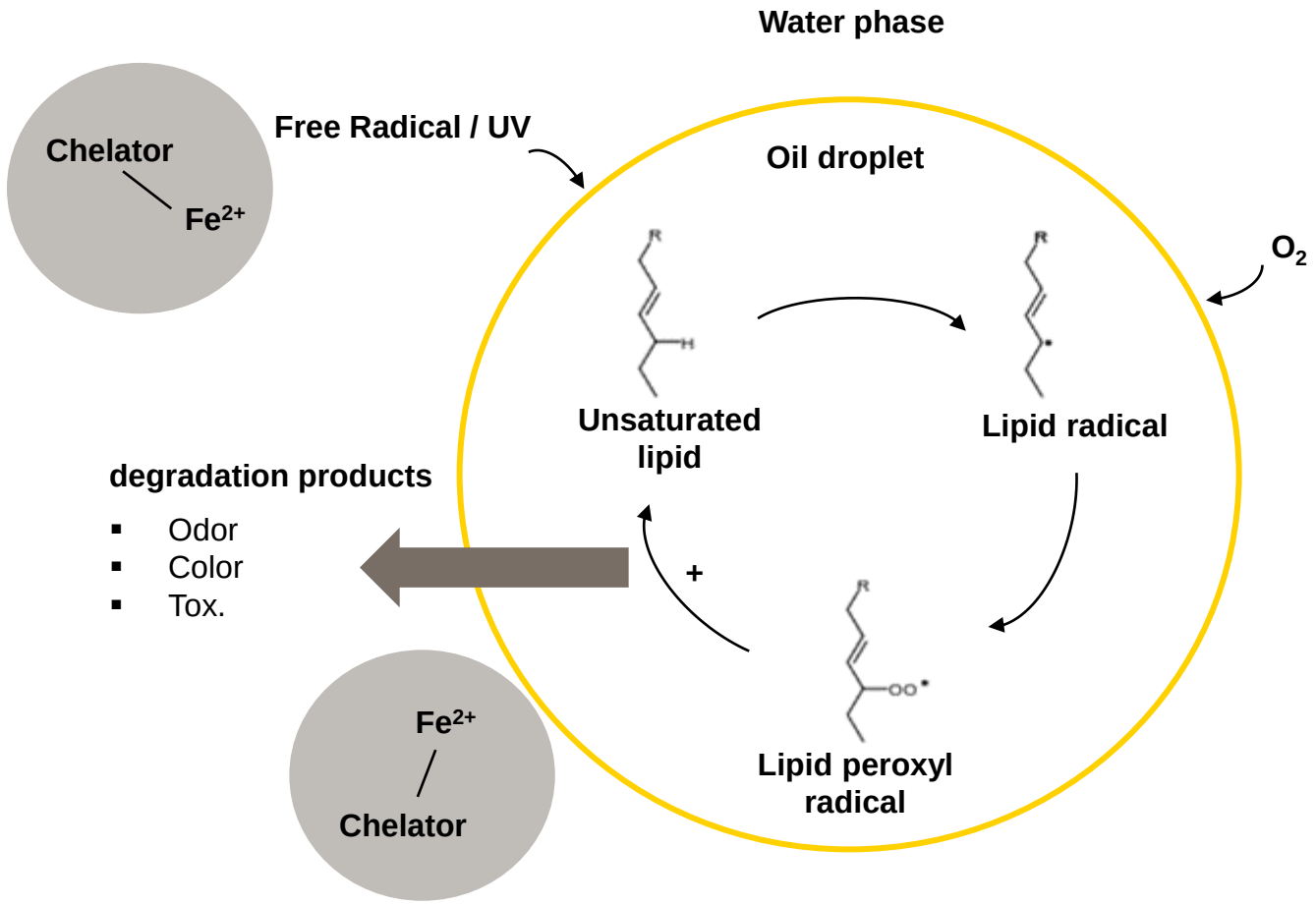
Metal ions in cosmetic formulations can

- Promote oxidation reactions (Cu^{+}, Fe^{2+})
- Cause discoloration
- Reduce foaming properties (Ca^{2+}, Mg^{2+})

Cations in tap water
Sodium (Na^{+})
Potassium (K^{+})
Magnesium (Mg^{2+})
Calcium (Ca^{2+})
Anions in tap water
Chloride (Cl^{-})
Fluoride (F^{-})
Sulfate (SO_4^{2-})
Hydrogen carbonate (HCO^{3-})
Nitrate (NO^{3-})

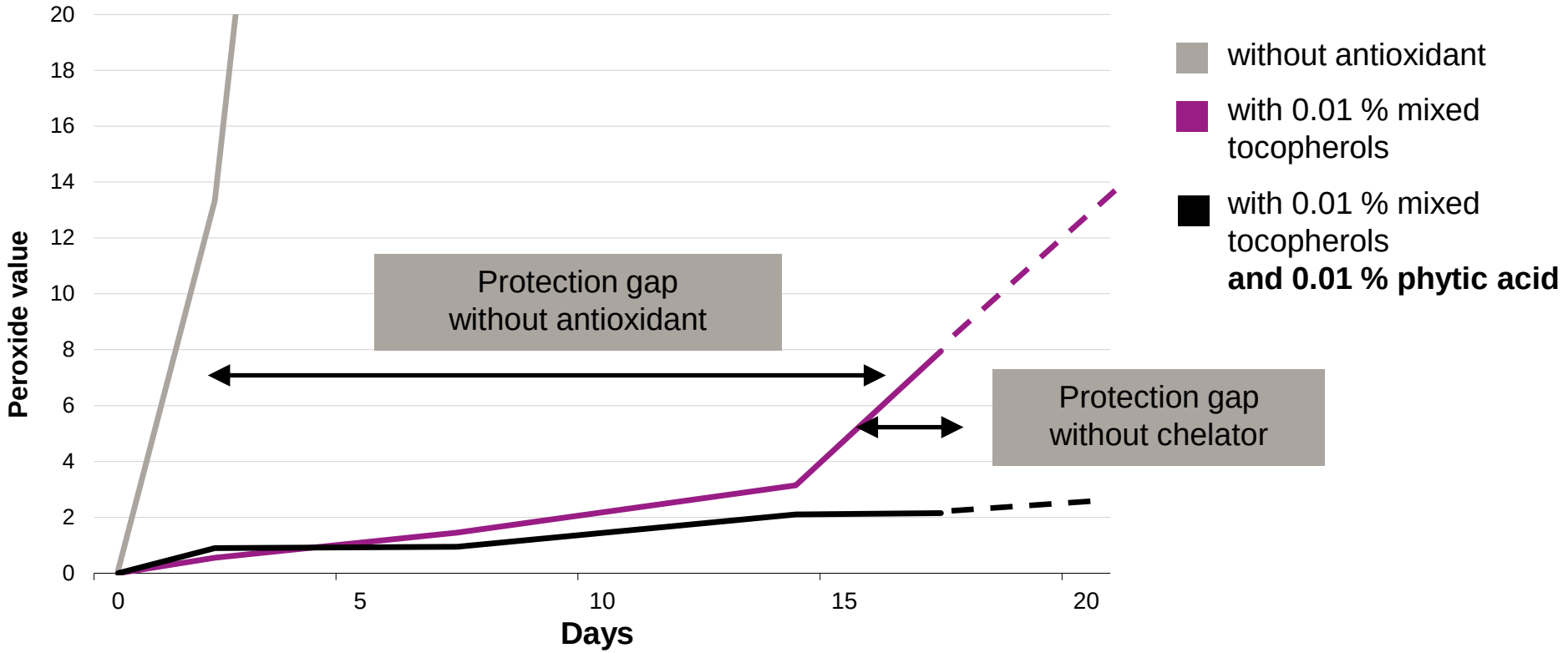
Function of chelators
Supporting the antioxidant system

Chelators are inactivating metals by forming a complex between the chelator and the metal.



Function of chelators
Supporting the antioxidant system

Peroxide value of Methyloleate
at 40°C in the presence of Cu^{2+}



Chelators acting synergistically in combination with antioxidants.

Source: Loury, M., François, R., Bloch, C., Rev. Fse Corps Gras 15 (1) (1968) 34 – 35.

Function of chelators

Bind metal ions to prevent their oxidation catalyst function

1. Protect valuable ingredients from oxidation, e.g. unsaturated oils, perfume, actives
2. Elongate the lifecycle of your antioxidation ingredients

Activity in rinse-off products

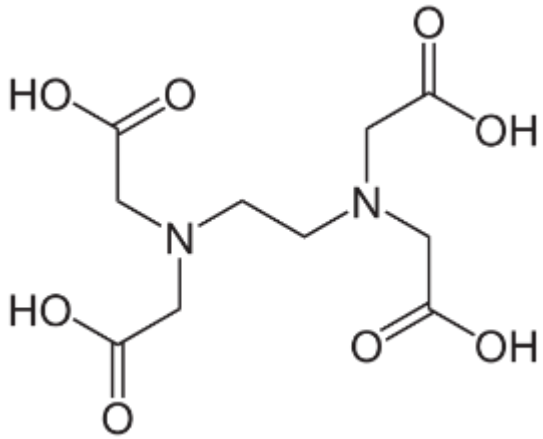
1. Maintains foaming properties in presence of hard water during application
2. Prevents precipitation of divalent fatty acid salts in soaps

The common chelator EDTA
– the downside?

1. Origin: Synthesis from petrochemically derived materials
   → not suitable for natural cosmetics

2. Biodegradability: very low or non-degradable, depending on the complexed metal ions[1]

3. Water endangering class = WGK 2 water endangering[2] (out of a 1-3 scale)



[1] *European Union Risk Assessment Report EDETIC ACID (EDTA) 2004, Van Ginkel 1999.* | [2] *German Environment Agency.*

dermofeel® PA Range

- Range of natural chelating agents
- For certified natural cosmetics
- Acts synergistically in combination with antioxidants

Range of natural chelating agents serving as a natural alternative to EDTA

dermofeel® PA Range
Natural chelating agents

dermofeel® PA

The economic, liquid alcohol-free

- INCI: Phytic Acid, Aqua
- Appearance: Colorless to brownish liquid
- Use concentration as chelator: 0.05 – 0.2 %
- pH of the raw material ~1

dermofeel® PA-3

The liquid, easy to work with

- INCI: Sodium Phytate, Aqua, Alcohol
- Appearance: Colorless to brownish liquid
- Use concentration as chelator: 0.05 – 0.2 %
- pH of the raw material 3

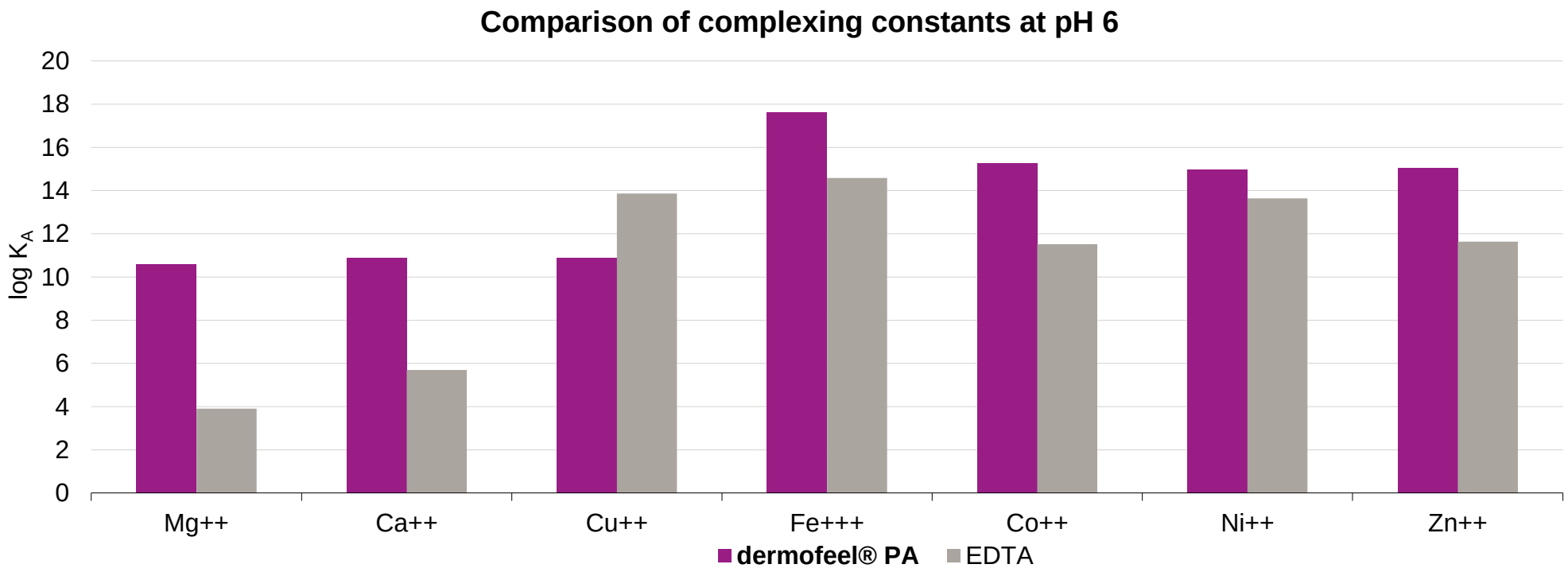
dermofeel® PA-12

The powder with high pH

- INCI: Sodium Phytate
- Appearance: white powder
- Use concentration as chelator: 0.05 – 0.5 %
- pH of the raw material 12

Further Product Information

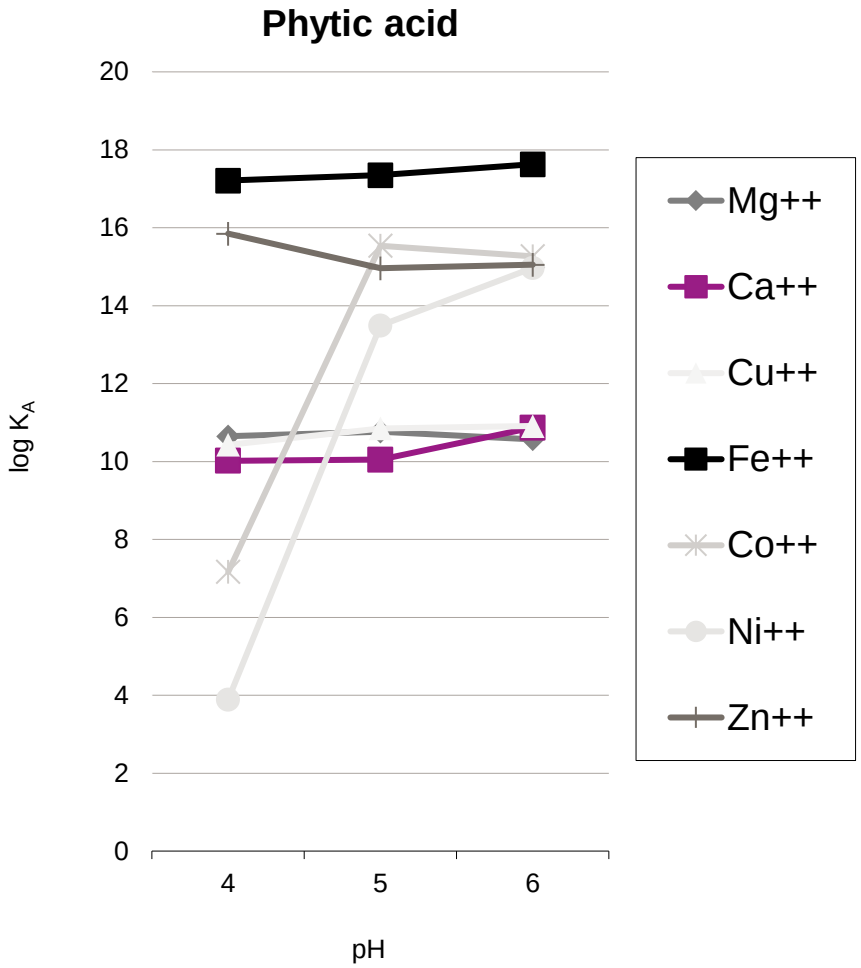
Comparison of chelating activity
dermofeel® PA vs. EDTA

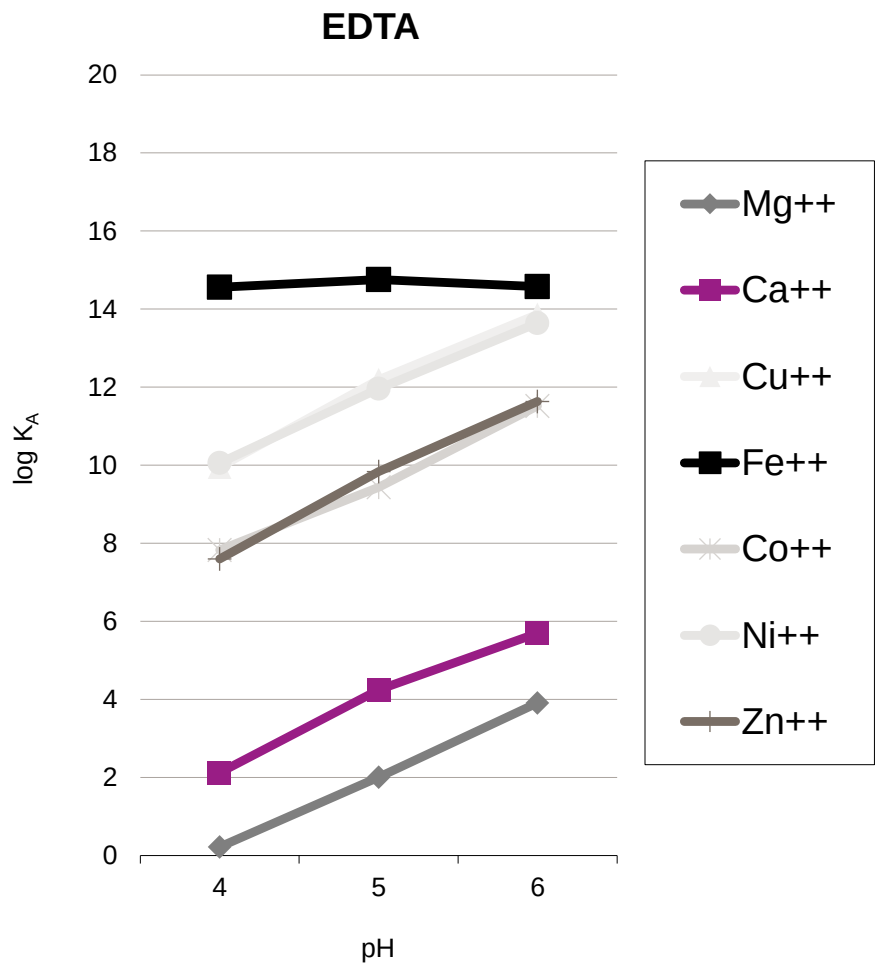


The chelating efficacy of dermofeel® PA is mostly comparable to the chelating activity of the commonly used EDTA.

Comparison of chelating activity
pH dependent complexing activity

Theoretical calculation





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Complete for product protection

Complete product protection

Antimicrobial protection	Antioxidant protection		
dermosoft® Verstatil®	Antioxidant skin protection	Antioxidant protection of ingredients	Extension of antioxidant protection
	dermofeel® TocoSkin dermofeel® E 67 non GMO dermofeel® E 74 A non GMO	**dermofeel® Toco 70 non GMO dermofeel® Toco 50 non GMO**	**dermofeel® PA dermofeel® PA-3 dermofeel® PA-12 dermofeel® AP MB**
		dermofeel® TocoBalance	


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