

# Vitamin E

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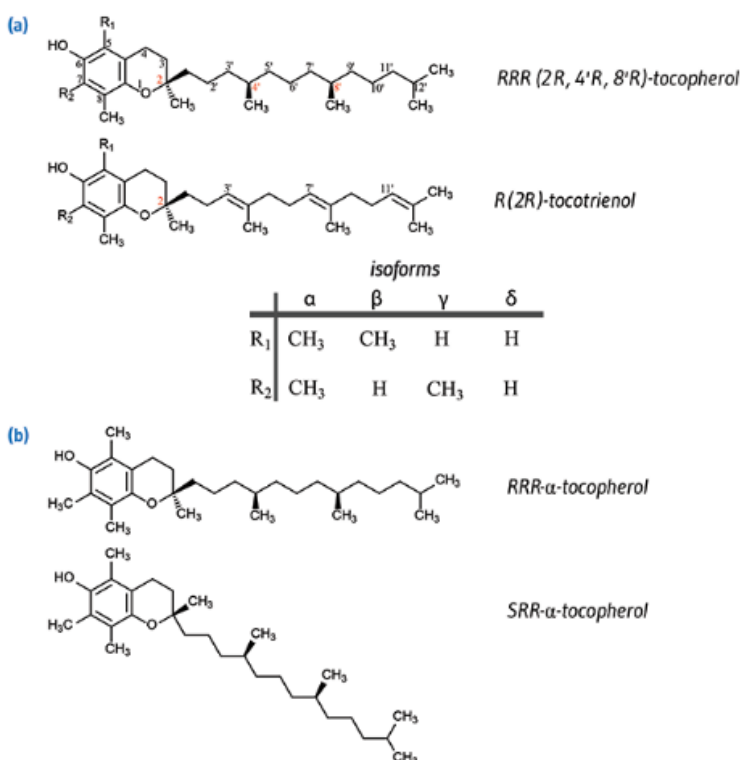
## plant oils



**Vitamin E** is a general term for 8 natural tocopherols & tocotrienols as well as for countless synthetic tocopherol-derivatives.

All vitamin E forms are oil soluble (lipophilic). The natural forms are  $\alpha$ -,  $\beta$ -,  $\gamma$ -, and  $\delta$ -tocopherol and  $\alpha$ -,  $\beta$ -,  $\gamma$ -, and  $\delta$ -tocotrienol.

**Figure 1. Chemical Structures of Vitamin E Isoforms**



(a) Tocotrienols differ from tocopherols in that they have an unsaturated side chain. The four isoforms of both tocopherol ( $\alpha$ -,  $\beta$ -,  $\gamma$ -, and  $\delta$ -tocopherol) and tocotrienol ( $\alpha$ -,  $\beta$ -,  $\gamma$ -, and  $\delta$ -tocotrienol) differ by the presence or absence of methyl groups on the chromanol ring (R<sub>1</sub> and R<sub>2</sub>). Natural tocopherols have an RRR-configuration at the three chiral centers at the 2, 4', and 8'-positions; natural tocotrienols have an R-configuration at the 2-position. Among the eight isoforms of vitamin E, only  $\alpha$ -tocopherol (R<sub>1</sub>=CH<sub>3</sub> and R<sub>2</sub>=CH<sub>3</sub>) has been found to reverse vitamin E deficiency symptoms in humans. (b) Chemically synthesized  $\alpha$ -tocopherol, known as *all-rac*- $\alpha$ -tocopherol, contains a mixture of eight stereoisomers that arose from the three chiral carbons at the positions 2, 4', and 8': RRR and SRR (shown here), and RSR, RRS, RSS, SSR, SRS, and SSS. Because only stereoisomers with an R-configuration in position 2 (aka 2R-stereoisomers) of  $\alpha$ -tocopherol meet human vitamin E requirements, half of the stereoisomers present in *all-rac*- $\alpha$ -tocopherol (RRR, RSR, RRS, and RSS) are considered to be biologically active forms of vitamin E.

*Tocopherol and tocotrienol structure- Courtesy of: Linus Pauling Institute*

Among all these forms the  $\alpha$ -tocopherol is the most effective and useful form and the only form that can compensate vitamin E deficiency as a dietary supplement. It is the same in skin care. All forms of tocopherol can protect the plant from damage and oxidation but in topical applications, but for the consumer the most useful form is the  $\alpha$ -tocopherol.

Being an effective antioxidant, it prevents skin ageing under oxidative stress, smooths the skin texture and accelerates wound-healing. It is even added at 0.1-0.5% concentration into sensitive plant oils to protect them from rancidity and oxidation and prolong their shelflife.

Natural tocopherol has a certain 3-D orientation which is called RRR-tocopherol (commonly called d- $\alpha$ -tocopherol). The synthetic one is a mixture of two isomers and is called (dl-  $\alpha$ -tocopherol).

Synthetic esters of vitamin E such as tocopheryl acetate are more stable compared to the original tocopherol but are biologically less effective.

Tocopherols are naturally present in grains and seeds as well as some fruits and nuts and we've summarized the tocopherol content of the most important and common cosmetic plant oils. This could help you choosing the right oil for the right purpose.

If you're adding tocopherol to your formulations as a stand-alone ingredient keep in mind that although it is an amazing cosmetic ingredient, it feels a little bit sticky over skin. You don't want to overdose it in your products to sacrifice the skin feel. The usual dosage is around 0.2-1.0%. In serums and masks you may want to increase the dosage to 5.0%.

Tocopherols are lipophilic and it means you have to add vitamin E (whatever form you apply in your formulation) in the oil phase of an emulsion or add it in your oils, serums, butters and balms. You can not apply it in an aqueous product without application of a suitable solubiliser.

In this list, we've mentioned plant oils with a noticeable tocopherol content. By some of them however, the content of the (for human being) useful form, which is the  $\alpha$ -tocopherol is quite negligible.

Have fun and enjoy reading.

Ref:

Krist, S., G. Buchbauer, and C. Klausberger. "Lexikon der pflanzlichen Öle und Fette." (2008).

Zadernowski, R., M. Naczki, and R. Amarowicz. "Tocopherols in sea buckthorn (*Hippophae rhamnoides* L.) berry oil." *Journal of the American Oil Chemists' Society* 80.1 (2003): 55-58.

Common Name	Botanical Name	a-Tocopherol (ppm)	Total Tocopherol (ppm)
<b>Almond oil</b>	Prunus amygdalus dulcis oil	420	440
<b>Apricot kernel oil</b>	Prunus armeniaca kernel oil	negligible	520
<b>Argan oil</b>	Argania spinosa kernel oil	370	620
<b>Black currant seed oil</b>	Ribes nigrum seed oil	320	1000
<b>Borage seed oil</b>	Borago officinalis seed oil	<40	900
<b>Castor oil</b>	Ricinus communis seed oil	negligible	700
<b>Elderberry seed oil</b>	Sambucus Nigra	negligible	500
<b>Evening primrose oil</b>	Oenothera Biennis	76-356	260-660
<b>Hemp seed oil</b>	Cannabis sativa seed oil	130	760
<b>Perilla seed oil</b>	Perilla ocymoides seed oil	570	6700
<b>Poppy seed oil</b>	Papaver somniferum seed oil	negligible	450
<b>Prickly pear seed oil</b>	Opuntia ficus-indica seed oil	100	720
<b>Pumpkin seed oil</b>	Cucurbita pepo seed oil	58	840
<b>Quinoa oil</b>	Chenopodium quinoa seed oil	700	1500
<b>Sacha-inchi oil</b>	Plukenetia Volubilis seed oil	negligible	2000
<b>Sea buckthorn fruit oil</b>	Hippophae rhamnoides fruit oil	700	1100
<b>Sesame oil</b>	Sesamum Indicum seed oil	negligible	400
<b>Soy bean oil</b>	Glycine soya oil	90	900
<b>Sunflower oil</b>	Helianthus annuus seed oil	1045	1100
<b>Tomato seed oil</b>	Solanum Lycopersicum Seed Oil	130	950
<b>Wheat germ oil</b>	Triticum vulgare germ oil	1600	2500