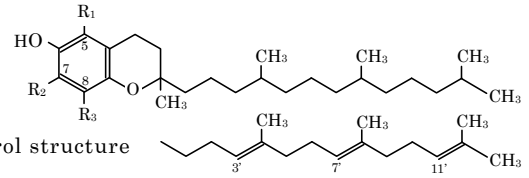
Refining of Vitamin E (Tocopherol)

Tocopherol, Vitamin E, is a fat-soluble vitamin that was found as antisterility factor in vegetable oils such as soybean, rape seed, cotton seed, safflower, rice bran, corn and sunflower oil, and it is categorized into α-, β-, γ- and δ-tocopherol based on the position of the methyl group in chroman ring, as shown in Fig.VIII-9-1. Synthetic intermediates, α-, β-, γ- and δ-tocotrienol with unsaturated side chain at 3', 7', 11' position, are also natural vitamins. All these compounds are colorless or pale yellow viscous oily materials and they are insoluble in organic solvents and easily oxidized to darken. Tocopherol has pharmacological effect and antioxidant power and thus is used for various objectives, and now further utilization is being developed. Examples are as follows:

- Antioxidants to protect oils in foodstuffs from change of color, odor and taste
- Anti aging agent
- Antioxidant of Vitamin A
- Cosmetics ingredient
- Anti thermal corrosion agent for plastics
- Preventive and treatment medicine for chronic diseases

Tocopherol is manufactured by molecular distillation or IER treatment from deodorized scum, byproduct in the deodorization process of vegetable oils as illustrated in Fig.VIII-9-2. Refining with IERs is superior to molecular distillation in recovery rate and purity of tocopherol and operation easiness that concentration can be finished by one operation. DIAION™ PA306S for this purpose has the narrow particle distribution, 150 ~300 μm, and thus can afford sharp separation peaks in chromatographic separation and can minimize dilution by eluents. It has not only strong basicity and high reaction rate as advantages but also good resistance against organic contamination, since it is one of porous-type IERs. Separation and refining with PA306S are illustrated in Figures VIII-9-3 and VIII-9-4, respectively.

Tocopherol structure

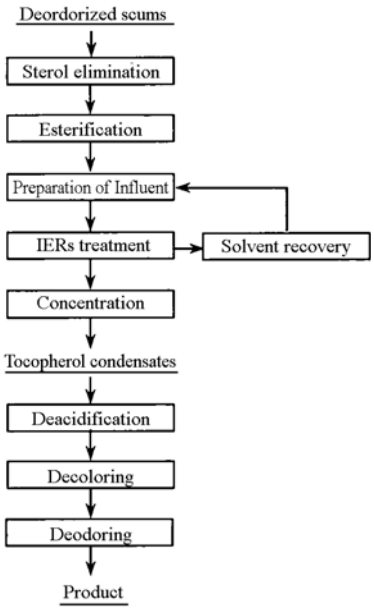


Tocopherol structure

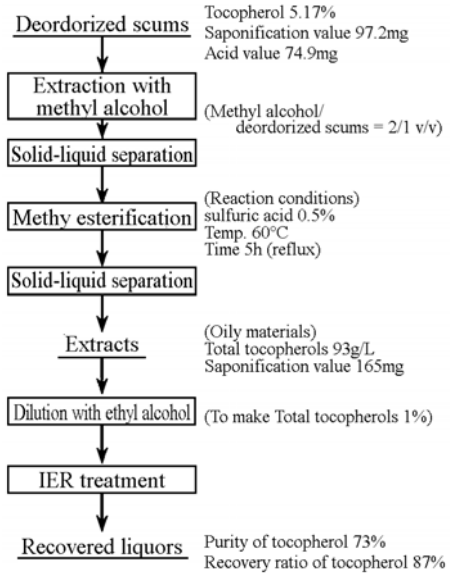
	Formula	M.W.	
α-tocopherol	$C_{29}H_{50}O_2$	430.7	5,7,8-trimethyl tocopherol
β-tocopherol	$C_{28}H_{48}O_2$	416.7	5,8-dimethyl tocopherol
γ-tocopherol	$C_{28}H_{48}O_2$	416.7	7,8-dimethyl tocopherol
δ-tocopherol	$C_{27}H_{46}O_2$	402.7	8-methyl tocopherol
ξ-tocopherol	$C_{28}H_{48}O_2$	416.7	5,7-dimethyl tocopherol
η-tocopherol	$C_{27}H_{46}O_2$	402.7	7-methyl tocopherol
α-tocotrienol (ζ-tocopherol)	$C_{29}H_{44}O_2$	424.7	5,7,8-trimethyl tocotrienol
β-tocotrienol (ε-tocopherol)	$C_{28}H_{42}O_2$	410.6	5,8-dimethyl tocotrienol

[Fig.VIII-9-1] Chemical structures of Tocopherols

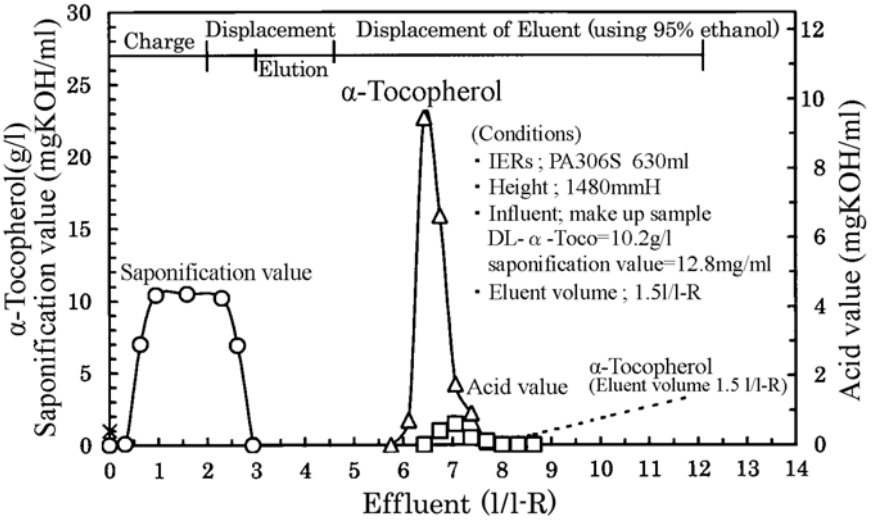
Tocopherol behaves as anions by dissociation of phenolic hydroxyl group at 6-position of chroman ring, and thus can be adsorbed by SACRRs, e.g. PA306S. In elution process, since isomers usually tend to elute as in the order of α-, β-, γ- and δ-tocopherol, tocopherol rich of α-isomer can be collected as the forwarding fraction. Acetic acid, phosphoric acid or boric acid is used as eluents. It is recommended that excess amount of eluents is used to obtain sharp elution and high recovery ratio. However, too much of eluents causes acid-leakage and decreases the product purity. Thus, 1.5 L/L-R amount of eluent is preferred as for 2.5% conc. acetic acid solution.



[Fig.VIII-9-2] Manufacturing process with IER treatment



[Fig.VIII-9-3] Separation of Tocopherol [105]



[Fig.VIII-9-4] Elution profile of Tocopherol [105]