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Antioxidant properties of vitamin E

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Core tip

Vitamin E (α-tocopherol), is an efficient lipid soluble antioxidant that actions as a 'chain breaker' during lipid peroxidation in cell membranes. This article describes the roles of vitamin E as an antioxidant and mechanisms of radical scavenging activity of α-tocopherol.

Introduction

Vitamin E is a fat-soluble vitamin with antioxidant properties that occurs naturally in many foods, especially certain fats and oils (1). Collectively, the term vitamin E describes exists in eight chemical forms (alpha-, beta-, gamma-, and delta-tocotrienol and alpha-, beta-, gamma-, and delta-tocopherol) (2), but the α-tocopherol form is the most active in humans with distinctive antioxidant activities and only form that is recognized to meet human requirements. Also this form is the most important lipid-soluble antioxidant, and that it protects membranes from oxidation by reacting with lipid radicals created in the lipid peroxidation chain reaction (3).

Lipid peroxidation is a chain reaction that done in three stages: initiation, propagation, and termination (4). In the initiation stage eq 1, a carbon-centered lipid radical (L•) is produced by the abstraction from a polyunsaturated fatty acid moiety. In the propagation stage eq 2, the alkyl radical (L•) reacts with O_2 at a very high rate and production a peroxyl radical (LOO•).

The peroxyl radical, is able to attack another polyunsaturated lipid molecule (LH) eq 3. Though the initial peroxyl radical is broken to a hydroperoxide, this process generates a new alkyl radical, which is rapidly converted into another peroxyl radical. Generally lipid hydroperoxides are broken down to peroxyl radical, lipid radical and aldehydes eq 4. Commonly aldehydes are biologically active compounds, which attack to the other parts of the cell.

The chain reaction does not finish until the chain-carrying peroxyl radical combines with another radical to form inactive products (Termination step).

Scheme 1 shows the mechanism of radical scavenging activity of α-tocopherol during the autoxidation of unsaturated lipids. Alfa-tocopherol **(A)** is a chain-breaking antioxidant to prevent the propagation step (5). Alfa-tocopherol donates its phenolic hydrogen atom to a peroxyl radical and converts it to a hydroperoxide. The tocopheroxyl radical (**B**) that is produced is sufficiently stable and cannot continue the chain and, instead, is outed from the cycle by reaction with other peroxyl radical to form a non-radical product (6). Because each tocopherol molecule can trap two peroxyl radicals, the stoichiometric factor (n) for the four tocopherol isomers is theoretically considered to be equal to 2. The rate at which tocopherol isomers react with peroxyl radicals is a direct measure of their antioxidant efficiency (7). It has been determined that α-tocopherol among the four isomers is the most efficient chain-breaking antioxidant. Alfa-tocopherol also can undergo self-coupling to form dimers and trimers or react with alkoxyl radicals (8). When oxygen is in trace amounts, α-tocopherol can react directly with alkyl radicals. Alfa-tocopherol at high concentrations lead to the production of lipid hydroperoxides (9). The pro-oxidant effect of α-tocopherol was related to the reaction of α-tocopheroxyl radicals with lipids (10).

(1) $LH + R^{\bullet} \longrightarrow L^{\bullet} + RH$

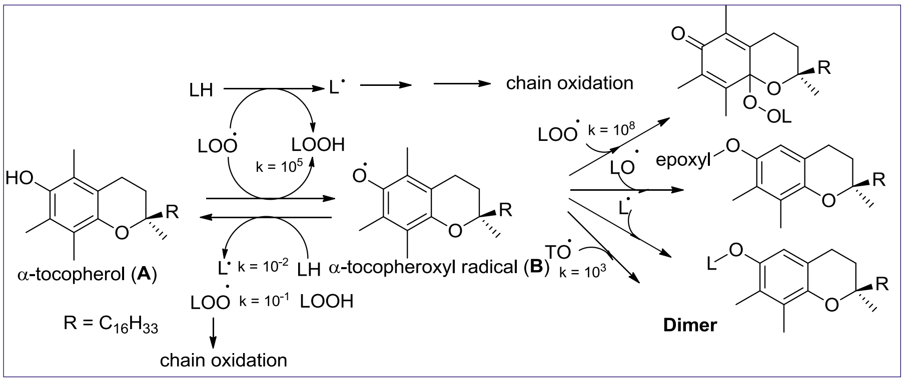
(2) $L^{\bullet} + O_2 \longrightarrow LOO^{\bullet}$

(3) $LOO^{\bullet} + LH \longrightarrow LOOH + L^{\bullet}$

(4) $LOOH \longrightarrow LO\dot{O} + L\dot{O} + \text{Aldehydes}$

Conclusion

Vitamin E is an important lipid-soluble antioxidant that has an essential role in membrane preservation against lipid peroxidation damage and can stop the radical chain by creating a low-reactivity derivative unable to



Scheme 1. Mechanism of radical scavenging activity of α-tocopherol.

attack lipid substrates.

Author's contribution

KH was the single author of the manuscript.

Conflicts of interest

The author declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the author.

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