Overview of antioxidant activities – the underlining science
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Background – Lipid oxidation is one of the most important chemical reactions, which lead to food spoilage. *In vivo* oxidation reactions have been associated with several important diseases, including cancer and cardiovascular diseases. Both in foods and *in vivo* oxidation reactions are complex. Therefore, comprehensive understanding of roles of various antioxidants and their activities is challenging. Natural plant-derived antioxidants continue to be one of the most popular research topics in food science. One of the trends is to search for simple measurements to characterize foods and their potential for providing antioxidants and thus supporting our health.

Review – In foods antioxidants are needed to inhibit lipid oxidation, which may proceed by autoxidation, photoxidation or enzymatic oxidation. Antioxidants act by several mechanisms, e.g. by donating phenolic hydrogen to radicals, chelating metals, and quenching singlet oxygen. In addition, food antioxidants are often multifunctional, i.e. each antioxidant may inhibit oxidation by several mechanisms. The dominant mechanism depends on conditions. For example, composition of foods and experimental systems (oxidizing substrates, initiators, and other components present), physical structure of foods, and temperature are among factors, which may influence the dominant mechanism and antioxidant activities. Partitioning of oxidizing substrates, antioxidants, and pro-oxidants in the studied food is critical. Antioxidant activity may thus be distinctly different in bulk oils and multiphase foods, such as emulsions. In addition, the method used to measure and calculate antioxidant activities has a major impact on the results. For all these reasons, use of several test conditions and methods simultaneously is generally highly recommended. Antioxidant activity in a given food is reliably shown by measuring decrease in the formation of a number oxidation products from different steps of the oxidation chain reactions. Antioxidant activities measured using radical scavenging tests do not take into account the effect of the substrate and its structure and other properties.

*In vivo*, imbalance between antioxidant defense and initiative factors may lead to oxidation reactions, which cause undesirable changes not only in lipids but also in DNA, enzymes and other proteins. *In vivo* the role of enzymatic defense is emphasized as compared with food systems. Liberation of antioxidants from foods in digestion may differ from liberation in extraction for antioxidant tests. Further, dietary antioxidants have to be absorbed and localized in active forms in the oxidation site to enable the antioxidant effect. Recently, there has growing interest in measuring total antioxidant activities or total antioxidant capacities of foods by simple radical trapping methods, with the aim of providing data on the nutritional quality of the studied foods. Because of the high number and diversity of individual antioxidants in our foods, efforts to look for simplified procedures is understandable. However, the current approaches still leave many open questions.

Conclusions – When antioxidant activities are considered we need to distinguish the role of antioxidants in foods and *in vivo*. Factors affecting oxidation reactions and antioxidant activities in foods and *in vivo* differ. In addition, multifunctionality of many antioxidants complicates further possibilities to find simple approaches for antioxidant activities.

References