

## Natural Antioxidants for Food Applications: Challenges and Recent Developments

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Lipid oxidation is one of the major causes of oil and fat deterioration, affecting the nutritional quality, safety and sensory properties of foods. The term used to describe the process of lipid oxidation is rancidity and is initiated by the reaction of oxygen with lipid radicals. The primary oxidation products are hydroperoxides which are highly unstable and are decomposed to a number of secondary oxidation products such as alkanes, alcohols, aldehydes and acids. The later are responsible for unpleasant odor and taste and may also contribute to the pathogenesis of cancer, atherosclerosis, heart and allergic diseases [1].

Many foods susceptible to the process of lipid oxidation, are endowed with their own endogenous antioxidants. For instance, most vegetable oils are rich in natural antioxidants such as tocopherols and tocotrienols, which confer protection against rancidity [2]. Furthermore, some vegetable oils are even better protected due to the presence of several classes of antioxidants naturally occurring in their composition. Olive oil contains a number of antioxidative compounds (phenolic acids, phenylethyl alcohols, flavonoids, lignans and seco-iridoids) in addition to tocopherols [3].

Edible oil processing steps during commercial production such as degumming, refining bleaching and deodorization often results in significant losses of endogenous antioxidants [4]. To compensate for the losses during oil manufacturing and extend the self-life of these products, fortification with antioxidants is commonly practiced. Traditionally, synthetic antioxidants are used for fortification of foods containing significant amounts of lipids (including vegetable oils) and common examples of such compounds are butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT), propyl gallate (PG) and tert-butyl hydroquinone (TBHQ). The use of synthetic antioxidants for food applications is tightly regulated by EU and local authorities and long term toxicological studies using animal models are required for approval and for determining safety limits [5].

During the last years, there is a growing demand for replacing synthetic antioxidants with natural alternatives. Consumers are concerned about the long-term effects of synthetic compounds in their diet and are seeking for clean label, “free-from” products which are perceived as reflecting a more natural and healthy life-style. The most common sources of natural antioxidants currently exploited for food applications include herbs and spices (rosemary, oregano, thyme, tea, turmeric etc.), fruits and berries (apple, strawberry, blueberry, cranberry, grape etc.) and vegetables (beetroot, carrot, kale, spinach, broccoli etc.) [6,7]. Other sources of natural antioxidants include agricultural and processing by-products (e.g. olive leaves) and antioxidants from animal sources (e.g. protein isolates).

The use of natural antioxidants for replacing their synthetic counterparts comes with numerous challenges. The most important barrier is the economic cost. For practical reasons, most natural antioxidants need to be extracted/purified or undergo some minimal processing (i.e. drying) prior their inclusion in food formulations. An additional problem with using natural products as antioxidants is that they are very likely to affect the sensory properties of foods. In terms of their ability to prevent oxidation, research has shown that many natural products can withstand processing and can be as effective (or more) compared to synthetic additives [8]. In conclusion, natural

antioxidants show potential for inclusion in food systems as alternatives to synthetic ones. Provided that their safety is proven and can be extracted or processed to a potent form at a low cost, natural antioxidants should replace the majority of synthetic compounds in food products in the future.

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