Synthetic antioxidants are routinely added to fats, oils and high-fat foods to limit lipid oxidation, thereby increasing shelf life by delaying the onset of off-odors and off-flavors hallmarking fat rancidity.

Antioxidants delay autoxidation by scavenging free-radicals. Most synthetic antioxidants, such as BHA (butylated hydroxyanisole), BHT (butylated hydroxytoluene), and TBHQ (tertiary butylhydroquinone) are phenolic compounds.

Increasing consumer concern regarding synthetic preservatives and prevailing maximum allowable limits of synthetic preservatives have prompted food manufacturers to explore the benefits of natural products to extend shelf life. Rosemary extract is approved as a natural flavoring and is subject to use under GMP (Good Manufacturing Practice) rules. Our recent research has demonstrated the effectiveness of natural rosemary extract as an alternative or addition to synthetic antioxidants in vegetable oils, animal fats, and high fat foods, to delay oxidative rancidity and stabilize color.

Rosemary extract is prepared by drying and grinding rosemary needles, followed by extraction using organic solvents, oil, water, or super-critical CO₂. The solvent extract is then separated from the biomass and the solvents evaporated. A great deal of variation exists in the source materials extracted, extraction methods, extract standardization methods, the carriers used, and the methods used to characterize formulated products. The form in which rosemary extract is delivered to the food matrix has a major impact on its efficacy. This has resulted in commercial formulations optimized for each respective application, such as concentrated oil-soluble formulations for fats and oils and high fat foods, more dilute formulations for improved dispersion, and formulations of varying water solubility for salad dressings, brines, and beverages. Dilute powder and liquid product forms are well suited for use in processed meats, where grinding increases the surface area susceptible to oxidative deterioration. Since rosemary extracts are generally lipophilic (fat-loving), various combinations of emulsifiers are necessary to facilitate their dispersion in aqueous systems such as brines and marinades.

Rosemary (Rosmarinus officinalis), a member of the Labiatae family of plants, has been recognized for its medicinal properties since antiquity and therapeutic uses are mentioned in Greek, Roman and medieval literature. The antioxidant activity of solvent extracts of Labiatae is attributed primarily to the presence of the phenolic diterpenes such as carnosic acid and its derivative carnosol, but additional antioxidant components include various phenolic acids and flavonoids. Amongst the Labiatae, extracts of rosemary have superior antioxidant activity in a variety of applications. Recent application and formulation research demonstrates the potential of natural rosemary extract as an alternative to or addition to synthetic antioxidants in vegetable oils such as corn, canola, soybean, and mid-oleic sunflower oils; animal fats such as lard, butter and poultry fat; and high fat foods such as salad dressing and sausage.

Oxidative stability
Accelerated oxidative stability experiments conducted to assess the feasibility of using a natural rosemary extract in animal fat and vegetable oil-based foods established that low dosages (100–500 ppm) of rosemary extract added to vegetable oils resulted in oxidation induction times similar to those obtained with treatment with 200 ppm BHA/BHT, the maximum allowable limit in the United States. In lard, butter and poultry fat, rosemary extract was required at slightly higher dosages (above 400 ppm) to achieve oxidation induction times similar to 200 ppm BHA/BHT (Table 1).

As one could expect, the required dosage of rosemary extract to match the efficacy of 200 ppm of BHA/BHT in animal fats was directly correlated with the concentration of polyunsaturated fatty acids (r=0.96). However, in vegetable oils the concentration of endogenous tocopherols (g + d) in the respective oils was the overriding factor in determining the required rosemary extract dosage to match BHA/BHT (r=-0.95).

Based on the performance in the Oxidative Stability Instrument (OSI), a relative freshness value (RFV) can be calculated for specific rosemary extract dosages. We have defined the Relative Freshness Value (RFV) as the OSI hours for the treated fat or oil divided by the OSI hours for the respective untreated control. As such, RFV indicates the fold improvement in freshness obtained with rosemary extract. The RFV response to increasing rosemary extract dosages is quadratic in nature rather than linear, as the response rate gradually tails off at dosages above 1500 ppm. Overall, these experiments contribute to our understanding that natural rosemary extract is effective in increasing relative freshness of both animal fats and vegetable oils.

Shelf life of high fat foods
The addition of 500 ppm rosemary extract to salad dressing can replace 75 ppm EDTA (ethylenediamine tetraacetate), the maxi-
mum allowable limit, while maintaining shelf life for 6 months.

Even in extremely hard to stabilize foods such as raw pork sausage, high rosemary extract dosage aided in maintaining freshness in refrigeration as well as the synthetic norm (200 ppm BHA/BHT) as measured by the thiobarbituric acid (TBARS) method. Rosemary extract outperformed BHA/BHT in extending freshness of raw frozen pork sausage up to 16 weeks by significantly (P<0.05) reducing the changes in TBARS values and red color scores relative to BHA/BHT. A similar advantage over BHA/BHT in maintaining lower oxidation by-products with RE has been observed in turkey sausage.

Color retention

Finally, application research into color stability of beverages, spices, and frozen pork sausage has shown the ability of rosemary extract to not only enhance lipid stability, but stability, the characteristic herbal flavor of rosemary extract can delay myoglobin oxidation, thus extending color shelf life.

Although adding 500-1500 ppm concentrated rosemary extract to foods will provide significant increases in flavor or color stability, the characteristic herbal flavor of rosemary extract typically limits application rates in delicately flavored foods such as mayonnaise and salad dressings to 750–1000 ppm. In beverages, the flavor threshold may be lower. On the other hand, seasoned meat products such as pork sausage will allow use of levels exceeding 1000 ppm without contributing any herbal off-flavors. Viscosity, fat content, moisture content, and particle size of the food all influence flavor release and flavor perception, so sensory testing must be conducted in order to determine the precise flavor threshold.

Use

Natural rosemary extract is effective in delaying oxidation induction times in various vegetable oils and animal fats, and has much potential in extending shelf life of foods containing unstable lipids and color compounds. However, as reviewed above, natural shelf life extension by rosemary extract does require formula optimization and specific validation methods that can be used to standardize the rosemary extract, establish oxidative stability, and predict shelf life in the target application.

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