Enhancing stability of **olive oils** by enrichment with **natural ingredients**

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Olive oil is an important component in the Mediterranean diet. Several positive health benefits are attributed to the oil, but its shelf life is limited since the bioactive compounds in the oil degrade during storage, which diminishes its organoleptic and healthful properties. For these reasons, the control of olive oil shelf life is an important area of research, and some recent studies have also used mathematical modeling to predict it. The main effects reported to occur in olive oils during storage are linked to the lipidic and polyphenolic fractions, and involve oxidative and hydrolytic degradation of several compounds.

- **The healthful properties of olive oils strongly decrease during storage due to oxidative and hydrolytic degradation of bioactive compounds.**
- **Aromatic plants, such as rosemary and oregano, and spices such as red chilli pepper powder are rich in compounds with strong antioxidant properties.**
- **A screening of olive and extra-virgin olive oils enriched with small amounts of essential oils or red chilli pepper powder was performed through a rapid analysis that measures oxidative stability without preliminary fat separation. Results showed an enhancement of shelf-life in all experiments.**

The oxidative stability of an olive oil seems to be highly correlated to its initial content of natural antioxidants.

Consequently, the addition of natural substances has been proposed as a way to protect foods from deterioration and to prolong their shelf life. Indeed, there is a historical basis for this approach as aromatic plants, which contain essential oils with important antimicrobial, antioxidant, and other biological activities, have been used since ancient times as natural preservatives in food flavorings, pharmaceuticals, cosmetics, and perfumes.

Essential oils from oregano and rosemary, for example, have been widely used in such diverse types of food products as cheese, olive oil, and mackerel oil, where they provide higher resistance to oxidation and increased thermal stability. Oregano contains high percentages of the phenols carvacrol and thymol (known for antimicrobial and antioxidant activity) as well as the monoterpene hydrocarbons p-cymene and c-terpinene, which are flavor and perfume ingredients. The flavonoids of oregano are also a group of compounds with antioxidant activity. Rosemary essential oil contains carnosic acid, carnosol, and rosmarinic acid, which impart effective antioxidant properties.

Spices have also been proposed as a way to protect food from oxidation. In particular, red chilli pepper powder (*Capsicum* ss. vv.) is a remarkable source of antioxidants, including flavonoids (quercetin, luteolin), phenolic acids, carotenoids (carotene, capxanthin, zeaxanthin), and vitamins (vitamin A, ascorbic acid, and tocopherols). The major pungent components of red chilli pepper powder are capsaicinoids. These compounds exhibit an interesting antioxidant activity, which has been found to prevent the oxidation of oleic acid at cooking temperatures as well as the formation of lipid hydroperoxides from the autoxidation of linoleic acid.

Scientists in the Department of Chemistry at the University of Parma (Parma, Italy) and Velp Scientifica (Usmate, Italy) recently conducted a screening to evaluate the effects of adding various natural products known for their antioxidant properties to virgin olive and extra-virgin olive oils. Two essential oils (rosemary and oregano) were added to olive oil, and two spices (sweet and hot red chilli pepper powders) were added to extra-virgin olive oil (Fig. 1).

The degree of lipid oxidation of an oil can be measured by chemical or physical methods (direct methods) that are often time consuming, expensive, and require trained people. The level of oxidation of fatty foods can be also determined with indirect methods through tests which measure the fatty food's stability under accelerated conditions (such as elevated temperatures) that allow autoxidation measurements to be obtained in a few hours instead of weeks or months. Generally, these accelerated tests provide an oxidation curve, characterized by an Induction Period (IP), which measures the time required to reach the starting point of oxidation that corresponds either to a level of detectable rancidity or a sudden change in the rate of oxidation.

In this screening, the oxidative stability of oil samples—both at the beginning and during storage—was investigated by accelerating the oxidation process through the use of Velp Scientifica's Oxitest reactor, an instrument that speeds up the oxidation process based on two accelerating factors: temperature and oxygen pressure. Compared to similar and conventional technologies, the Oxitest reactor is easy to use, as it allows the analysis to be performed directly on the food (liquid, solid, or pasty) without previous fat separation.

FIG.1. Olive oil and an example of essential oil bordered by three sources of essential oils: red chili pepper, rosemary, and oregano

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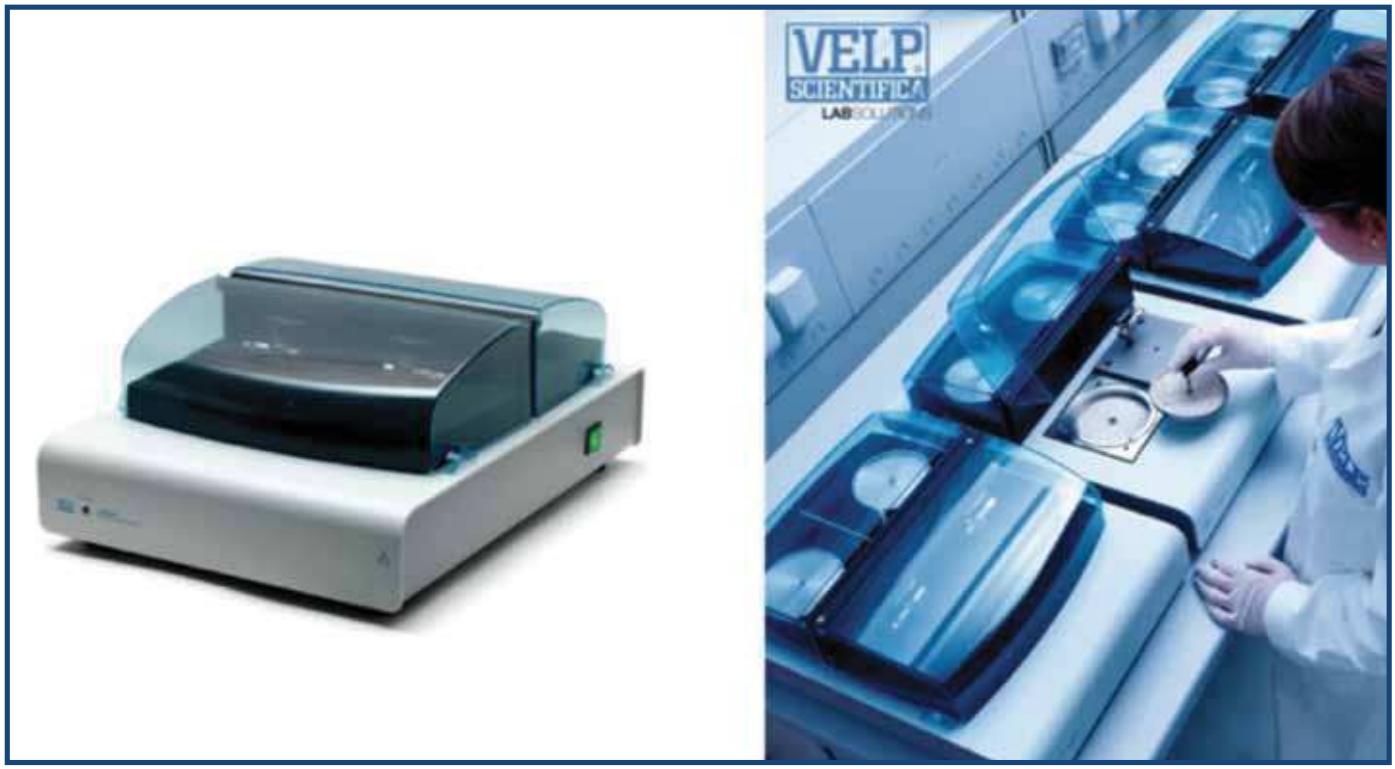

FIG. 2. Oxitest reactor

The instrument, shown in Fig. 2, measures the absolute pressure change inside two independent, closed, and thermostated chambers, monitors the oxygen uptake by reactive components in the samples, and automatically generates an Induction Period (IP) value (Maiocchi, P. and U. Bersellini, 2007). The longer the IP was, the higher the stability against oxidation over time.

A series of preliminary experiments indicated that the quantities sufficient for observing a significant effect on stability were 1% w/w for red pepper powder and 3% w/w for essential oils, respectively.

Oil stability was measured on the blank oils (to which nothing was added) and on enriched oils just after the adding the natural product, to evaluate a possible immediate effect in protection from oxidation. Measurements of the extra-virgin oil samples were repeated after aging them in a dark room at room temperature for one year.

Fig. 3 is a graph of induction time obtained for blank olive oil (A) and for olive oil enriched with rosemary essential oil (B), where the difference in the flex point of the curve can be seen.

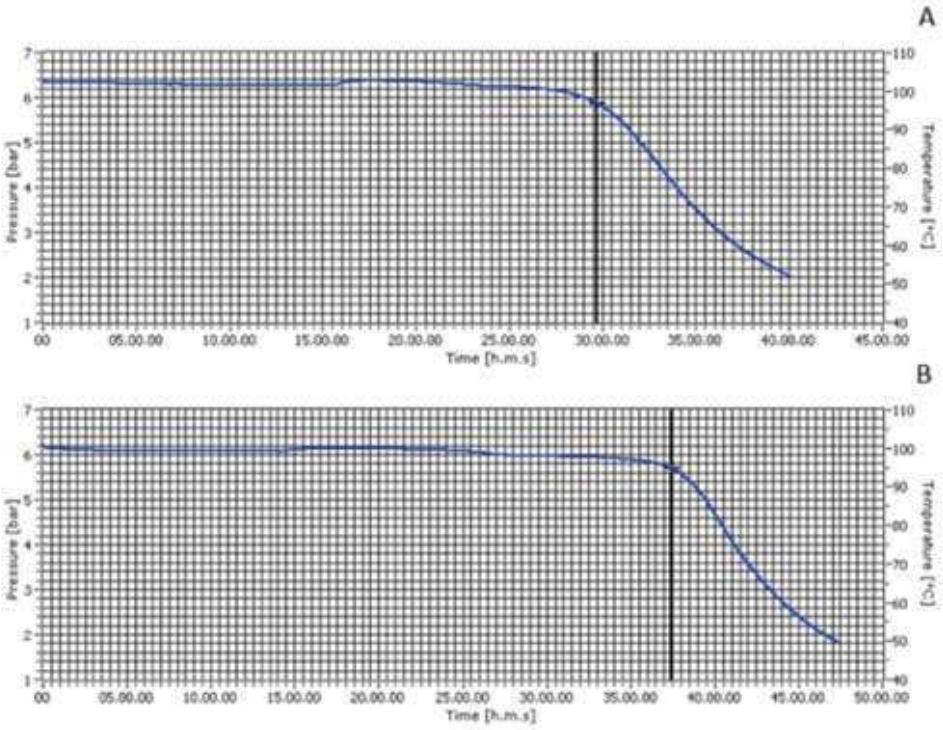

FIG. 3. IP of blank olive oil (A) and olive oil samples enriched with 3% of rosemary essential oil (B)

Results about samples examined are reported in Figs. 4 and 5. All samples enriched with essential oils and spices showed a longer IP than blank oils, thus confirming the antioxidant activity exerted by the natural product that was added.

Previous studies had shown rosemary to be more effective than oregano in stabilizing olive oil—most likely because oregano essential oil has a higher content of volatile antioxidants, such as carvacrol, which may have partially evaporated during storage (Antoun *et al*, 1997). However, in our study, the evaporation of volatile components of oregano essential oil did not affect the final result, and oregano demonstrated stronger antioxidant activity than rosemary oil. This is most likely because the experiments were performed in a closed thermostated chamber, where any evaporated volatile compounds would remain in contact with the oil sample. Thus, minimizing evaporation as a factor provided a more realistic evaluation of the effects exerted by the essential oils.

In measuring the stabilizing effects of the red pepper powders that had been added to the extra-virgin oil, we observed that the increase in IP became more pronounced after aging, suggesting

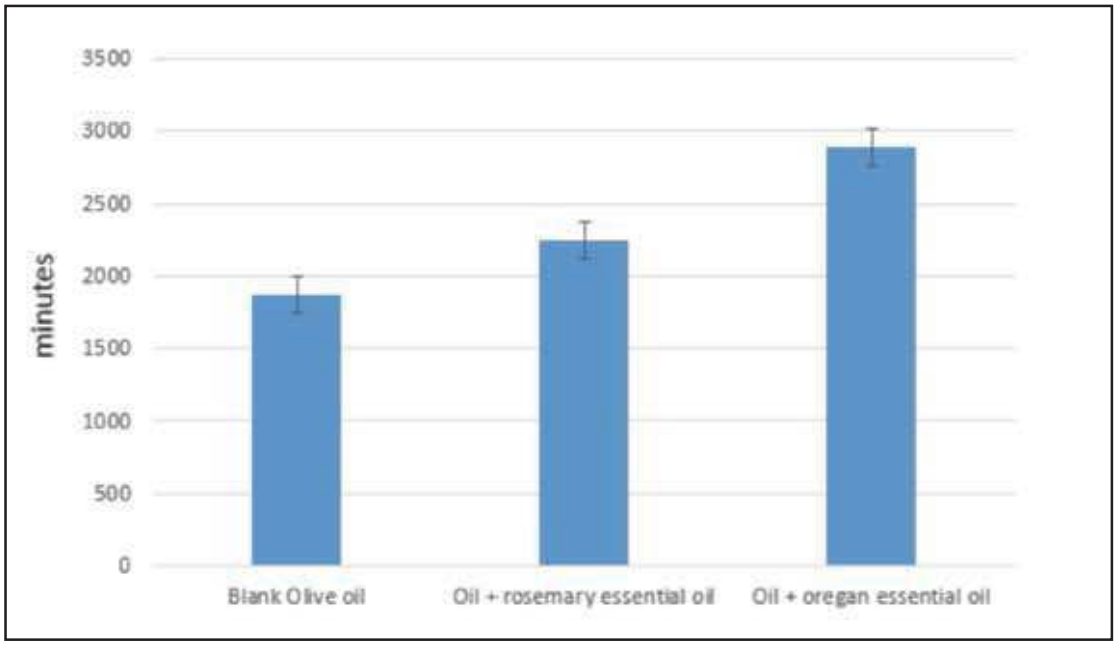

FIG. 4. IP (minutes) of blank olive oil and olive oil samples enriched with 3% of essential oil

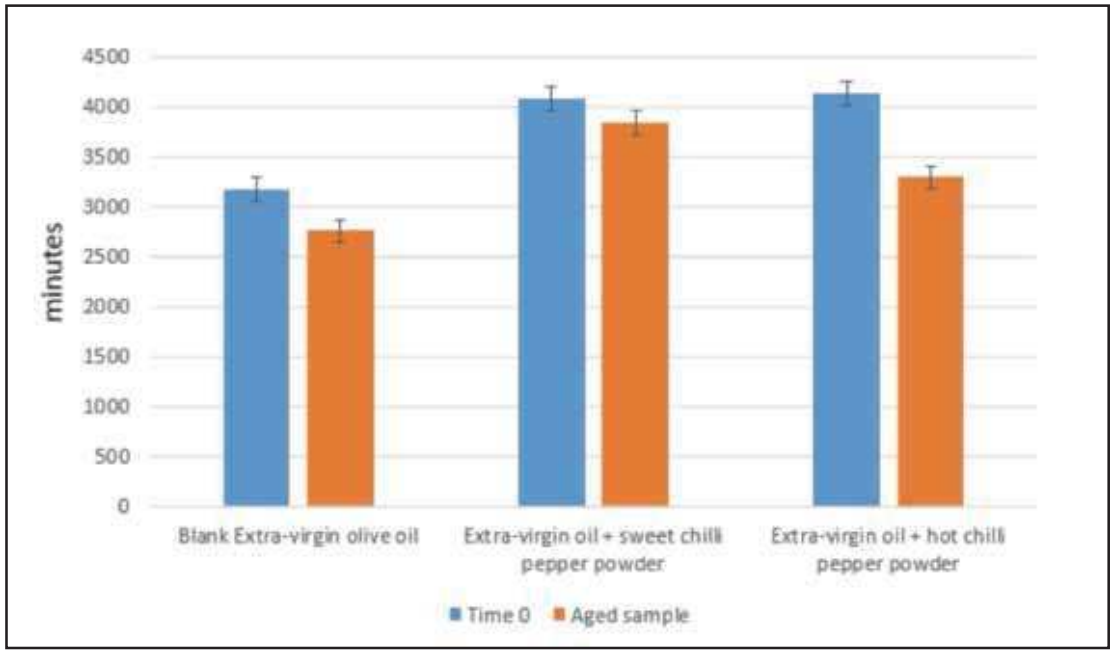

FIG. 5. IP (minutes) of blank extra-virgin olive oil and extra-virgin olive oil samples enriched with 1% of spices

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that the protective effect of the antioxidant ingredients is more effective during storage. It is also interesting to note that at time zero both pepper varieties exerted a similar activity, while after ageing the sweet pepper shown higher activity than the hot one. These data suggest that the antioxidant activity is not connected to the capsaicinoids content, but is probably due to the combined action of all the antioxidants compounds occurring in the pepper variety.

It can be concluded that a perishable food such as olive oil can be protected by adding natural products at very low percentage, without significantly affecting its organoleptic properties. In particular, the strong effect recorded by the addition of only 1% of sweet red pepper suggests that this fruit could have important applications in canned food, as it should not significantly affect the overall flavor of the final product.

Claudio Corradini is an associate professor in the Department of Chemistry at the University of Parma (Parma, Italy), where Antonella Cavazza is a researcher, Paola Salvadeo is a research fellow, and Carmen Laganà is a doctoral student.

Further reading

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