Storage stability of encapsulated and unencapsulated olive oil in the absence or presence of caffeic acid

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Plant oils like olive oil, rich in unsaturated fatty acids (UFA), possess poor storage stability. Lipid oxidation during storage causes loss of nutrients, conversion of UFA to saturated FA, and development of deleterious products such as reactive oxygen species. Protection from lipid oxidation is a critical factor in oil quality. Fortification of oils with antioxidants and encapsulation of oils have been adopted as good approaches to address this issue. Natural antioxidants have gained more consumer popularity than synthetic ones, because of their perceived safety. Caffeic acid is widespread in the plant kingdom and is a potent antioxidant among the hydroxycinnamic acids. It may provide dual benefits through inhibiting lipid oxidation as a free radical scavenger and increasing nutritional values of the final product. Furthermore, microencapsulation of oils would confer better stability to the oils (core products) by preventing contact with air and light using a wall material (shell).

The aim of this study is to compare the storage stability of encapsulated caffeic acid-fortified olive oil and encapsulated olive oil with those of their unencapsulated counterparts. Olive oil in the absence or presence of caffeic acid (300 ppm) was encapsulated in 1.5% alginate shell using an Inotech IE-50R Encapsulator. The encapsulated (treated) and unencapsulated (control) oils were stored at 20 or 65°C for 30 days in the same types of sealed containers (with the same headspace : volume ratio). Aliquots of control or treated oils sampled at different storage stages were subjected to chemical analyses of peroxide value, *p*-anisidine value, free fatty acid and total phenolic content, while the fatty acid composition was analysed by gas chromatography-mass spectrometry (GC-MS).

Caffeic acid addition improved the oil stability and increased the total phenolic content of the final oil product. The oil stability decreased significantly at higher temperatures (i.e. 65°C) in all cases, but was improved after encapsulation. Changes in the fatty acid profile indicated that caffeic acid protected some unsaturated fatty acids, such as linolenic acid. Lipid oxidation involves a series of reactions between unsaturated fatty alkyl groups and active oxygen. The presence of hydrogen-donating substituents and the ability of caffeic acid to delocalise free electrons enable it to act as an antioxidant to preserve oil stability. We conclude that the current oil encapsulation method using alginate microspheres could be a feasible approach to increase oil stability. The addition of caffeic acid to the oil not only provides additional protection, but also increases the product's nutritional values by increasing the level of phenolic antioxidants and preserving desirable lipid composition.