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Use of mid-infrared spectroscopy to monitor shelf-life of ready-made meals

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The objective of this work is to evaluate the possibility of using mid-infrared spectroscopy as a rapid analytical method to monitor the change in stored ready-made meals over time, for example oxidation phenomena occurring particularly in ready-made meals in plastic packaging.

Six ready-made meals models (lentils, mashed potatoes, mashed potatoes with cheese, béchamel sauce, vegetable soup, Bolognese sauce) were prepared and packaged in plastic bags. They were stored at 23°C and at a partial oxygen pressure of 96 KPa to accelerate the oxidation phenomena. Two plastic packaging, Alu and Alox, were used presenting in these conditions an oxygen permeability of respectively 0.028 and 0.040 cm³/(packaging.day). Three bags of each ready-meal x plastic packaging combinations were sampled at 6 different times: T0 the start of the experiment, 20 days (equivalent to 3 months), 40 days (equivalent to 6 months), 59 days (equivalent to 9 months), 79 days (equivalent to 12 months) and 119 days (equivalent to 18 months). Samples were then frozen at -20°C until measurements. After thawing, samples were directly, without grinding, measured in attenuated total reflectance mid-infrared spectroscopy between 4000 and 650 cm⁻¹ performing five replications to evaluate the sample heterogeneity.

Multivariate analyses applied on spectral data allowed to highlight some changes in the global profile. For example, in the case of Bolognese sauce, samples were clearly discriminated (i) from 12 months, (ii) according to the packaging at 18 months with a greater oxidation in the Alox packaging. The eigenvectors allowed to identify several clear absorption bands which increased over storage, such as 2918 cm⁻¹, 2850 cm⁻¹, 1741 cm⁻¹ and 1164 cm⁻¹. These absorption bands could be attributed to fats, which thus appeared to have a major effect in sample discrimination.

The Mid-infrared spectroscopy was shown in this study to be a simple, rapid and relevant tool for discriminating the oxidation state of canned ready-made meals and might be used to determine their shelf-life.

Keywords: FTIR-ATR, multivariate analyses, oxidation over time, two plastic packaging.