

## LOW-COST PORTABLE NIR SPECTROMETERS FOR FRAUD DETECTION IN FISH

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Development of tools to control and prevent fraudulent practices and unfair competition by false labelling in the fish sector is a significant issue. In this sense, near-infrared spectroscopy (NIRS) has demonstrated its potential to identify changes associated with freezing-thawing practices. The aim of this study was to determine the ability of low-cost portable NIR devices to discriminate between fresh and thawed fish (submitted to one or two freezing-thawing cycles) and to different freezing conditions. For this purpose, a total of 25 mackerel were divided into four fillets and assigned to different freezing conditions (C0, kept at 4°C; C1, frozen at -20°C; C2, frozen at -80°C; and C3, quick frozen at -20°C in <45 min.). Water content and weight loss were determined, and NIR spectra were acquired using a portable spectrometer (SCiO, Consumer Physics, Israel) and an in-house spectrometer (NIRTA 2.0, Hamamatsu, Japan). Discriminant models were developed using partial least squares discriminant analysis (PLS Toolbox, Mathworks, USA) and validated. Results showed that SCiO and NIRTA are useful to discriminate between fresh samples and the same samples subjected to a different number of freezing-thawing cycles, with an overall performance of 100%. This fact was attributed to the different water content present in the fish tissue after different freezing-thawing conditions ( $p < 0.05$ ) that produces absorption changes around 980 nm associated with water (Qin et al., 2020). When measuring on frozen samples, discrimination performance was 92% and 100% for SCiO and NIRTA since the scattering of light is affected by the differential ice crystalline structure resulting from the different freezing conditions (Washburn et al., 2017). When measuring on thawed samples, discrimination was attributed again to the different water content ( $p < 0.05$ ) and structural alterations caused by the different freezing systems. We can conclude that low-cost spectrometers could be useful for food inspectors and consumers to assess product quality and prevent food fraud on-site. However, validation with independent samples must be done.

**Keywords:** Near-infrared spectroscopy; Chemometrics; Fish quality; Consumer trust; Labelling.

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