Raman Spectroscopy for In-line Estimation of Fatty Acid Features in Salmon Fillets

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In the food industry, smart in-line sensor systems are under constant development, aiming to effectively handle massive streams of food raw materials and products. Raman spectroscopy is gaining increasing interest for its chemical specificity. Recent feasibility studies show how the technique can be used to quantify fatty acids in muscle foods, water holding capacity in pork meat and mineral and bone contents in meat slurries. Furthermore, robust, and more low-cost Raman instrumentation has become available and paves the way for affordable and practical in-line sensor solutions in the food industry. The development of stand-off wide area illumination probes which utilize a defocused laser combined with multiple collection fibers is a cornerstone for Raman based in-line evaluation of food samples because of the insensitivity to smaller variations in working distance. This enables an in-line scanning strategy which facilitates more representative sampling of heterogeneous foods. In the current study, we employ such a probe and demonstrate the viability of an in-line scanning strategy for %EPA+DHA estimation in salmon fillets moving along a conveyor belt. One essential question was how to employ the surface scanning strategy to obtain a best possible predictive power. In general, Raman signals from food components can be of low intensity, and the signal to noise ratio (SNR) of the acquired spectra may be critical. This was also demonstrated in earlier work on %EPA+DHA estimation, where homogenized salmon samples were scanned at high speeds (Lintvedt et al., 2022). A successful scanning strategy must provide representative measurements for a whole fillet as well as obtaining adequate SNRs. For comparison, samples were also scanned by NIR hyperspectral imaging, which is another relevant method for fast stand-off measurements which undoubtedly has practical advantages over Raman but in return have lower chemical resolution.

**Keywords:** Raman spectroscopy, NIR hyperspectral imaging, In-line food evaluation, Representative sampling, Salmon, Omega-3 fatty acids

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