# Fish Authentication

**Growth of the Global Seafood Market**

According to Allied Market Research, the global seafood market accounted for $125.44 billion in 2017 and is projected to reach $155.32 billion by 2023, registering a CAGR of 3.6% from 2017 to 2023. Changing lifestyle and consumer preferences, rise in disposable income, increased awareness regarding health benefits associated with seafood, and extensive availability of different species of fish have boosted the growth of the global seafood market. However, depletion of wild fish stocks hampers the market growth. The flat fish segment is projected to register the fastest CAGR of 4.7% during the forecast period.

## The Challenge of Fish Mislabeling and Fish Substitution

However, depletion of wild fish stocks hampers the market growth, and additional problems in seafood marketing occur because seafood products are intentionally or accidently mislabeled in the harvesting and processing chain or because fishmongers or restaurateurs substitute one species for another. In a 2013 analysis by ocean advocacy group Oceana, the researchers found that as much as one-third of fish sold in the US was mislabeled.

## Current Identification Practices: Costly, Scarce Equipment

As a result, research on authentication of fish species has been on the rise. However, such activity has only been conducted by trained research teams using one of several spectroscopic techniques, near-infrared (NIR), mid-infrared (MIR), Raman, fluorescence or absorption ultraviolet-visible (UV–Vis), and nuclear magnetic resonance (NMR) spectroscopies, and hyperspectral imaging (HSI) some of which are still in development.

This equipment is expensive, typically available only in labs, and requires adequately trained staff. Days can be lost sending samples back and forth from central labs. The result is that both suppliers and consumers of fish cannot always be sure of what they have purchased or consumed.

## Handheld Scanners for Fish Identification in the Field

More recently, wireless handheld scanners have been developed that show promise in the field and on the factory floor. The advent of handheld NIR-based scanners may signal the ability to have more inspectors out in and around the ports, fish markets, warehouses and restaurants to prevent mislabeling of fish. A 2019 study was conducted by the researchers from the Department of Physical Chemistry at the University of Duisberg-Essen in Germany, where the team used a NeoSpectra-Micro sensor to differentiate high-quality from lower-quality fish, using measurements from the skin of four different species.

## Methodology

The team used two different pairs of fish, samlet and salmon trout, and sole and lemon sole, which represent species considered superior from a gourmet and price perspective (samlet, sole), and cheaper substitutes (salmon trout and lemon sole), see Figure 1.

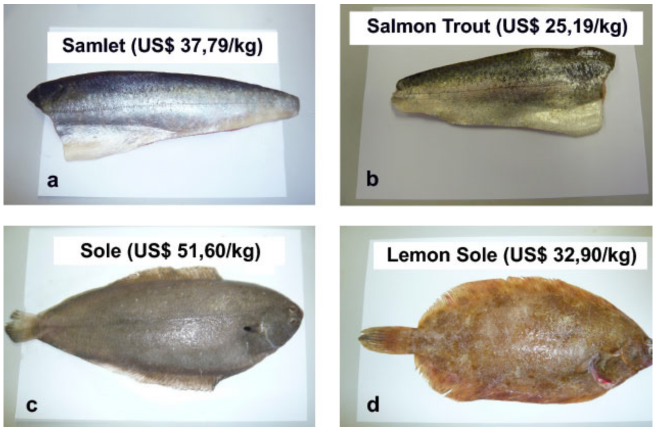


**Figure 1:** *Filets of Samlet (a) and Salmon Trout (b) and whole fish of Sole (c) and Lemon Sole (d).*

The researchers scanned the fish filets by placing the sensor directly on the skin (Figure 2). A reference scan was conducted with Labsphere's 99% Spectralon™ reflection standard. 10 spectra with a scan time of 10 seconds were recorded in diffuse reflection from different positions on each fish filet. The team used Unscrambler™ software for the data pre-treatment and the development of PCA (Principal Component Analysis) and SIMCA (Soft Independent Modeling of Class Analogies) models.

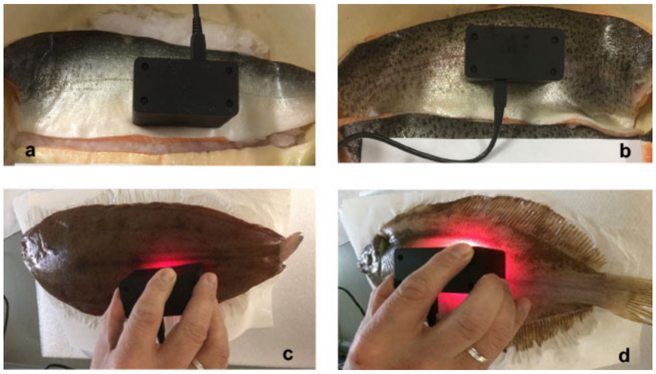


**Figure 2:** *Sample presentation of Samlet (a), Salmon Trout (b), Sole (c) and Lemon Sole (d) for NIR spectra measurements with the NeoSpectra sensor.*

## Samlet and Salmon Trout

For the samlet and salmon trout comparison, the researchers used 4 samlet and 6 salmon trout filets. The 100 spectra measurement are shown after pre-treatment in Figure 3. Using the PCA model the researchers were able to distinctly discriminate the two fish classes in a 2D score plot (Figure 4). Using the SIMCA classification based on the two PCA models for each fish class, the researchers were able to use a Coomans plot ascertain to which class the spectra of an unknown fish belong, including a French salmon trout and a German salmon trout.

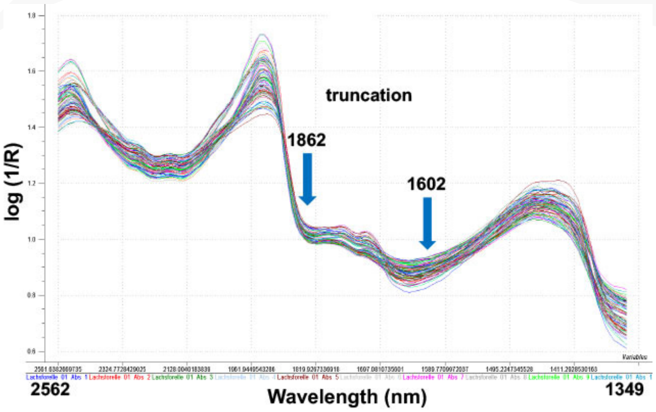


**Figure 3:** *NIR spectra measured with the NeoSpectra sensor of all Samlet and Salmon Trout species after EMSC (including truncation range for PCA).*

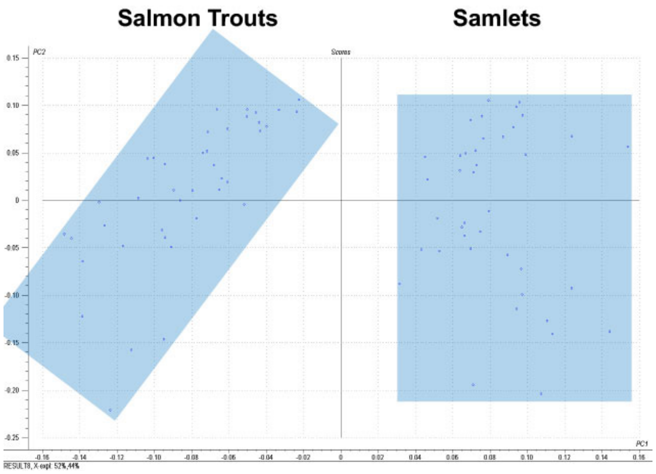


**Figure 4:** *2D (PC1/PC2) score plot based on the PCA of 40 calibration spectra each of the investigated Samlets and Salmon Trouts.*

## Sole and Lemon Sole

For the sole and lemon sole comparison, similar methods were used. In this case the two species could be distinctly identified even from the initial wavelength graph (**Figure 5**). The fish species were also distinguishable from each other in the 2D core plot, while unknown species could be identified from the Coomans plot.

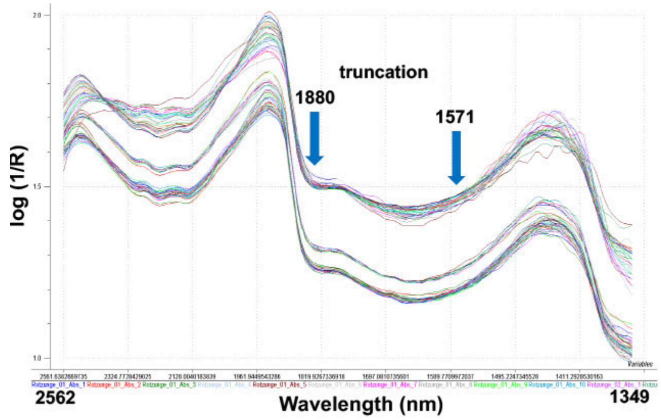


**Figure 5:** *NIR spectra measured with the NeoSpectra sensor of all Sole and Lemon Sole species after EMSC (including truncation range for PCA).*

## Conclusions

The study was able to clearly demonstrate that on the basis of NIR-based diffuse reflection spectra both filets and whole fish, an individual or a team could use the Neospectra sensor to correctly identify species of similar-looking fish. Equally significant, unknown fish within the two classes in the study could be accurately assigned to the correct class using SIMCA analysis.

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