



Verification of the geographical origin of European plaice (*Pleuronectes platessa*)

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Objective

The objective of this study is to evaluate the analysis of:

- Volatile compounds by Proton Transfer Reaction Mass Spectrometry (PTR-MS),
- Fatty acid composition by Gas Chromatography (GC), and
- Isotope ratios by Isotope Ratio Mass Spectrometry (IRMS) for their applicability in the verification of the geographical origin of European plaice (*Pleuronectes platessa*).

Background

European plaice is the principle commercial flatfish in Europe. Plaice live at the bottom of the sea close to the shore, predominantly in the North Sea, but extend to the Baltic Sea, the White Sea, and the seas around Ireland and Iceland (Figure 1).

Fish and fish products are common targets for food adulteration. During production, fish species can be completely interchanged or mixed with cheaper or less sustainable fish types. EU Regulation No. 1379/2013 states that, amongst others, catch area should be mentioned on the label of all unprocessed fish and certain processed fish products.

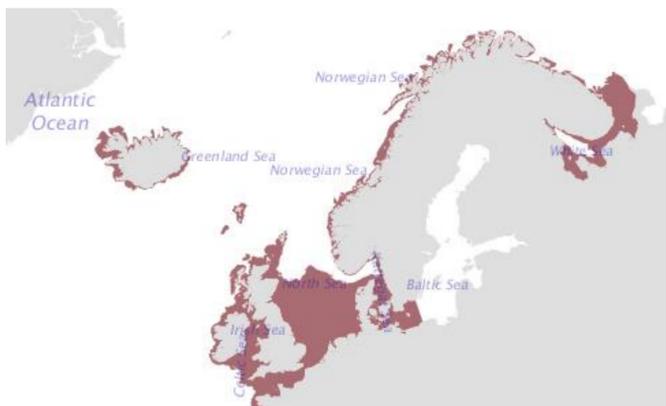


Figure 1. Habitat of European plaice (FAO FishFinder).

Materials and methods

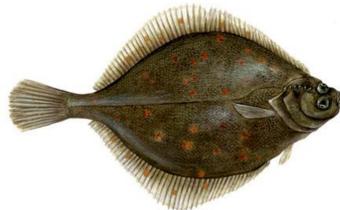
A total of 25 European plaice samples from 5 different regions in the North Sea were obtained and stored frozen as soon as possible.

- PTR-MS analysis was performed on thawed sample (~1 g) after equilibration at 25°C for 30 minutes of m/z 20-160.
- Fat was extracted from freeze-dried sample (~2 g) using chloroform:methanol (2:1). The fatty acids were methylated and their composition was analysed by GC-FID.
- The defatted fraction of the samples was rinsed with water and acetone for removal of sodium sulphate. These samples were dried and analysed for $\delta^2\text{H}$ in a continuous flow IRMS and for $\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$ in an elemental analyser IRMS.

Results and discussion

Volatile compounds

- The profile of volatile compounds is often used to verify the geographical origin of food products.
- Analysis is influenced by freshness of the product, e.g. production of methanol. Therefore, appropriate masses were selected.
- With the help of chemometric modelling >90% of the samples could be classified in the correct region of the North Sea.



Conclusions

- With all three evaluated methods (PTR-MS, GC and IRMS) European plaice from different locations within the North Sea seem to group together.
- More distinct differences are expected for samples from other locations than the North Sea.
- The methods evaluated in this study will also be tested to distinguish between wild and farmed fish.

Results and discussion (continued)

Fatty acid composition

- Fatty acid composition of fish is influenced by the fish' food source.
- Most abundant fatty acids: C20:5, C16:0 and C22:6.
- Consistent differences were found in the content of C22:6 and total content of omega-3 fatty acids between European plaice from different locations in the North Sea (Figure 2).

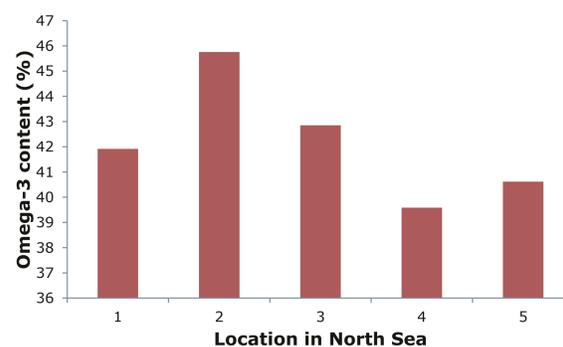


Figure 2. Content of omega-3 fatty acids in European plaice from different locations in the North Sea (numbered 1-5; coefficient of variation= 0,16%).

Isotope ratio

- Main difference between different region of the North Sea is seen in $\delta^2\text{H}$ and $\delta^{34}\text{S}$ isotope ratios (Figure 3).
- $\delta^2\text{H}$ is severely depleted compared with sea water, range: -49.6 to -88.2‰. Isotopic composition is referenced to local food chain rather than dissolved water isotopes.
- $\delta^{34}\text{S}$ is enriched compared to its standard, range: +5.7 to +16.3‰. This is typical for marine fish, whereas freshwater fish typically show depleted $\delta^{34}\text{S}$.

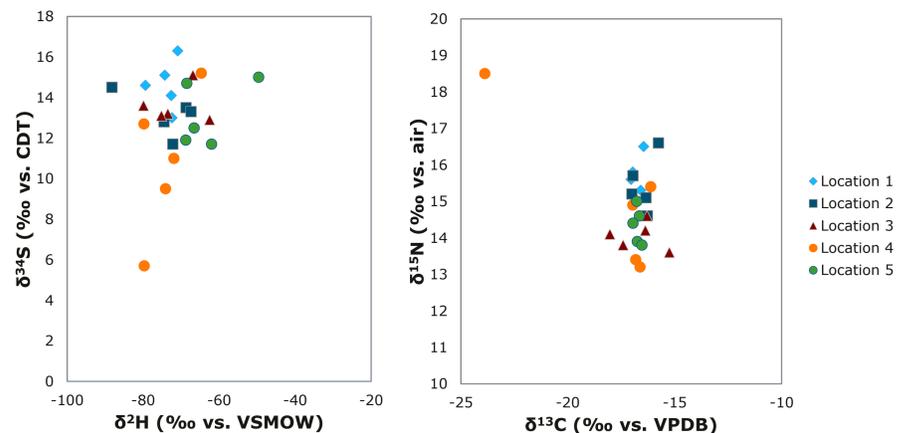


Figure 3. Scatter plot of $\delta^2\text{H}$ versus $\delta^{34}\text{S}$ (left) and $\delta^{13}\text{C}$ versus $\delta^{15}\text{N}$ (right). Different colours represent European plaice from different locations in the North Sea.

Acknowledgements

The research is funded by the European Fisheries Fund.

