AUTHENTICATION OF PRODUCTION METHOD OF FISH BY FATTY ACID AND STABLE ISOTOPE PROFILING

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Introduction

International fish trade is nowadays strongly influenced by food authenticity and safety norms. Particularly, EC Regulations No 104/2000 and No 2065/2001 require the statement of the official commercial name, the geographical origin and the production method of fish. In this context, national laboratories should be able to guarantee that fish products sold in their country respect the Council and the Commission Regulations.

The present work shows the potential application of fatty acid and stable isotope analysis, combined with chemometrics, to discriminate the method of fish production.

Materials and methods

From September 2004 to February 2007 60 intensively farmed (mean weight 326.2 g), 60 extensively farmed (355.5 g) and 59 wild seabream (157.3 g) were collected from wholesale fish market of Milan. At the same time 30 cultured (mean weight 666.5 g) and 30 wild turbot (608.1g) were collected. Chromatographic analysis of flesh fatty acids was performed on each wild and farmed sample. Carbon and nitrogen isotope ratios were measured on freezed-dried flesh by continuous flow isotope ratio mass spectrometry. Principal Component and Linear Discriminant Analysis were performed on the obtained data sets.

Results and discussion

Monounsaturated fatty acids (MUFA), in particular 20:1n-9 and 22:1n-11, were higher in farmed than in wild animals. These two fatty acids derive from dietary fish meals and oils included in commercial feed for aquaculture and from small fish consumed by wild turbot in their natural habitat. Among n-6 polyunsaturated fatty acids (PUFA n-6), 18:2n-6 was much higher in cultured fish than in wild individuals. This fatty acid is present in plant meals and oils included in the feed for cultured fish, and accumulate largely unchanged in the lipids of marine fish. PUFA n-3 and 22:6n-3 were higher in wild than in farmed specimens. In fact, the marine food web is characterized mostly by PUFA n-3; conversely, the manufactured feeds for fish contain lower amount of PUFA n-3 (Sargent et al., 2002).

Principal Component Analysis revealed that the cluster of cultured seabream was associated with 18:1n-9, 20:1n-9, 22:1n-11 and 18:2n-6, whereas wild seabream was associated with PUFA n-3,

20:4n-6 and 22:6n-3. The cluster of farmed turbot was correlated to PUFA n-6 and 18:2n-6, while wild turbot was associated with PUFA n-3, 22:6n-3 and 20:4n-6.

Carbon isotope ratios allowed to discriminate between intensively farmed and wild seabream, but not between wild and extensively farmed specimens, reasonably because extensively farmed seabream feed on organisms very similar to those utilised by their wild counterparts. Carbon isotope ratios did not differentiate farmed turbot from wild individuals. Nitrogen isotope ratios showed a quite similar distribution between wild and farmed fish, and did not permit the discrimination between samples. On the other hand, wild turbot showed higher $\delta^{15}N$ values in comparison with wild seabream. This difference might be attributed to the different diets consumed (De Niro and Epstein, 1981): a tentative explanation is that the predator feeding regime of fish like turbot is responsible for a major nitrogen isotopic fractionation than the diet of seabream, based primarily on molluscs and crustaceans.

Discrimination was achieved between wild and cultured seabream using linear discriminant analysis, with $\delta^{13}C$, 18:2n-6, 20:1n-9, 20:2n-6 and 20:5n-3 (98,5% of cross-validated grouped samples was correctly classified) providing the highest contribution for discrimination. The variables selected to distinguish farmed from wild turbot were $\delta^{15}N$, $\delta^{13}C$, 18:2n-6, 18:3n-3 and 20:4n-6 (100% of cross-validated grouped samples was correctly classified).

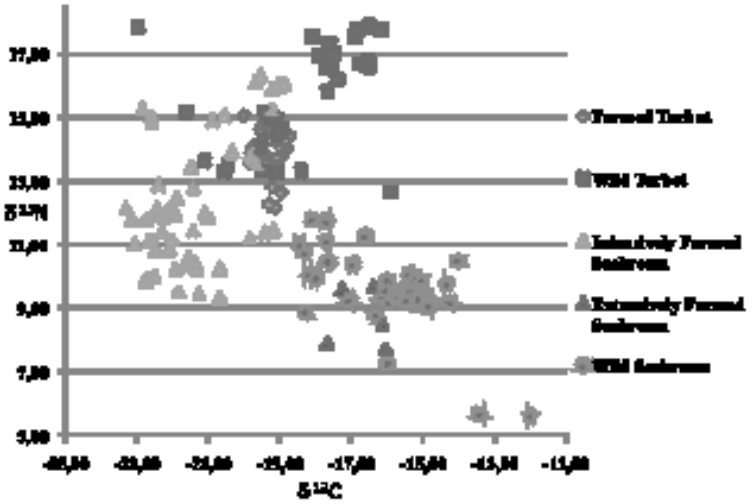

Fig. 1. ^{15}N vs ^{13}C values of muscle of wild and farmed seabream and turbot

Conclusions

In the present study we have shown that wild and cultured seabream and turbot can be differentiated using muscular tissue fatty acid composition. We have also proved that both Principal Component and Linear Discriminant Analyses on fatty acid and stable isotope data are suitable chemometric methods to elucidate the method of production of the samples collected.

References

De Niro M.J. and Epstein S., 1981. Influence of diet on the distribution of nitrogen isotopes in animals. Geochimica et Cosmochimica Acta; 45, 341-351.

Sargent J.R., Tocher D.R. and Bell J.G., 2002. The lipids. p. 181-257. In: Fish Nutrition. Halver J.E. and Hardy R.W. (Eds.). Academic Press, San Diego, CA (USA). 824 p.