Microbial communities to assess the traceability and freshness of seafood: A metagenomic approach

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With the exponential growth of world population, also seafood consumption is constantly growing, thus making sustainability, transparency and safety of fishery a challenge for policy makers. Microbial communities associated with seafood have been already proposed as markers for food tracking and safety.

This work aimed at: 1) the exploration of seafood traceability and safety through the analysis of its associated bacterial communities; 2) the development of aptamer-based sensors to be used to assess fish freshness at the future service of governments' control/regulatory bodies; 3) the development of a tool for the detection of marker DNA sequences.

In particular, the targeted metagenomic sequencing of bacterial 16S rRNA gene from two different fish species (Dicentrarchus labrax and Sparus aurata) caught in different geographical locations along the Tuscan coast, was used to explore the link between geographical distribution of fishes and their microbiota, and so to assess the possible microbial communities-based traceability.

The same organisms were stored in a fridge and sampled every day for three days to simulate the fish spoilage on the consumer side, to identify SSOs (specific Spoilage Organisms) and changes to microbial communities related to storage time.

Shotgun sequencing was used to find location- and freshness-specific marker k-mers (using a newly-developed R package, "MARKUS") to be used for the development of aptamer-based sensors.

Analysis of gills' microbial communities revealed significant differences both between the two species and the different sampling sites, suggesting a possible traceability of fish based on the gill microbiota. The spoilage test showed that, even at small time ranges, gills' communities change very quickly. Indeed, well-known SSOs (e.g., Genus Photobacterium) showed a fast overtaking at the expense of other taxa. Shotgun sequencing corroborated those results and produced a number of markers for the development of aptamer-based sensors.