

VOLATILE COMPOUNDS AS QUALITY INDICATORS IN CHILLED FISH:
EVALUATION OF MICROBIAL METABOLITES BY AN ELECTRONIC NOSE

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ABSTRACT

Key determinants of chilled fish quality are characteristic odor changes caused by the formation of volatile compounds, like alcohols, aldehydes, ketones, esters, sulfur compounds and amines, by specific spoilage organisms (SSO). The objective of this thesis was to explore the potential use of electronic nose as a rapid technique to detect volatile compounds related to quality changes during chilled storage of different species of fish and fish products (capelin, cod, haddock, red fish and cold smoked salmon). The influence of various storage conditions (-1.5 to 15 °C) on the proliferation of SSO was studied and their spoilage potential was evaluated by electronic nose, chemical analysis of TVB-N and TMA and sensory analysis.

The results of measurements with electrochemical sensors (CO, NH₃, H₂S and SO₂), sensitive to the main classes of microbially produced compounds, demonstrated the spoilage potential of the SSO. The increased CO sensor response during early storage in all fish species, suggested the formation of alcohols, aldehydes and esters and the role of *Pseudomonas* spp. in the incipient spoilage changes. The response of the NH₃, H₂S and SO₂ sensors, sensitive to amines and sulfur compounds, respectively, indicated the importance of *S. putrefaciens* as a late spoiler in whole fish and in fillets stored under abusive temperature conditions. Production of ketones in high levels, contributed mainly by 3-hydroxy-2-butanone as identified by GC-MS, was associated with the active growth of *Photobacterium phosphoreum*. This bacterium was identified as the dominating SSO based on its growth and production of TMA as reflected by high levels of TVB-N in chilled cod and haddock fillets packed in styrofoam boxes.

Multivariate PCA and PLSR based models were used to predict the quality of the fish. Multiple quality indices based on the electronic nose sensors, SSOs and TVB-N were needed for classification or prediction of the complex quality changes of fish stored under different temperature conditions. However, when applying models adapted for each storage condition the ability of the electronic nose to classify samples was improved. For products like capelin with high concentration of volatile spoilage compounds a single sensor (NH₃) was sufficient to predict the TVB-N value by fitting a generalized linear model to the data and estimating parameters for each storage condition. Addition of sensors for the detection of ketones and increased sensitivity of sensors for TMA is suggested to improve the performance of the electronic nose to predict the quality of fish fillets.

KEYWORDS: Volatile compounds; quality indicators; electronic nose; gas chromatography; SSO; capelin, cod, haddock, red fish, cold smoked salmon, chilled, superchilled, MA