

## **T11. Beer quality assessment by hybrid spectroscopic-electrochemical technique**

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A combination of two powerful analytical techniques, optical spectroscopy (OS) and electrochemical potentiometric multisensor system (electronic tongue, ET) has been studied within a joint multi-sensor technology for beer quality assessment. Based on different physical principles, ET and OS are not just different, but also complementary techniques that derive different kinds of chemical and physicochemical information about a sample. Such a hybrid optical-electrochemical analyzer appears to be very attractive for express quality control. It could offer an alternative to the standard physicochemical analysis as well as the sensory taste assessment, which are time-consuming and may be too expensive for small- to middle-scale breweries.

Twenty different brands of beer produced in Germany, Russia and Czech Republic were analysed. Most of them were Pilsener and other high-quality blond beers, having a very similar composition. It was necessary to test the method's capability of recognising delicate taste-related differences. Some other different beer types like dark, alcohol-free, strong, yeast-containing and filtered white beer were tested as well. All the samples were analyzed with the potentiometric electronic tongue and with a number of different spectroscopic techniques. The latter included: attenuated total reflectance infrared (ATR-IR), near infrared (NIR), visible (Vis), and ultraviolet (UV) spectroscopy as well as fluorescence at two different excitation wavelengths and 2D-fluorescence spectroscopy (full excitation-emission spectra). In most cases the spectra were measured directly in a sample through an appropriate immersion probe, operating in ATR, transmittance, transreflectance or diffuse reflectance mode. The measurement geometry and conditions were optimised for the beer analysis. Reproducible data acquisition procedures, suitable for sample quantitative analysis, were developed in each case.

Independent reference analyses of the same beer samples were carried out by certified laboratories in Germany. The analysis has covered standard characterisation of the beer quality attributes in accordance with German regulations, e.g. extractivity, alcohol content, colour, pH, foam resistance, turbidity, concentrations of bitter-forming components and other standard parameters. Besides, the samples were assessed by a trained commercial sensory panel to estimate taste and flavour details as well as the overall quality in accordance with a standard procedure.

In the present work we report the results of multivariate analysis performed on the collected data. The sensitivity of individual techniques to certain beer components and properties is presented. The main accent is made on the feasibility analysis of the suggested hybrid ET-OS technique to detect the main taste-related attributes of the beer quality.