"Determination of Quality Criteria for Raw Materials Used in Rectification of Ethyl Alcohol of Agricultural Origin in Order to Improve Efficiency of the Process"

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Abstract

The aim of this project was to establish theoretical and practical basis for new criteria of raw material selection to the process of ethyl alcohol rectification in the Wyborowa S.A. company, allowing for an increase the efficiency of the process and further development of the sensory quality of vodkas competing on domestic and export markets.

The thesis contains an extended review of the current state of quality of the company's ethyl alcohol of agricultural origin and vodka, as well as the raw materials used in their production (distillate of agricultural origin, technological water). It also evaluates the available methods of instrumental and sensory analysis. Gas chromatography coupled with mass spectrometry with the use of the solid phase microextraction (SPME) technique was applied to analyse trace amounts of flavour-active volatile organic compounds (VOCs). The results of qualitative and quantitative determination of congeners were checked against legal provisions, literature data and compared with selected market benchmarks representing high quality.

Distillates of different botanical origin, from various suppliers, were screened for congeners. Subsequent stages of the distillery process were analysed for possible root causes of congener formation.

The scientific part of the project comprised a series of experiments, conducted in collaboration with a selected supplier, in which samples of distillery mashes obtained from rye were fermented in lab-scale, using targeted yeast and enzymes. In frame of these experiments, concentrations of sensory- and chemical quality-relevant congeners were monitored at several points in time during fermentation progress, depending on pH and temperature of yeast inoculation as well as external temperature. Recommendations for the participating distillery were based on statistical analysis of the results.

The aforementioned qualitative review, together with the conclusions from the experiments, gave reason to examine how sensory quality and purity of alcohol are shaped by the levels of VOCs present in the distillates subjecting to rectification and how those features can be influenced by modification of process parameters. Samples of several key fractions in the rectification process, the flow and extraction rates of which may be regulated to a certain feasible degree, were taken and analysed for a selected group of VOCs relevant for final product quality. Different available ways of selective reduction of the concentration of those compounds were taken into consideration, with regard to the technical capabilities of the rectification equipment, alcohol yield and water consumption.

The implementational part of the project describes the principles and outcomes of industrial scale rectification trials, including:

- a switch to an alternative mode of technological water treatment
- sensory improvement of ethyl alcohol obtained from rye, upon change of flow and extraction rates of selected fractions in the rectification process.

All the aforementioned trials were based on proposed, modified quality criteria for raw materials used in rectification.

Two different samples of alcohol produced in the sensory improvement trial were used to make vodkas of a new, enhanced quality that were later evaluated in vast market research on a representative target consumer group, in comparison with leading vodka brands. The new vodkas were also analysed with a wide array of instrumental and sensory analysis techniques available in the company, at the Łódź University of Technology and external entities. The quality of one of the tested vodkas was determined as promising in terms of improvement of the sensory profile, whilst maintaining all favourable chemical parameters. This forms a foundation to the implementation of the solution in the future, basing on the proposed quality criteria.