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Quantification of Ethyl Acetate using FAIMS

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2. Ethyl Acetate within Wine

Ethyl Acetate is a popular ester found in a wide variety of wines. It is known for its fruity and floral notes, making it a desirable component in wine.

1. Abstract

This work details an investigation into the quantification of ethyl acetate within wine using a Gas Chromatograph (GC) coupled with a Field Asymmetric Ion Mobility Spectrometer (FAIMS). The justification for an analytical approach to grading wine is presented along with how the GC-FAIMS technology may benefit the wine industry.

The quantification of ethyl acetate within a complex background such as wine also presented an excellent opportunity to investigate the capabilities of a FAIMS device as a GC detector.

It was found that the GC-FAIMS device was able to detect quantities of ethyl acetate below the human threshold within a simple solvent. Detection of ethyl acetate within wine was found to be hindered due to the presence of ethanol. The loss sensitivity was recovered through increasing the pressure that the FAIMS sensor operated at.

3. Apparatus and Experiment

The GC-FAIMS system investigated was created through coupling a SRI 8610C with an Owstone Tourist [12] incorporating a FAIMS sensor equivalent to that available within the Owstone Lonestar [12]. The two separate units complement one another providing orthogonal data to one another. This provides greater separation of compounds which is ideal for investigating a particular compound within a complex background. The response of the system from wine is shown within [6].

For those unfamiliar with FAIMS it is a technique capable of detecting trace quantities of analytes through the ionisation of a gaseous sample stream and filtering of resultant molecular ions through the use of an electric field. The filtering can be adapted through modification of the imposed electric field so that it is possible to sweep across a range and detection of all the molecular ions present is possible. FAIMS separates compounds due to their unique mobility within the environment of the sensor.

4. Detection of Ethyl Acetate and the effect of Ethanol

The response due to ethyl acetate was isolated through preliminary testing. Following this a stock of distilled water spiked with ethyl acetate was successively diluted so that a range of concentrations could be tested. It was found the system had a very good sensitivity to ethyl acetate and reliable readings thirty times below the human threshold were recorded [A].

The same procedure was undertaken with wine as the solvent. It was found the sensitivity was severely impaired. It appeared that ethanol, due to its abundance within wine, was acting as a co-solvent and depleting the reservoir of reactant ions required for detection. This was tested by creating a solvent of distilled water and 12% ethanol. The result was an identical response to when the solvent was wine. Sensitivity was improved by substituting the non-polar GC column with a greater polarity. As ethanol elutes from the GC column before ethyl acetate increasing the separation time between the compounds should reduce the depletion of reactant ions. This was found to be the case (A). The analysis time however increased and saturation of the reactant ions was still observed.

5. Recovery of lost signal and Conclusions

A method to overcome the loss of sensitivity while not increasing the analysis time was sought. The answer required increasing the pressure of the make-up flow of air through the FAIMS device. Due to the high frequency of the electric waveform used within the Owstone device a phenomenon known as clustering [13] is unlikely. However, increasing the pressure promotes interaction of constituents (and therefore clustering) which increases the separation of ion species within the FAIMS device (B).

As the separation of ions is increased through the pressure the strength of the applied waveform is increased resulting in a larger reservoir of available reactant ions for analysis. This led to improved sensitivity of ethyl acetate even within a complex solvent such as wine (C).

It has been found that a GC-FAIMS system is capable of detecting ethyl acetate within wine at levels far below the human perception threshold. It has also been shown that a FAIMS device can be tailored to account for a complex background without increasing analysis time or resources.