

# Assessment of champagne glass geometries - Dynamic head space sampling of champagne aromas

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## Abstract

Enjoying a glass of champagne where the evolution of aromas is carried by the wine's effervescence in a process changing over time is a challenging phenomenon to characterise using instrumental analysis.

A time-resolved instrumental analysis set-up using desorption liners in combination with gas chromatography-mass spectrometry (GC-MS) was successfully used to characterise aroma evolution from different champagne glass geometries as a function of time.

The present work showed that by using thermal desorption technique it is possible to characterise aroma evolution from different champagne glass geometries as a function of time.

**Keywords:** wine aroma, champagne, aroma release, dynamic sampling

## Introduction

Glass vessels for drinking have been used and discussed at least since the days of Pliny (23-79 AD), but the importance of glass geometries for the hedonistic enjoyment of wine has been out of focus until rather recently. Most research activities have been assessing orthonasal olfaction using trained or untrained sensory panels [1, 2], and only a limited amount of research has been focusing on the chemical composition of the headspace in a wineglass using chemical analysis [3].

Many identifications and quantifications have been based on a steady state sampling situation, often using Solid Phase Micro Extraction (SPME) techniques with long sampling times. This will assess a situation far from the real-life situation when enjoying a glass of champagne, where the evolution of aromas is carried by the wine's effervescence in a process changing over time. Hence a dynamic analytical approach is needed to evaluate the evolution over time.

## Experimental

### Material and method

Champagne *Duménil Brut Premier Cru*, 2008 (part 1) and *Veuve Clicquot Brut NV* (part 2).

Glass Richard **Juhlin** champagne glass (*Reijmyre, Sweden*), **Grand Cru** champagne (*Skruf, Sweden*), both of flute shape and **ICA** supermarket champagne glass, of cylinder shape without tapered opening.

Equipment and method The aroma air samples (240 mL) were collected at the mouth of the champagne glasses onto desorption liners for a Thermal Desorption Unit (*Gerstel, Mülheim an der Ruhr, Germany*) packed with Carbopack C & B and Carbosieve SIII) of 4 mm inner diameter, using a plastic syringe.

The adsorbed aroma components were subsequently thermally desorbed by heating the liner (30 to 285 °C (120 °C/min), 10 min hold) into a cryo-cooling trap (-30 °C) using Tenax TA liner and then rapidly heated (to 275 °C, 12 °C/sec) hold 4 sec) to inject the sample into a gas chromatograph (Agilent 7890B, *Agilent Technologies Inc. USA*) equipped with a HP-5MS UI column (*Agilent J&W*, 30 m x 0.25 mm x 25 µm), He carrier gas at 1 mL/min, temperature program from 35 to 210 °C (4 /min) then to 275 °C (20.0 °C/min) connected to a QTOF mass spectrometer operated in EI mode (70 eV), scan range 35-500, 200 ms/spectrum using a solvent delay of 3 min, using quench gas (He) and collision gas (N<sub>2</sub>). The data were analysed using Masshunter software (*Agilent Technologies Inc. USA*) and NIST/EPA/NIH EI-MS library.

### Experimental

The investigations presented were performed in subsequent steps, in order to refine the experimental set-up and to study different aspects of aroma evolution.

Part 1. An initial comparison was performed using **ICA** and **Juhlin** glasses (n=1). Aliquots of champagne were poured, and headspace air samples (240 mL at a sampling rate of approx. 120 mL/min) were withdrawn after 30

and 90 minutes. In order to facilitate the data evaluation some aroma marker compounds were selected and monitored (ethyl acetate, 3-methyl-butanol, ethyl hexanoate, ethyl octanoate).

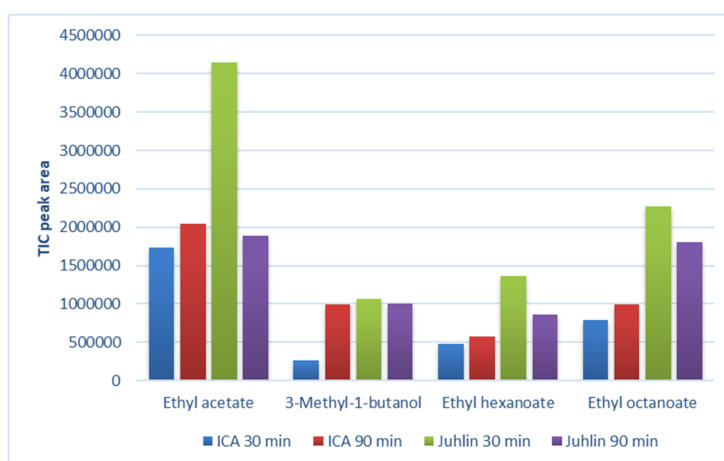
**Part 2.** In the subsequent part, the temporal evolution, shortly after pouring, was studied using the **Grand Cru** glass (n=1) in order to illustrate the role of the effervescence as an aroma carrier. Two minutes after pouring, four samples were withdrawn directly after each other using same volume but at a slower flow rate as compared to study part 1 (240 mL at a sampling rate of approx. 60 mL/min). By the time of withdrawing the fourth sample, the initially brisk effervescence had ceased considerably.

The aroma marker compounds ethyl butanoate, ethyl hexanoate, ethyl octanoate, and ethyl decanoate were selected and monitored.

## Results and discussion

**Part 1.** It was found that the flute shaped champagne glass gave slightly higher amounts of some selected aroma components as compared to the basic supermarket cylindrical shaped champagne glass, see Figure 1.

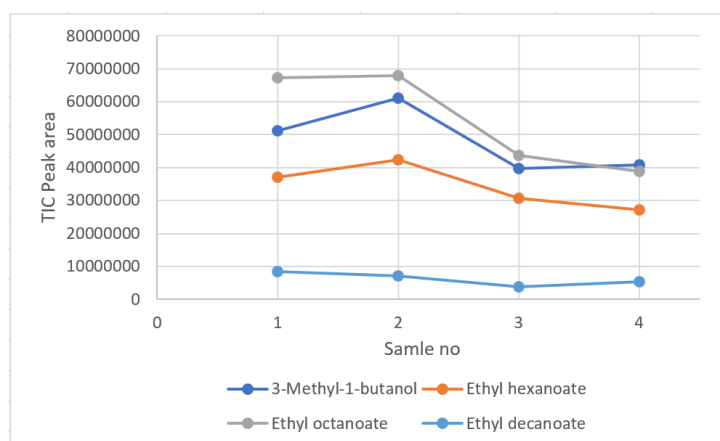
The time-resolved air sampling indicated that the two glasses gave rise to somewhat different aroma development. This illustrates possible effects of glass shapes on the aroma development over time in a poured glass of champagne.



**Figure 1.** Aroma evolution in ICA and Juhlin champagne glasses, sampled at 30 and 90 minutes after pouring.

**Part 2.** The four consecutive samples showed a decay of the selected aroma components after an initial partial increase, see Figure 2.

The overall aroma decay coincided with the effervescence decay, thus indicating the role of effervescence as aroma carrier. A blank sample from ambient atmosphere was also collected, showing no detectable levels of aroma components.



**Figure 2:** Aroma evolution in **Grand Cru** champagne glass over time.

### *Considerations*

The variability of the results found during method development indicates that an improved sampling procedure would be beneficial. By slightly increasing the diameter of the sampling tube (i.e., the desorption liner opening) a sampling set-up closer to the human orthonasal olfaction situation could be obtained. In combination with a further reduced sampling flow rate and sampling volume, the risk of local depletion of analytes during the air sampling would be reduced. In order to obtain more robust datasets and to draw more firm conclusions, automating the air sampling and thus increasing the number of samples withdrawn would be beneficial.

### **Conclusion**

Enjoying a glass of champagne where the evolution of aromas is carried by the wine's effervescence in a process changing over time is a challenging phenomenon to characterise using instrumental analysis. The concentration levels of the relevant aroma compounds are challengingly low and the available air volume to sample is limited.

However, the presented work indicates that by using thermal desorption technique in combination with GC/MS it is possible to characterise aroma evolution from different champagne glass geometries as a function of time.

### **References**

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