What do we know about the kerosene/petrol aroma in Riesling wines?

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Introduction

1,1,6,-Trimethyl-1,2-dihydronaphthalene (TDN) is an aroma substance in wine with a controversial sensory effect. Its odor is usually associated with kerosene and petrol notes. Noticeable content of TDN is present mostly in Riesling wines. At low concentrations TDN can play a positive role bringing complexity to the wine bouquet. However, high TDN content can evoke negative impressions causing a strong dominance of kerosene/petrol aroma.

Management of TDN in wine is an important topic nowadays due to the global warming, which can induce higher TDN formation. Absorption of TDN by bottle closures can also have a significant impact on the TDN content in wine. In the current research we studied kinetics of TDN scalping process by different bottle closures.

Perception thresholds of TDN in wine was another aspect of our investigation since the sensory thresholds values reported in the literature varied between 2 and 20 µg/L.

Synthesis of high-purity TDN

Synthesis of TDN was based on the protocol of Miginic (1990) with our modifications in order to obtain analytical specimens of TDN of high purity, 95% and 99.5% [1]. Both β-ionone or α-ionone were suitable to be used as a starting material (*Figure 1*). The obtained TDN was applied for the calibrations in GC-MS (SBSE) analysis as well as for the following sensory studies and TDN scalping experiments.

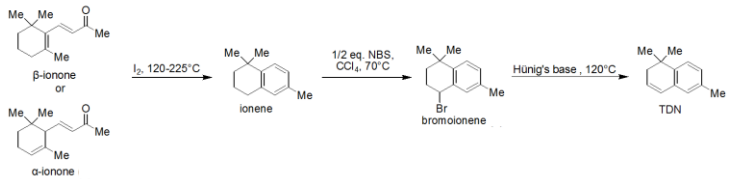

Figure 1. Scheme of TDN synthesis [1]

Determination of TDN sensory thresholds

The sensory analysis of Riesling wine samples spiked with TDN (and presented in the order of increasing TDN concentration) resulted in the determination of the following sensory thresholds [2]:

- *detection threshold* – about 4 µg/L;
- *recognition threshold* – about 10-12 µg/L;
- *rejection threshold* - about 70-80 µg/L.

The presented thresholds were discussed in relation to the previously reported sensory thresholds determined for other panels and other Riesling wine matrices. For example, our *recognition threshold* was somewhat lower than the earlier reported *consumer detection threshold* of 14.7 µg/L (Ziegler et al., 2019), while the *rejection threshold* values were comparable with some of the recently published *consumer rejection thresholds* (Ross et al., 2014; Ziegler et al., 2019).

The box plots in *Figure 2* demonstrate the distribution of the panelists' answers for the wines with High and Low free SO_2 level. It was also found, that the TDN aroma recognition was easier for the cooled wine samples.

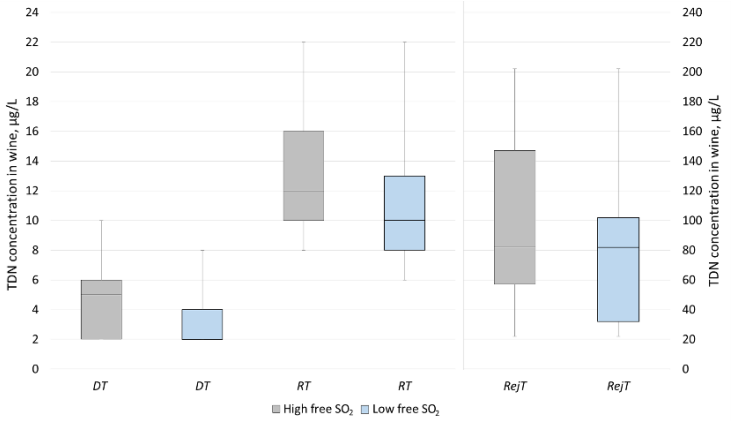

Figure 2. Distribution of the panelists' answers for the determination of *detection threshold* (*DT*), *recognition threshold* (*RT*), and *rejection threshold* (*RejT*) of TDN in Riesling wine. Median is represented by the horizontal line. The bottom and top of the box represent the 1st and the 3rd quartiles, respectively. The whiskers represent the minimum and maximum values [2]

Absorption of TDN by bottle closures

TDN, in contrast to many other wine aroma substances, is a hydrophobic nonpolar compound. Due to these properties TDN can be effectively absorbed by hydrophobic materials of bottle closures: cork, various polymers etc. In the presented work the rate of TDN absorption (scalping) was investigated. Bottles with the TDN spiked wine and five types of closures were stored at conditions with following parameters:

Variants of bottle closures:		Variants of storage conditions	
BVS screw cap	Synthetic stopper	Temperature of storage:	14 °C *and* 27 °C
Glass stopper	Natural cork stopper	Time of storage:	3 months *and* 6 months
Micro-agglomerated stopper		Bottles position:	vertical *and* horizontal

Besides the time of storage, bottles position and storage temperature had a significant impact on the rate of TDN absorption. Glass, micro-agglomerated, and synthetic stoppers were able to scalp a major part of TDN, however, with a various rate. Glass stoppers showed the slowest absorption due to the small surface contact of the plastic sealing ring with wine. Storage conditions played also an important role for these stoppers. For example, vertical bottles position and lower temperature induced much faster TDN absorption for glass and synthetic stoppers after 3 months of storage. Cork stoppers demonstrated quick scalping process at all storage conditions, but only of a limited amount of TDN (less than half) was absorbed. In the case of BVS screw caps, just a minor drop of TDN content was observed for all the variants [3].

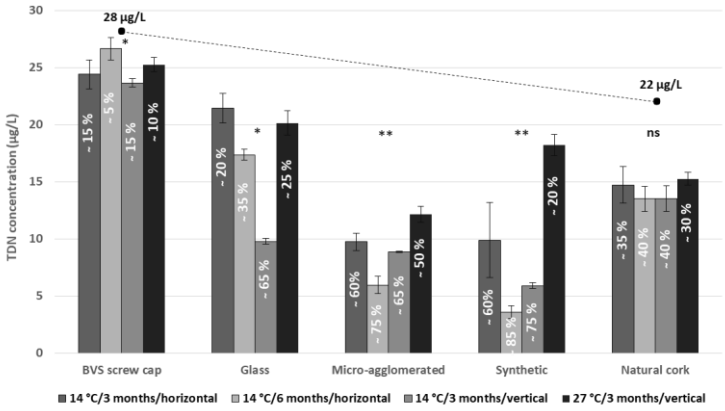

Figure 3. The concentration of TDN in wine after storage (averages of three replicates with standard deviations). Percentages indicate the approximate amount of scalped TDN. The black dashed line illustrates the TDN level decrease in the wine during the bottling (at the beginning and at the end of the bottling). Small letters with asterisks denote significant differences according to the Tukey's test for each type of closures separately (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; *ns* no significant difference) [3]

[1] A. Dobrydnev, et al. (2020). An optimized method for synthesis and purification of 1,1,6-trimethyl-1,2-dihydronaphthalene (TDN). *MethodsX*, **7**, 100768. https://doi.org/10.1016/j.mex.2019.12.009

[2] A. Tarasov, et al. (2020). 1,1,6-Trimethyl-1,2-dihydronaphthalene (TDN) Sensory Thresholds in Riesling Wine. *Foods*, **9**, 606. https://doi.org/10.3390/foods9050606

[3] A. Tarasov, et al. (2019). Absorption of 1,1,6-trimethyl-1,2-dihydronaphthalene (TDN) from wine by bottle closures. *Eur.Food Res.Technol.* **245**, 2343–2351. https://doi.org/10.1007/s00217-019-03351-8