Minerality in wines: fact or fiction? Aromatic profiles of Chasselas grape variety

Pascal Fuchsmann[1], Mireille Tena Stern[1] and Pascale Deneulin[2]

[1] Agroscope, Schwarzenburgstrasse 161, 3003 Berne, Switzerland

[2] Changins University of Applied Sciences and Arts of Western Switzerland, Route de Duillier 50, 1260 Nyon 1, Switzerland

Contact: pascal.fuchsmann@agroscope.admin.ch www.agroscope.ch

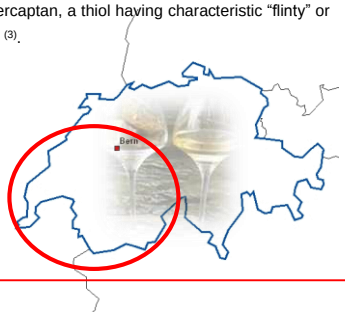
Introduction

Over the past decade, the use of the descriptors "mineral" or "minerality" has become more and more common in the sensory description of wine, but no precise definition exists to date. Minerality may describes aroma notes like flint, chalk, oyster shell or petroleum in wine and can be perceived both by nose (orthonasally) or mouth (retronasally and taste). It is considered by the wine world as positively influencing the aroma of a white wine and giving an aromatic freshness touch and should not be confused with the geological minerals naturally present in soils and grapes (1). The wine's acidity, saltiness, bitterness and the SO_2 (Sulphur dioxide) content could also have an impact on the perception of minerality (2).

The origin of this aroma and the responsible chemical molecules are only partially known: Tominaga et al. (2003) hypothesized that benzyl mercaptan, a thiol having characteristic "flinty" or "smoky" aroma, is one of the responsible molecules (3).

Objectives

The objective was to describe the perception of minerality in Swiss Chasselas white wine by sensory analysis and determination of odorant markers by Gas chromatography–Olfactometry (GC-O).



Experimental

Sensory methodology

- 14 Chasselas white wines were selected by 62 wine professionals by an exemplarity/global judgment. Seven wines were judged "very mineral" (M in label) and seven wines were judged with a "low minerality" (A in label).
- Quantitative Descriptive Analysis QDA was obtained by 13 trained panellists who rated the intensity of 25 sensory attributes (Nose and mouth)
- PCA and cluster analysis were performed on significant attributes

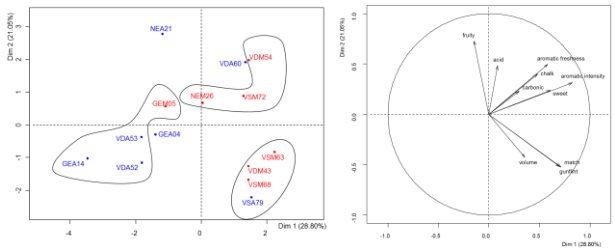
Benzyl mercaptan determination by GC-MS/PFPD

- HS-SPME: T= 70 °C; $t_{extraction}$= 60 min, fibre: DVB/CAR/PDMS 50/30 µm 1 cm
- Alkylation and extraction were performed according to Lauren E. Musumeci *et al.* (2015) and L. Mateo-Vivaracho *et al.* (2010) (4,5)

GC-Olfactometry

- HS-ITEx: T= 50 °C; $t_{extraction}$= 15 min (60 strokes), microtrap: Tenax® TA 80/100 mesh
- Trained panellists (total n = 8; two at a time on a 2W-GC-O-setup) described the perceived odours and rated their intensity on a five-point-scale according to the VIDEO-Sniff-method (6, 7)
- Data were processed taking into account detection frequency and odour intensity (mean olfactory signal by classes ($OSC_{Int\ x\ Det}$) as well as the employed descriptive vocabulary sorted into ten odour classes using the Acquisniff® software (8)

Sensory results



a b

Fig. 1 PCA biplot (axes 1-2) on sensory attributes. Products map (a) in red the 7 mineral wines and in blue the 7 non mineral wines. Ellipses represent groups from cluster analysis. Attributes map (b) 10 attributes were significantly different at 5% level of ANOVA (judge and wine effects): aromatic intensity, fruity, chalk, match, gunflint, aromatic freshness, carbonic, acid, sweet, volume.

Three groups of wines are distinct.

Non mineral wines

Higher diversity of aroma : fruity, lactic or honey aromas

Mineral wines

Gunflint and match aroma with volume in mouth. (VSm63, VDm43, VSm68, VSa79)

Aromatic freshness with acidity (3 wines without malolactic fermentation). (NEm26, VDm54, VSm72)

Analytical results

Odour descriptions given by the panellists were classified into ten different families (**buttery-cheesy**, **empyreumatic**, **floral-fruity**, **green-fatty**, **malty-chemical**, **meaty**, **spicy**, **nutty**, **sulphur** and **earthy-undergrowth**)

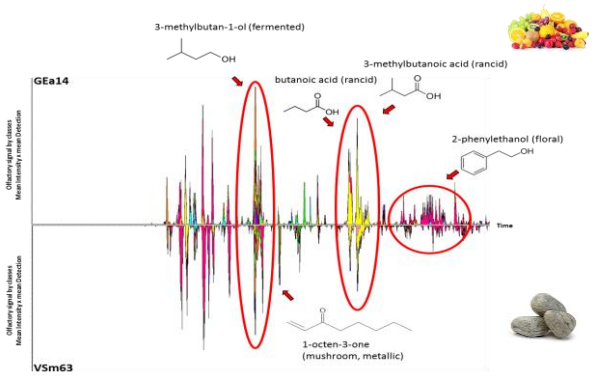


Fig. 2 Mean olfactory signal by classes ($OSC_{Int\ \times\ Det}$) of one mineral (top) and non mineral (bottom) wine over eight panellists.

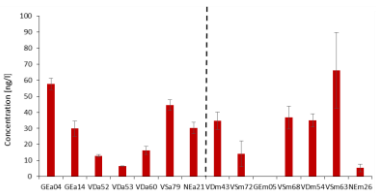


Fig. 3 Quantification of derivatized benzyl mercaptan by HS-SPME-GC-MS following extractive alkylation. Left "non mineral", right "mineral".

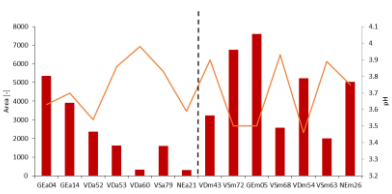


Fig. 4 Qualitative analysis of SO_2 released in headspace by HS-SPME-GC/PFPD depending on the wine pH (orange curve). Left "non mineral", right "mineral".

Conclusion

More than 200 volatile compounds were detected in Chasselas white wine but only 60 odorants were perceived by the panellists during the GC-O using vocabulary−intensity−duration of elementary odours by sniffing methodology (VIDEO-Sniff). The results indicate that the overall "mineral" sensory perception might not be determined by a single molecule, but rather by the general aromatic balance of the wine. The aromagrams of the wines showing mineral notes are less influenced by the perception of carboxylic acids (described by the panellists as rancid, fermented) and 3-methylbutan-1-ol (pineapple, malty, cooked) than the wines classified as fruity. Oct-1-en-3-one, on the other hand, a trace odour compound known for its earthy, metallic, and mushroom aroma in combination with a low odour threshold, was perceived more intensely. These differences could contribute to the described "freshness" in the mineral wines (9). As benzyl mercaptan degrades during GC analysis, its influence could not be evaluated on the GC-O-profile. However, quantification of derivatized benzyl mercaptan did not show a systematic correlation between the wines classified as "mineral" and a high concentration of this molecule. The presence of SO_2 does not directly contribute to the aroma but could help to preserve the oxidation of some volatile compounds responsible for the "mineral" note. These results correlate with the sensory analysis that describes the mineral wine as fresh and acid with gunflint notes.

The authors thank the panellists for their participation.

References

1. A. Maltman et al. J. Wine Res., **2013**, *24*, 169-181
2. H. Heymann et al. J. Sens. Stud., **2014**, *29*, 1-13
3. T. Tominaga et al. J.Agric. Food Chem., **2003**, *51*, 1373-1376
4. L.E. Musumeci et al. Molecules, **2015**, *20*, 12280-12299
5. L. Mateo-Vivaracho et al. J. Agric. Food Chem., **2010**, *59*, 10184-10194
6. J.-L. Berdagué et al., J. Chromatogr. A, **2007**, *1146*, 85.
7. Fuchsmann, P. *et al. J. Agric. Food Chem*. **2015**, *63*, 7511.
8. Acquisniff® software: developed and provided by INRA, distributed by INRA Transfert, F-75015 Paris, France. AcquiSniff@clermont.inra.fr
9. W. V. Parr et al. Food Qual. Prefer., **2015**, *41*, 121-132

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