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Characterization of key aroma compounds in Burgundy truffle

Isabelle Andriot, Karine Gourrat, Rémy Reynaud, Sylvie Cordelle, Caroline Peltier, Olivier Berdeaux, Géraldine Lucchi

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Introduction

Truffles are a fungus of the genus *Tuber*. Some of them have an important economic value due to their gastronomic qualities appreciated in “grande cuisine”. Périgord truffle (*Tuber melanosporum* or Black truffle) and White Alba truffle (*Tuber magnatum pico*) are actually the noblest ones. While these two species are well-valued, Burgundy truffle (*Tuber uncinatum*) is less well-characterized in its production area and truffle producers encounter some difficulties to sell their harvest at its fair value.
The aroma compounds in truffles are investigated with sensory evaluation and two physico-chemical methods.

Methodology

French Fresh truffles

- ✓ Burgundy truffles (summer, autumn)
- ✓ Truffles of south region (summer)

Diced truffles

Sensory analysis

- ✓ 16 panellists were trained with 8 sessions
- ✓ Truffles were evaluated only by olfaction

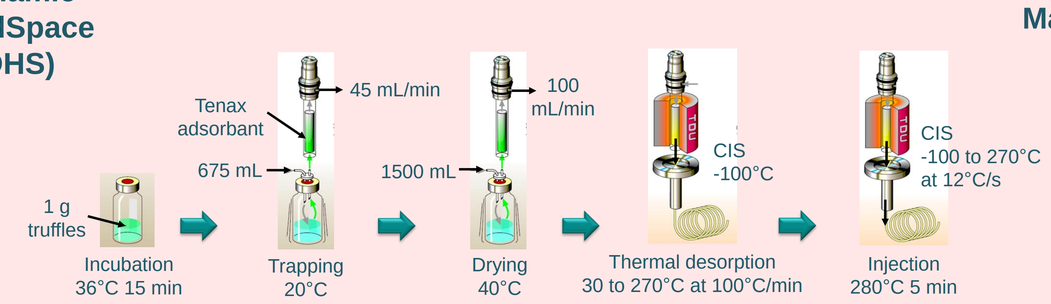
Classical descriptive profile (QDA)

Descriptor: Weak — Strong

Button mushroom	Spicy
Cep	Smoked
Girolle mushroom	Animal
Undergrowth	Pungent
Earthy	Pepper
Mouldy	Fruity
Nut	Vanilla
Alcohol, pharmaceutical	Bread

Grounded truffles

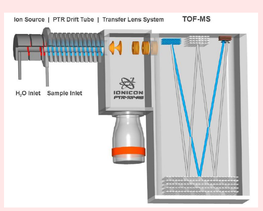
Dynamic HeadSpace (DHS)



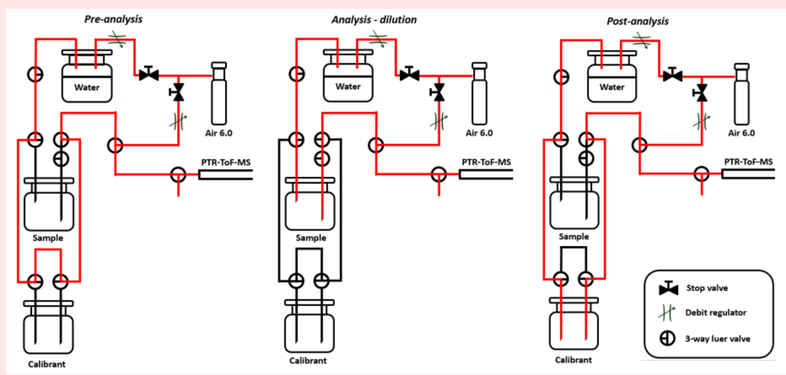
Gas Chromatography – Mass Spectrometry (GC-MS)

GC-MS parameters	
GC-MS	7890A - 8975 C TAD (Agilent Technologies)
Column	DB-HeavyWax (30 m x 0.25 mm x 0.5 µm)
T°C	40 to 240°C at 4°C/min
He	40 cm/s
Injection	Split/splitless 1 min 25 mL/min
Ionisation	Electronic impact
Detector	Quadripole

Retention index
m/z
Aroma compounds identification
(NIST08, INRAMass, WILEY11N17)



In vitro dilution system :
- 25 mg of truffles
- Incubation 36°C 2h
- Pre-analysis (blank): 1 min
- Analysis (sample): 2 min 15 s
- Post-analysis (calibration): 15 s



Proton Transfer Reaction – Mass Spectrometry (PTR-MS)

PTR-MS parameters	
MS	PTR-TOF 8000 (Ionicon)
Mode	Funnel
Ionisation	H_3O^+
H_2O	5.6 sccm
Transfert line	110°C
E/N	92 Td
Inlet flow	65 mL/min
Scans	500 ms

m/z
Peak area
Aroma compounds mass fingerprint
(statistical analysis)

Results

Sensory analysis

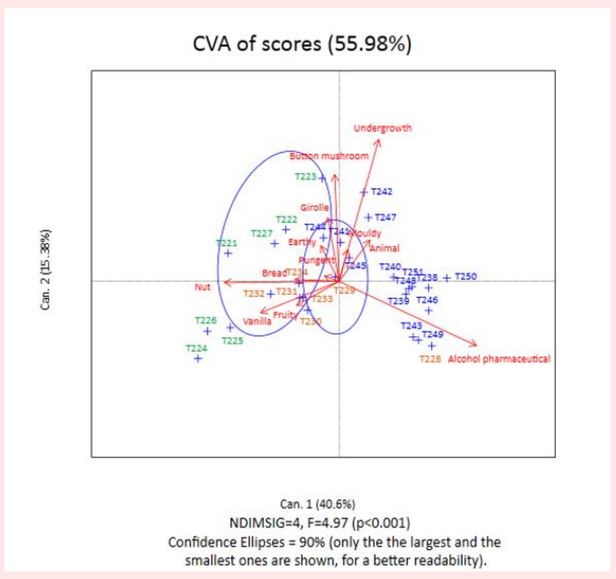
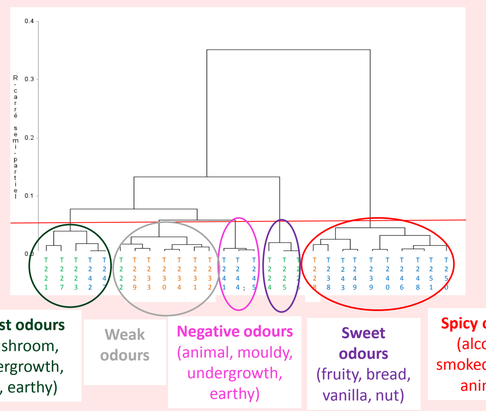


Figure 1: Canonic variables analysis of truffles (QDA)
Truffles of Lot (south of France , summer)
Burgundy Truffles (summer) / Burgundy Truffles (autumn)



Forest odours (mushroom, undergrowth, cep, earthy) | Weak odours | **Negative odours** (animal, mouldy, undergrowth, earthy) | **Sweet odours** (fruity, bread, vanilla, nut) | **Spicy odours** (alcohol, smoked, spicy, animal)

Figure 2 : Hierarchical classification analysis of truffles
Truffles of Lot (south of France, summer)
Burgundy Truffles (summer) / Burgundy Truffles (autumn)

The figures 1 and 2 showed that:
- The Burgundy truffles (summer) are weakly odorant,
- The Lot truffles are characterised by forest odours and sweet odours,
- The Burgundy truffles (autumn) are characterised by negative odours and spicy odours.

PTR-MS analysis

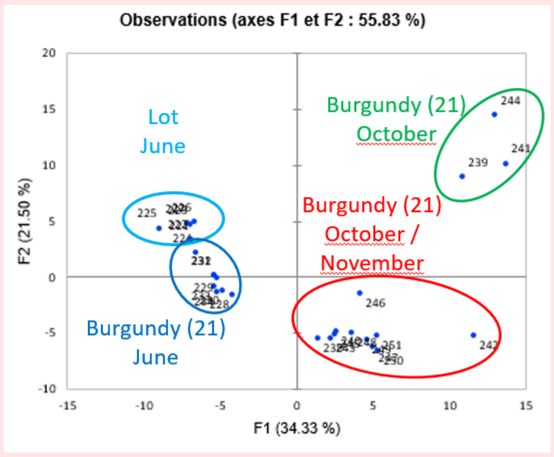


Figure 3: PCA of truffles from different harvests and places

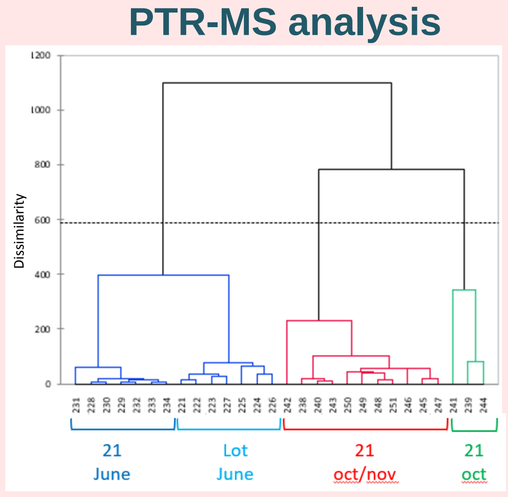


Figure 4: Dendogram of truffles (the same truffles as PCA)

The results presented in figure 3 and 4 show that it is possible to discriminate the truffles according to places and seasons [1,2,3].
However, the analyses of frozen mix truffles as a control have shown a sample dispersion according to time from June to November (data not shown).
We can suspect truffle conservation problems and / or an instrumental bias.

GC-MS analysis

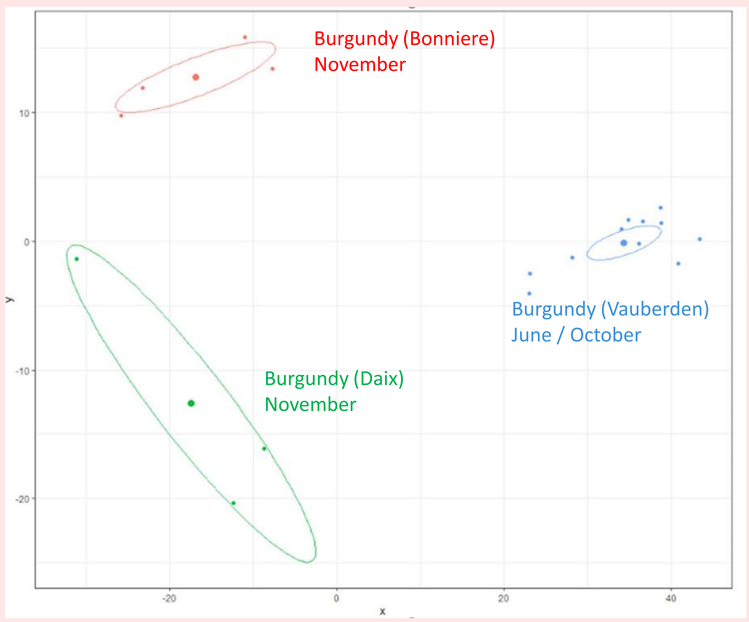


Figure 5: PCA of truffles from different places in Burgundy, the same truffles analysed by sensory analyses and PTR-MS analyses. Unfortunately, the Lot truffles are not enough for the GC-MS

The results obtained by GC-MS confirm the results obtained by PTR-MS and sensory analyses.
The truffles are separated according to harvest places and seasons (Figure 5).
A volcano plot with a foldchange higher than 3 and p-value<10^{-5} allows compounds to be discriminated depending on their peak area in the TIC of the chromatogram. The results are presented in Table 1.

Table 1: Compounds over-expressed, and the corresponding truffles

Compounds which the quantities are more important	Truffles
butan-2-one	Bonniere – Daix / November
butan-2-ol	Bonniere – Daix / November
pentane-2,3-dione	Bonniere – Daix / November
3-hydroxypentan-2-one	Bonniere – Daix / November
2-hydroxypentan-3-one	Bonniere – Daix / November
4-hydroxyhexan-3-one	Vauderben / June

Pentane-2,3-dione and butan-2-one are characteristic of the truffle freshness [4].

The same results are found with the PTR-MS for the truffles of october and november.

Conclusion & Perspectives

Sensory analyses, PTR-MS, GC-MS are, three of them, good methods to differentiate truffles according to harvest places and the seasons.
The Burgundy truffles harvested in summer are less odorant than Burgundy truffles harvested in autumn.
These results will have to be combined to microbiota and genetic analyses.
This work will bring a scientific contribution to the creation of an IGP (Indication Géographique Protégée) request.

Contact

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