Fault focus: Mousiness

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Basic Wine

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Mousy off-flavour is a **relatively infrequent yet serious phenomenon** in wine and other fermented beverages. In severe cases, the spoilage can render wine unpalatable and, since there is no known satisfactory method for its removal, its occurrence can cause major economic loss to the wine producer.

What does mousiness in wine smell/taste like?

Mousiness is described as a particularly unpleasant defect reminiscent of **rodent urine** or **a dirty mouse cage**. Other aroma descriptors such as popcorn, rice, crackers, bread crust and beer have also been used to describe mousiness in tainted wines. According to some, the specific character can be replicated by adding a spoonful of uncooked jasmine rice to a glass of wine[1].

The mousy character in wine is **generally not perceptible with sniffing** and is **usually only perceived after the wine is swallowed**. This is because the compounds responsible for the off aroma are only aromatic at neutral or higher pH levels. In wine (which has low pH) the compounds responsible for mousy off-flavours are in acidified non-aromatic forms. When the wine is swirled in the mouth, it mixes with saliva which increases the pH and converts the compounds to aromatic forms. Therefore, the off aroma is detected through retronasal olfaction (the perception of odours emanating from the oral cavity) as opposed to orthonasal olfaction (the perception of odours during sniffing).

Detection, identification, characterization and measurement

It is estimated that about **30% of the population cannot perceive the mousy character** at all[1]. There is also a **wide range of sensitivities** among those that can identify the character. Some people perceive mousiness immediately often with the flavour persisting for minutes after swallowing the wine. For others, it may take more than 30 seconds before the character even becomes apparent. Winemakers should **be aware of their sensitivity** to mousiness and if not very sensitive, seek out others who can perceive the character to assist with detection of the fault and regular screening of wines.

The variation in sensitivity to mousiness between individuals complicates the sensory detection, identification, and characterization of the fault. Other than that, multiple compounds may be involved and several parameters such as the compounds' concentrations, the matrix effect, sensory interactive effects (suppression and/or enhancement) and the composition and pH of the saliva, may impact the perception of mousiness. **This results in a variety of descriptors being generated often leading to a lack of consensus for the detection, identification, and characterization of mousiness in wine.**

There is currently no ***simple*** chemical analysis test method available to quantitatively test for mouse taint in wines, but there are other sensory evaluation methods that might **help to identify** the suspected problem. These simple methods are all **based on changing the pH of the sample** (therefore aromatising the compounds responsible for mousiness) followed by sniffing. However, the challenges regarding sensitivity and detection (as mentioned above) should be kept in mind when performing these simple and subjective tests.

1) Place a drop of wine on the palm or the back of the hand. The skin can now be sniffed for mousiness.[2,3]

2) Soak a paper strip in sodium hydroxide and then dip it in the wine. The strip can now be sniffed for mousiness.

3) Add 5 g/L of bicarbonate of soda to the wine and then assess the wine by sniffing.

Certain analytical methods for the quantification of the individual aroma compounds do exist[4] and will be able to provide insight, however, these methods require sophisticated instrumentation and experienced personnel and are usually expensive to perform.

What compounds are responsible for mousiness in wines?

Three major compounds have been identified as responsible for the mousy off-flavour in wines:

- 2-acetyl-1-pyrroline (APY)
- 2-acetyltetrahydropyridine (ATHP)
- 2-ethyltetrahydropyridine (ETHP)

Reported concentrations in spoiled wines are 7.8 µg/L for APY[5] and between 0.7 and 106 µg/L for ATHP[6], while the concentration of ETHP can exceed 150 µg/L[3]. In general, no strong correlation between the three compounds has been established and the compounds **can therefore be present in the wine in isolation**[4]. However, a correlation between ETHP and ATHP (ratio 1:10) can exist when the formation is due to the activity of certain *Brettanomyces* yeast strains[7].

Sensory detection thresholds in water by orthonasal evaluation are 0.1 µg/L for APY[8], 1.6 µg/L for ATHP[9] and 140.5 µg/L ETHP [10]. It should be noted that these thresholds were determined by using **water** (and not wine) and by **orthonasal evaluation** (and not retronasal). Therefore, the **validity of these thresholds for oenological use** should be considered.

As mentioned previously many factors can contribute to the perception of mousiness which complicates the determination of definite sensory detection thresholds even if the thresholds were determined using retronasal evaluation methodology. Therefore, **sensory detection thresholds do not enable a direct deduction of the impact of a molecule** and its contribution to the perceived fault in wine.

The causes of mousiness in wine

There are two origins of mousy off-flavour in wine:

1. Microbiological origin

Microbiological activity of most strains of the ***Lactobacillus* genus** (including *Lactobacillus hilgardii*, *Lactobacillus plantarum* and *Lactobacillus brevis)* as well as other lactic acid bacteria such as ***Oenococcus oeni***[11] can contribute significantly to the mousy character in wines. Certain yeasts of the ***Brettanomyces* genus** can also result in the formation of the unpleasant mousy off-flavour. The concentrations and the ratios of the three compounds responsible for mousiness present **large variations according to the microbiological species** from which it originated. Other than that, it should be noted that other microorganisms present during winemaking could also be implicated.

Microorganisms could **directly produce** the compounds responsible for mousy off-flavour but can also play a role in the **formation of precursors** such as methylglyoxal, which is produced during fermentation. These precursors can be further transformed (chemically) into mousy off-flavour compounds[4].

Very little is known about the possible link between growth conditions (nutrients, temperature, pH and various stress factors) and the capacity of microbial flora to develop mousy odours[4]. However, it is well accepted that the **production of the compounds responsible for mousiness is favoured in high pH juice/wines, high solids environment, high nutrient loads, and the presence of oxygen.**

2. Chemical origin

Compounds responsible for **mousiness can form chemically** during hyperoxidation for instance when hydrogen peroxide is used to remove sulphur dioxide from juice or wine. Research also suggests formation is possible via the Maillard reaction between an amino acid and a reducing sugar during extended wine ageing[12,13]. This may be particularly relevant to wines made with high solids or extended lees ageing and/or stored with low levels of sulphur dioxide.

Why are we seeing more mousiness issues recently?

Although mousiness is technically not a new problem (studies on the subject date from the end of the 19th century[5]), it does seem to be **more prevalent in recent years**. Mousiness is often associated with the **general increase in juice and wine pH, an increase in the use of spontaneous fermentations as well as the rise in popularity of certain oenological practices associated with decreased sulphur dioxide levels**. These practices have become increasingly popular with consumers seeking more natural products with fewer additives[14].

Many winemakers are experimenting with new techniques in white winemaking such as high grape solids ferments, extended lees ageing, higher pH with minimal sulphur dioxide, oxidative ageing and minimal clarification or filtration. In many cases, these practices aim to produce white wines with more texture. While these changing practices have resulted in some great successes, they also come with some increased risks.

Can mousy wines be treated?

Currently, there are no verified ways to remove the character, other than attempting to **blend it away**. If the character was produced by microorganisms then it is important to **sterile filter** the wine to make sure that the microorganisms responsible for the production of the mousy compounds are removed from the matrix. High additions of sulphur dioxide, particularly in white wines, can mask the character, however, the character is likely to be observed again over time as the sulphur dioxide level drops.

Conclusion

The persistent, albeit irregular occurrence of mousy off-flavour warrants further investigation of the factors which control the formation of the unpleasant aroma compounds. However, the **risk of the fault developing can be minimised by limiting microbiological contamination and growth**. Special attention should be paid to hygiene protocols with the simultaneous use of antimicrobial agents such as sulphur dioxide, especially when certain winemaking techniques that could enhance microbiological activity are employed. It is also advised to taste the wines regularly during wine ageing and include tasters known to be **sensitive to the mousy character**.

References[11,12,15]

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