FAULT FOCUS – "CORKED" WINE UNDER SCREWCAP?

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Basic Wine

30 July 2021

Mouldy or musty aromas in wine are probably one of the most unpleasant oenological defects. Corks have been singled out (rather unfairly) as being the main source responsible for "cork taint", and although cork can be a major contributor, it certainly is not the only possible instigator[1]. Occasionally, winemakers report **mouldy characters** in wines that are **still in the tank** or even **after being packaged** in containers that do not seal with a cork, such as bottles under screwcap and bag-in-box.

"CORK TAINT" COMPOUNDS

There are four main haloanisoles (HA) believed to be responsible for most "cork" taint incidents:

2,4,6-Trichloroanisole (TCA)
2,3,4,6-Tetrachloroanisole (TeCA)
Pentachloroanisole (PCA)
2,4,6-Tribromoanisole (TBA)

TCA is believed to be the most prevalent HA in "corked" wines. However, a study that screened 145 "mouldy" international commercial wine samples showed that **TCA was only responsible for the aroma perceived in about half of the tainted wines**[2]. **Haloanisoles other than TCA**, such as TeCA, PCA and TBA can also contribute significantly to mouldy characters in tainted wines.
To complicate things even further, it is not only HA that can cause the off-aroma. **Non-HA compounds** such as geosmine, 2-methoxy-3,5-dimethylpyrazine, 1-octen-3-one, 1-octen-3-ol and 2-methylisoborneolhave have also been reported to contribute to off aromas described as "earthy", "mouldy", "musty", "mushroom" and "muddy".[1,3,4]

FORMATION OF HALOANISOLES

Haloanisoles form due to a biochemical reaction initiated by several kinds of microorganisms, most notably filamentous fungi (mould)[5]. **The fungi on its own cannot form HA as it needs a source of chlorine or bromine to generate the odoriferous HA**.
Until recently, chlorine bleach was widely used as a sanitizer in wineries. When chlorine comes into contact with sources of phenol, such as wood, plastics, or even grape and wine phenolics, it can form halophenols (HP), the direct precursor to HA.

Therefore, two factors are key:
1) the presence of the fungi and
2) contact with precursor

THE ROLE OF THE CORK – DIRECT/INDIRECT/NONE

Direct

Cork is a very complex microbial ecosystem and during the initial stages of the manufacturing process, it can contain very large microbial populations including bacteria and fungal strains[5]. The microbial populations decrease rapidly during processing and the final cork product usually contains very few active microorganisms if at all. Even so, **fungal activity together with a source of HA precursors will most likely lead to significant increases in HA**. This increase in HA can occur before and/or during manufacturing, before bottling or even after bottling during storage.

Indirect

Cork has a high capacity to **absorb HA from a contaminated environment**. Therefore, the cork can arrive at the cellar clear of any faults, but absorb HA from polluted material and later transfer it to the wine.

OTHER SOURCES OF CONTAMINATION (NON-CORK)

HP/HA can contaminate whole winemaking facilities and can be introduced through contaminated structures, water supplies or even from the vineyard.

- Herbicides, fungicides and insecticides often contain the precursor compounds needed for the formation of HA. In the cellar, these compounds can be transferred to the cork or other materials.

- HA are biodegraded byproducts of certain substances used for the preservation of wood, cardboard, paint, vegetable fibres, textile goods, leather and more. HP/HA can thus originate from treated wood structures (walls, floors, ceilings) or other wood-based winemaking equipment such as barrels, wood cases, palettes and wooden stands for bottle storage. Flame retardants can also be a source of TBA.

CONTAMINATION BEFORE BOTTLING

Haloanisoles can be transferred to wine through the cellar's environment or by contact with contaminated materials such as tank coatings, hoses, barrels, oak chips, filter pads, closures and additives such as bentonite. Low concentrations of these compounds are needed to contaminate the environment and even if the contaminated structures/elements were identified and removed, HP and **HA can adsorb in the microporous winery structure and be released over time** and therefore continue contaminating the surrounding spaces and equipment[6].

Several **products used during the winemaking process such as bentonite and filter powder can also absorb HP and HA from the environment and transfer the compounds to the wine**. It is therefore critical to keep the cellar environment completely devoid of any potential HA precursors.

HINTS OF WHERE THE TAINT CAME FROM

This is the tricky part. There is no definite way to determine the source of contamination. However, the following can be used as guidelines:

- Contaminated wines sealed in packaging where there is **no cork involved** would suggest that the source of the problem originated in the cellar environment (unless there are some serious packaging issues!). Even so, one cannot assume that a wine sealed under a cork is tainted because of the cork. See the next point.

- **Bottle differences would provide important insights as to the source of the contamination**. Variation from one bottle to the next (assuming the same batch of wine was used) would suggest that the stopper/packaging is fully or partially responsible for the taint. However, **if the taint is present in all the bottled wines from a specific batch, it would point to contamination prior to bottling**, and thus not a packaging issue. **Pre-bottling analysis will establish baseline HA levels in a wine at the time of bottling.**

- The possibility of **multiple sources** of contamination (cellar environment as well as the packaging) also exists.

CONCLUSION

Identifying the source of "cork taint" contamination (cellar environment vs packaging) is relatively easy, while further troubleshooting can be more tricky. What makes identification a difficult task is that the contaminating compounds can remain in the cellar environment for extended lengths, therefore the discontinuation of the use of contaminated products in the cellar does not necessarily remove the compounds from the environment. Using a process of elimination might therefore not be successful.

"Mouldy" aroma in wine can occur due to several contaminating sources. The term "cork taint" should perhaps be replaced by "fungal taint" / "mould taint" unless it can be well demonstrated that the closure is the primary source of contamination.

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