FOCUS ON H_2S: PART 2

LATENT H_2S FORMATION – HOW IS IT POSSIBLE?

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Basic Wine

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In Part 1 of this *Focus on H_2S* series, the role of copper for the remediation of hydrogen sulphide (H_2S) and the difficulties in removing the resulting copper-H_2S complex, was studied[1]. It is recommended to first read through Part 1 before continuing with the current blog post as it will provide important background information.

Under certain conditions, considerable amounts of H_2S can be generated by the yeast during fermentation. To date, yeast mechanisms of H_2S liberation during wine fermentation are well understood, however, the **formation of H_2S and other reductive sulphur compounds after fermentation and during the ageing period is still unclear**.

This time of year, Sauvignon Blanc wines are often treated with copper(II) sulphate to remove or prevent the formation of reductive aromas, especially considering the reductive winemaking techniques employed that could promote latent H_2S formation.

The question is thus,

Where does post-fermentation H_2S come from?

Mechanisms for the latent formation of H_2S

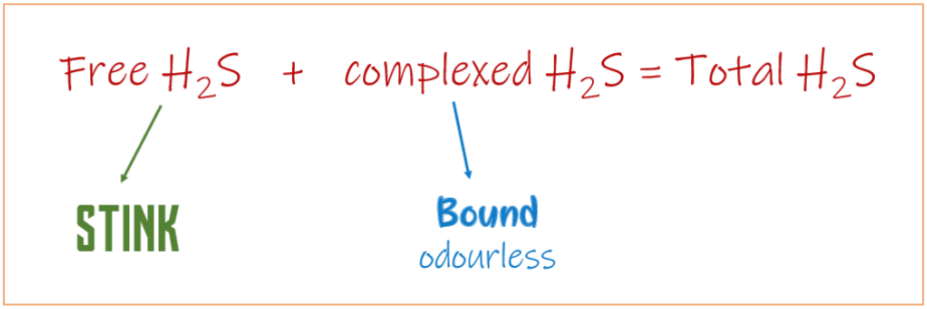
Several hypotheses for the latent formation of H_2S have been formulated[2]. Many of these hypotheses are **based on the *de novo* formation of H_2S**. (The term *de novo* is used to refer to the formation of a molecule from simpler molecules or precursors via a certain biochemical pathway. Therefore, it is produced anew and was not present before.)

Other research results suggest that **H_2S are released from metal complexes** such as the copper-H_2S complex already present in the wine as a result of the reaction between Cu^{2+} and H_2S. The effectivity of the removal of the copper-H_2S complex from the wine (by racking and/or filtration) is under question. In Part 1 of this series, the presence of this copper-H_2S complex after racking and/or filtration is shown[1]. The implication is that H_2S remains in the wine, albeit in an odourless, metal complexed form, which would not have been a problem was it not for the fact that the reaction of complex formation is reversable[3]. Certain conditions could thus result in the release of H_2S from these metal complexes.

A group of researchers studied the possible post-fermentation **H_2S accumulation pathways** to determine the main mechanism involved. The study focussed on the two likely mechanisms 1) the contribution of ***de novo* formation of H_2S** compared to 2) the **release of H_2S from complexes**[2]. The study is titled, "Reductive off-odors in wines: Formation and release of H_2S and methanethiol during accelerated anoxic storage of wines".

H_2S IS PRESENT IN FREE AND BOUND FORMS

Just like sulphur dioxide, H_2S is present in the wine in different forms. The **free H_2S** is the unpleasant-smelling compound and is predominantly responsible for reductive aromas in wine. The complexed H_2S is H_2S that is in a **bound form** with other compounds, often metals such as copper. This complexed/bound form is odourless. The sum of the free and bound H_2S equals the **total H_2S** in the wine.



TESTING THE POSSIBLE MECHANISMS

Twenty-four wines were analysed for their levels of free H_2S and total H_2S. Results showed that **most of the wines contained only small amounts of free H_2S** (6-8% of the total), while the remaining **H_2S was present in the complexed/bound form**. The concentrations of these bound forms in the wines were enough to potentially cause an aromatic problem if the H_2S was to be released.

The wines were stored under strictly anaerobic conditions at 50°C for three weeks. Samples were analysed for free and total H_2S at regular intervals.

RESULTS

For the **white and rosé** wines

- The levels of **free H_2S increased** relatively rapidly (within one week). This increase coincided with a **rapid decrease in bound H_2S**. Results showed that about **58% of the accumulated H_2S can be attributed by the release from the complexed/bound forms.**
- The amount of **total H_2S increased** over time and was on average 9.4 µg/L higher than the initial concentration. The result suggests that there was ***de novo* formation of H_2S**, leading to an increase in free H_2S (and therefore total H_2S).

During the storage of the white and rosé wines, both mechanisms, 1) *de novo* formation and 2) the release of H_2S from complexes, was significant.

For the **red wines**,

- The average levels of **free H_2S increased** continuously during the storage period. The average total increase in free H_2S was above 16 µg/L (a significant amount). This increase coincided with a **decrease in complexed/bound H_2S**. Initially, the percentage of bound H_2S was 94% of the total H_2S. By the end of the storage period, the percentage of bound H_2S amounted to 23% of the total H_2S.
- The **total H_2S content remained constant** during the ageing period. This would indicate that there was **no *de novo* synthesis** of H_2S in the red wines during the period tested.

The results would suggest that there **was a significant transformation of complexed H_2S into free odorous H_2S** in the red wines. Calculations estimate that of this 16.2 µg/L free H_2S accumulated, about 14.7 µg/L (90%) can be attributed to the release of H_2S from the complexed H_2S.

CONCLUSION

The complexation of free H_2S into a non-volatile metal complex (by adding copper(II)sulphate), leads the producer to believe that the problem is taken care of. However, the results reported in the study[2] clearly indicates that the **release of free H_2S from complexes (copper as well as other metals) is the dominant source of latent H_2S accumulation in white and red wines**. This brings us back to Part 1 of the blog series: **the importance of removing these copper complexes after treating the wine** with copper(II) sulphate. Some wines are also naturally high in copper or could have elevated copper concentrations due to vineyard treatments. For these wines, bottling under a **hermetic closure could be detrimental due to the release of H_2S over time**.

***De novo* synthesis also contributed to the accumulation of H_2S in the white and rosé wine samples but played a minor role in red wines** under the conditions of this study. The exact mechanisms involved in the *de novo* synthesis of H_2S during the post-fermentation period as well as factors affecting the formation still needs further investigation. The study also looked at the formation of MeSH (another prominent reductive compound) and found that *de novo* formation is the dominant source of MeSH, particularly in white and rosé wines. More information on the accumulation of MeSH is available in the full text.

Even though the conditions off the study was quite extreme, the same pattern could be expected in a more realistic environment. In the current study, the accumulated H_2S concentration was, for the majority of the wines, significant and would have a profound effect on the wine sensory profile.

REFERENCES

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