VITICULTURE & ENOLOGY
UNIVERSITY OF CALIFORNIA DAVIS

Title: **"Research on 2-methoxy-3-isobutylpyrazine in grapes and wines"**

By: Dominique Roujou De Boubee

School of Enology, University of Bordeaux II. Unpublished.

Pyrazines are nitrogen-containing heterocyclic compounds that can be classified in 3 categories, depending on their origin: 1) those formed by heat treatment, 2) those formed by microorganisms, and 3) those present naturally in plants. We are particularly interested in the latter category, and within it, in 2-methoxy-3-isobutylpyrazine (IBMP), the main compound responsible for green bell pepper aroma in wines.

Enological implications:

- It has already been established that IBMP's detection threshold in water is 2 ng/l. The researchers went on to determine the equivalent threshold in red wine. Because the answer varied with the type of wine, they had to be more specific. Using a trained panel, they found that the IBMP detection threshold in Bordeaux-type red wine is 15 ng/l

- High concentrations of IBMP are associated with a lack of ripeness and winemakers often associate this bell pepper character with low anthocyanins, or weak color, and mediocre tannin quality. Therefore the paper proceeds to explore actual production operations or winemaking conditions that would minimize IBMP concentration.

- The researchers looked at the IBMP concentration in different SB press fractions. Similar concentrations were found in the free run and in the 1.5 or 2 bar fraction (pneumatic pressing of whole clusters), so the compound is easily extractable.

- They looked at the effect of white must settling on IBMP. After settling of the SB, the compound was half the original amount. So this step is important to reduce greenness. They thought what was going on was that IBMP interacted with grape solids and was carried down with them.

- The researchers also looked at different pump-over regimes and different lengths of skin contact. They concluded that the IBMP was not significantly affected by these extraction techniques. So more punch-downs, or extended macerations will not increase IBMP concentration.

- Thermovinification, however, was the only winemaking technique that actually decreased IBMP concentrations in their trials. This is believed to be due to methoxypyrazine's volatilization at 50°C. So this is an interesting alternative when grapes are believed to be unripe, or moldy. Heating the must to 50°C actually increased the perceived fruity character in these wines and decreased the IBMP concentration.

- They looked at how IBMP evolves in a bottle for CS and SB. After 3 years of aging they found no change. One should not count on time to diminish a methoxypyrazine, or bell pepper, defect.

Viticultural implications:

- It seems IBMP is directly related to vegetative growth. Vigorous vines that stopped growing relatively late in the season produced higher IBMP concentrations. Also, higher irrigated vines produced more IBMP compared to normal or dry-farmed vines, as has been previously reported.

- IBMP synthesis takes place between fruit set and 2-3 weeks prior to veraison. In the berry, it is synthesized mainly in the skins, some in the seeds, and very little in the pulp.

- The authors found that leaves had the highest concentrations of IBMP. Furthermore, using radioactive IBMP they were able to see that the compound was transported by the phloem from the leaves to the berries. The compound is also believed to be synthesized in the berries, so its presence in the berry is likely due to both transport from leaves and synthesis *in situ.*

- From veraison to ripeness, the cycle changes and IBMP begins to break down. It actually breaks down faster than it is synthesized. And daylight accelerates this degradation. The authors found that the degradation products have no bell pepper character. By exposing grapes to sunlight, leaf removal helps decrease IBMP.

- After harvest, IBMP still remains high only in the stems. That explains why destemming decreases bell pepper character and improves quality.

- In a detailed experiment, the researchers compared IBMP levels of summer-pruned vines (basal leaves and laterals removed) which had also been cluster thinned, against a control. The former vines had much lower IBMP, as well as higher phenols and more alcohol, than the control. In general, they recommend lateral and leaf removal as a means to produce high-quality grapes. The benefits they found include: improved crop healthiness, better aeration, and removal of "sinks", which in turn promoted better photosynthate distribution and grape ripeness.

- When leaves are removed early, grape sugar is higher, berries are smaller, and IBMP decreases. A later leaf removal will still facilitate earlier sugar ripeness, but it doesn't decrease IBMP concentrations in the fruit. Thus, the researchers recommend that leaf removal be performed early, between set and berry touch, or green berry size.

- To conclude, the author notes "it is probable that an early diagnosis (July) of the grape IBMP would help determine whether lateral removal or leaf removal are needed in a vineyard block". This would help reduce costs in some instances and still achieve high quality grapes.

In conclusion, the researchers determined that, in this study, there was only one way to effectively decrease IBMP concentrations once the affected red grapes have reached the winery: **thermovinification**. There are obvious pros and cons with heating a red must, though, and the winemaker would have to make that judgment. As for white grapes, **must cold-settling** was the only way to reduce IBMP, since this compound tended to sediment along with the grape solids.

It seems that the most effective and efficient way to mitigate IBMP concentration in grape berries is by vineyard management practices. If it isn't managed in the vineyard, it will most certainly become a winemaking problem with few alternatives besides blending.

Author: Bibiana Guerra, Editor: Kay Bogart. This summary series funded by J. Lohr Vineyards & Wines.