

Introduction

This is a preview which only displays sample 1: green bell pepper.

Get the full document here: <https://artoftasting.nl/product/white-wine-flavour-compounds-information-booklet/>

This document provides extensive information about 10 flavour compounds that commonly occur in white wine. It is meant to accompany the white wine tasting kit, which features wine samples that have the described flavour compounds added. You can order the kit here: <https://artoftasting.nl/product/tasting-kit-white/>

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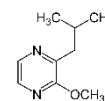
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1. Green bell pepper

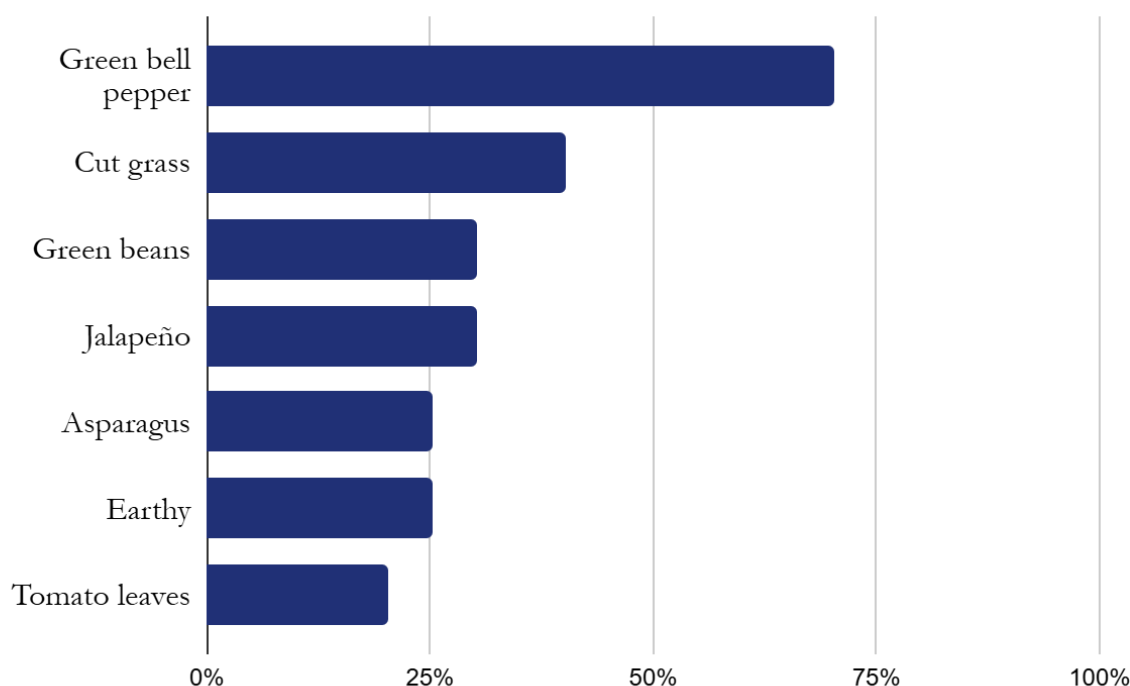
Flavour compound [i](#)

3-isobutyl-2-methoxypyrazine, also known as IBMP or bell pepper pyrazine.



Descriptors [i](#)

Green bell pepper, cut grass, green beans, jalapeño, asparagus, earthy, tomato leaves, herbaceous, green, capsicum, vegetal, raw coffee beans, ginseng, gochujang, black-jack



Origins [i](#)

Primary flavour. The compound is closely associated with Sauvignon Blanc and related grape varieties, and therefore considered a varietal flavour.

The compound is found in the grape flesh and skins in its free, volatile form. Hence, when grapes contain IBMP, you would be able to notice it when tasting those grapes from the vine. Importantly, this is different from many other primary flavour compounds, including thiols and terpenes, which are bound to a grape component and hence odourless until released during fermentation. Stems and leaves of the Sauvignon Blanc vine also contain IBMP.

Other origins [i](#)

IBMP and other methoxypyrazines are also secreted by ladybirds, causing ladybird taint in wine [1].

Influencing factors – vineyard [i](#)

Ripeness is a crucial factor. IBMP peaks at veraison, after which it steadily declines. Vineyard temperature is another factor, where cooler conditions lead to higher levels of IBMP. Sunlight exposure to grape bunches leads to a decrease in IBMP. Therefore, training an open canopy can help lower levels of IBMP. Warmer sites, or those with slopes facing the sun typically yield grapes with lower levels of IBMP. Climate change means that this flavour is seen less often.

Soils with plenty of nutrients and a good water retaining capacity (e.g. deep clay soils) are associated with higher levels of IBMP [2]. Mechanical harvesting creates some contact between skin and juice from crushed grapes during transportation to the winery, leading to higher levels of IBMP.

Influencing factors – winery [i](#)

Generally, this flavour is managed in the vineyard and there are less options available in the winery to modulate the flavour. Leaf and stem inclusion increases the flavour. Skin contact (cold soaking) increases the flavour. Press wine has higher IBMP compared with free run juice. Juice clarification prior to fermentation reduces the compound to some extent. Oak ageing can also reduce the impact of the flavour by masking it with other flavours such as vanilla (from vanillin) and cloves (from eugenol). Oak ageing, however, is not commonly practised with Sauvignon Blanc. Separate batches of wine with different levels of IBMP could be blended to modify the impact of IBMP. Other options in terms of winemaking are limited. IBMP is not very sensitive to oxidative treatments [3].

Bottle ageing [i](#)

IBMP is a stable compound which is little affected by bottle ageing.

Assessment technique [i](#)

After swirling the wine, a short sniff of about one second should be enough to detect any methoxypyrazines present. The flavour is moderately noticeable on the palate.

Wine styles [i](#)

Cool climate Sauvignon Blancs such as those from New Zealand and the Loire Valley.

Commercial examples [i](#)

Cloudy Bay Sauvignon Blanc, Kim Crawford 'Spitfire' Small Parcels Sauvignon Blanc 2021

Compound class [i](#)

IBMP is one of several methoxypyrazines found in wine.

Although methoxypyrazines are often shortened to 'pyrazines', they are not mutually exclusive. While all methoxypyrazines are indeed pyrazines, methoxypyrazines specifically refer to IBMP and IPMP. IPMP smells like potato skins or dug soil. In wine it is often at levels below the detection threshold, making this compound less relevant than IBMP.

Other pyrazines, not belonging to the methoxypyrazines family, are the result of the Maillard reaction, and can impart roastiness, nuttiness and chocolate notes. Examples are 2,3,5-trimethylpyrazine (chocolate) and 2-acetyl pyrazine (popcorn). They may play a role in barrel ageing.

Precursor [i](#)

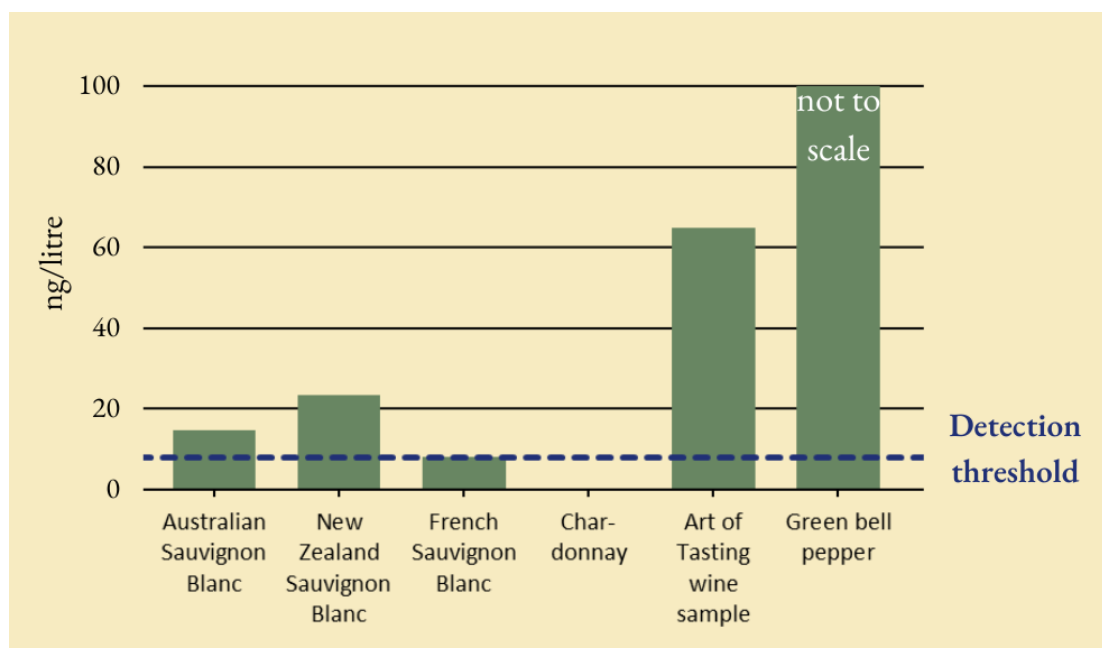
3-isobutyl-2-hydroxypyrazine

Threshold [i](#)

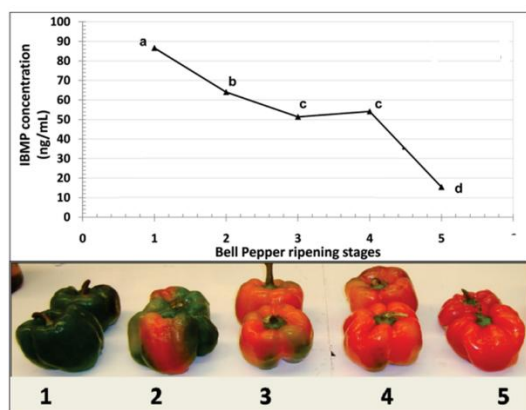
The detection threshold is about 8 ng / litre. This sample contains 65 ng / litre.

Concentrations in white wine [i](#)

Wine style	Average (ng / litre)	Lowest (ng / litre)	Highest (ng / litre)	Number of wines analysed	Reference
Australian Sauvignon Blanc	14.5	10	19	5	4
New Zealand Sauvignon Blanc (Marlborough, Wairarapa, Hawke's Bay)	23.5	9	47	29	4
French Sauvignon Blanc (Bordeaux, Loire Valley, Sancerre)	7.9	4.8	11.8	5	4

Presence elsewhere [i](#)

IBMP is the main constituent of the aroma of green bell peppers. In bell peppers, the compound develops in a similar way as in grapes. In green bell peppers, which are essentially the unripe version of its red counterpart, IBMP levels are high. It declines during ripening, as shown by the graph below [5]. IBMP is also found in green beans and coffee beans.



Specific anosmia [i](#)

7%

Miscellaneous [i](#)

It is thought that methoxypyrazines have a protective role in plants as they decrease the likelihood of vegetative tissue and immature fruit being eaten, increasing the chance of reproduction [6]

Further reading [i](#)

1. Pickering, G.J. and A. Botezatu, *A review of ladybug taint in wine: origins, prevention, and remediation*. *Molecules*, 2021. **26**(14): p. 4341.
2. Sidhu, D., et al., *Methoxypyrazine analysis and influence of viticultural and enological procedures on their levels in grapes, musts, and wines*. *Critical reviews in food science and nutrition*, 2015. **55**(4): p. 485-502.
3. Coetzee, C., *Oxygen and sulphur dioxide additions to Sauvignon blanc: effect on must and wine composition*. 2011, Stellenbosch: University of Stellenbosch.
4. Lund, C.M., *Investigation of New Zealand Sauvignon Blanc wine using trained sensory panels*. 2009, ResearchSpace@ Auckland.
5. Ryona, I., S. Leclerc, and G.L. Sacks, *Correlation of 3-isobutyl-2-methoxypyrazine to 3-isobutyl-2-hydroxypyrazine during maturation of bell pepper (Capsicum annuum) and wine grapes (Vitis vinifera)*. *Journal of agricultural and food chemistry*, 2010. **58**(17): p. 9723-9730.
6. Mortzfeld, F., et al., *Pyrazines—valuable flavour & fragrance compounds: Biocatalytic synthesis and industrial applications*. Authorea Preprints, 2020.
7. Coetzee, C. and W.J. du Toit, *A comprehensive review on Sauvignon blanc aroma with a focus on certain positive volatile thiols*. *Food Research International*, 2012. **45**(1): p. 287-298.
8. Marais, J., *Effect of grape temperature, oxidation and skin contact on Sauvignon blanc juice and wine composition and wine quality*. *South African Journal for Enology and Viticulture*, 1998. **19**: p. 10-16.
9. De Boubée, D.R., *Research on 2-Methoxy-3-isobutylpyrazine in grapes and wines*. Academie Amorim, Bordeaux, 2003.

Glossary

Flavour compound

Name of the molecule/chemical compound.

Descriptors

A range of descriptors will be provided for each flavour compound, starting with the commonly agreed upon descriptor. These are intended to help you to build an association with the flavour compound. This list is a collection of descriptors that wine tasters have provided when smelling the compound. If you have an association with the flavour which is not on the list, feel free to share with Sietze (sietze@artoftasting.nl).

It is followed by a pie chart that shows how frequently a descriptor is used. This is based on descriptors of a group of wine tasters (people that have attended masterclasses). The commonly agreed upon descriptor is typically the most frequently mentioned.

Origins

Origin and formation of the flavour compound are discussed. Primary flavours are those formed in the grape berry or during fermentation. Secondary flavours are the result of winemaking techniques, such as oak ageing, malolactic fermentation and lees ageing. Tertiary flavours develop during bottle ageing.

Other origins

How the compound may find its way into wine via a different route than its main origin.

Influencing factors – vineyard

The natural factors and the viticultural practices that impact the level of this flavour compound.

Influencing factors – winery

The winemaking choices that affect the flavour compound in question.

Bottle ageing

How the flavour is affected by storage after bottling.

Assessment technique

The most effective method of detecting the flavour compound is presented here. This is related to the volatility of the compound. Volatile compounds are easily picked up by swirling the glass and taking a short, one-second sniff. Less volatile compounds are more easily picked up with the following method: cover the glass with your hand (make sure your hand is free of odours!), swirl for about five seconds, release the hand and simultaneously take a long, two-second sniff.

The palate is also mentioned here: compounds range from being very noticeable on the palate to not being present on the palate at all. For flavours that should be very noticeable on the palate, the following technique may help: pinch your nose, take wine into your mouth, move the wine around in your mouth, swallow/spit the wine, release your nose. The flavour should now come through noticeably.

Wine styles

The wine styles that commonly display this flavour compound.

Commercial examples

“Real-world” commercially available wines that feature noticeable levels of this compound.

Compound class

Describes the chemical class/family of the flavour compound. This section may list related compounds.

Precursor

A precursor is a compound that becomes something else during a chemical conversion. In other words, this is your starting material before it becomes the flavour compound in question.

Grapes contain precursors to flavours that may be in a so-called “bound” form, i.e. the flavour compound is linked to a different compound that makes it non-volatile. Non-volatile compounds cannot reach olfactory receptors and therefore have no aroma. During fermentation, yeast breaks up the link and releases the flavour compound. Sometimes precursors are volatile and have an aroma. For example, 3-MH (3-mercaptohexanol), which smells of grapefruit, is the precursor to 3-MHA (3-mercaptohexyl acetate), which smells of passion fruit.

Threshold

The detection threshold is the minimum required quantity present of the compound to impart a flavour for 50% of the human population. For example, the threshold of IBMP is 8 ng / litre. At this concentration, half of the population will be able to differentiate this wine from the same wine with 0 ng / litre of IBMP. The detection threshold for flavour compounds may vary slightly between wine styles.

The conversion table is as follows:

1 g (gram) = 1000 mg (milligram)

1 mg (milligram) = 1000 µg (microgram)

1 µg (microgram) = 1000 ng (nanogram)

For reference, 1 mg is about the equivalent of a sugar granule.

The level of flavour addition to the sample in the tasting kit is also mentioned here (typically formulated at 8 times the threshold).

Concentrations in white wine

Concentrations of the flavour compound, based on analytical data from literature. The Art of Tasting wine sample is also included for reference. The detection threshold is indicated with a dotted line.

Some graphs include natural sources other than wine, such as fruits and vegetables. The concentration of the compound in these sources is typically much higher than wine and is therefore not presented to scale.

Presence elsewhere

Sources of the compound other than wine, such as food, beverages or plants.

Specific anosmia

The percentage of the population that has specific anosmia towards this compound.

Specific anosmia is an inability to smell specific compounds, where your sense of smell is otherwise intact. We are equipped with around 400 types of olfactory receptors, however, individual differences exist. Some people may have some receptors not functioning or missing altogether. If one of the samples is not different to the reference sample to you, you may have specific anosmia towards the compound. This is genetically determined.

For example, about 1 in 10 people have specific anosmia to geraniol, which smells of roses. That does not mean that roses are odourless to you, because you will still be able to detect the other aroma compounds that are released by roses. However, a rose will smell slightly different to you than to someone who is able to pick up geraniol.

Even when the level of the added aroma is increased tenfold, the person with specific anosmia is usually not able to pick up the aroma.

Specific anosmia is often likened to colour blindness: people with colour blindness struggle to recognise specific colours, but otherwise have a normal functioning sense of vision.

Miscellaneous

Miscellaneous information about the compound.

Further reading

References to articles cited in the text, as well as additional material for the keen reader to dig deeper into the flavour.