Introduction

This is a preview which only displays sample 1: green bell pepper. Get the full document here: https://www.art-of-tasting.com/shop/information-booklet-white-wine-molecules

This document provides extensive information about 10 flavour compounds that commonly occur in white wine. It is meant to accompany the set of white wine flavour compounds, which are available in a tasting kit and in flavouring vials. These are linked below.

Tasting kit (containing wines with the compounds pre-added): https://www.art-of-tasting.com/shop/tasting-samples-molecules-of-white-wine

Flavouring vials (allowing you to make your own flavour additions to wine): https://www.art-of-tasting.com/shop/flavouring-vials-molecules-of-white-wine

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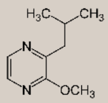
Table of contents

1. Green bell pepper

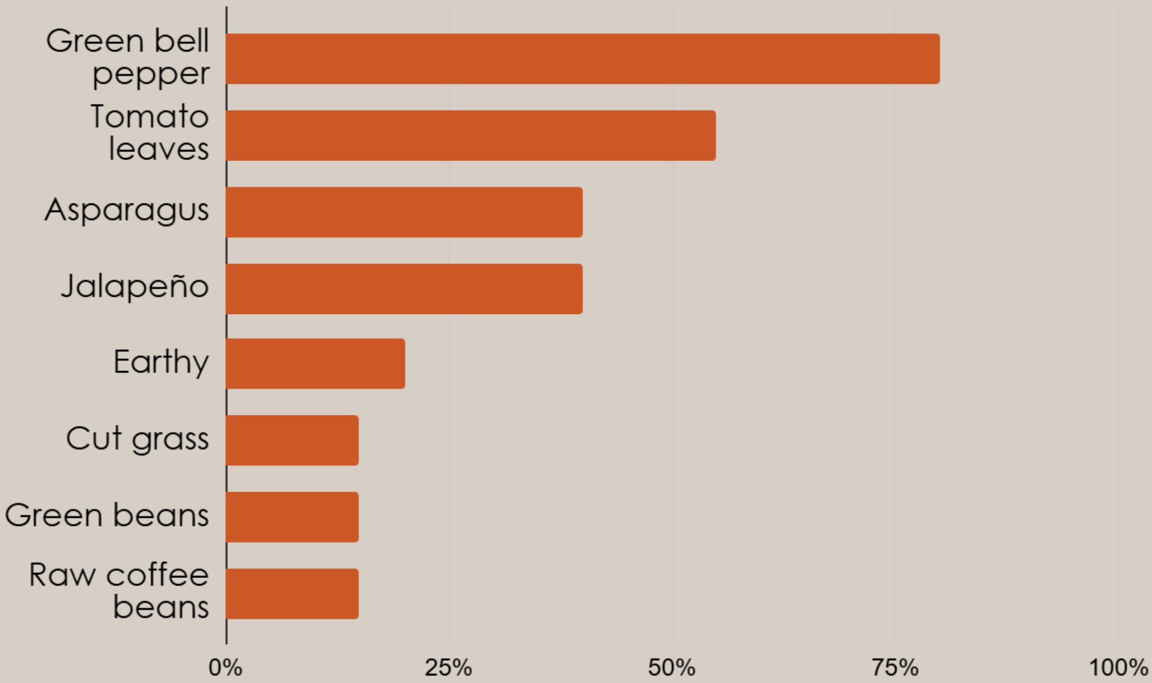


Flavour compound ⓘ

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

Descriptors ⓘ

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



Origins ⓘ

The compound is closely associated with Sauvignon Blanc [7], and related grape varieties, and therefore considered a varietal flavour. Its first discovery in Sauvignon Blanc was in 1982 [16]

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 wine flavour compounds, including thiols and terpenes, which are bound to a grape component and hence cannot be noticed in the grape or grape juice. Then are only detectible when fermentation has started.

Stems and leaves also contain IBMP [14].

Other origins ⓘ

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

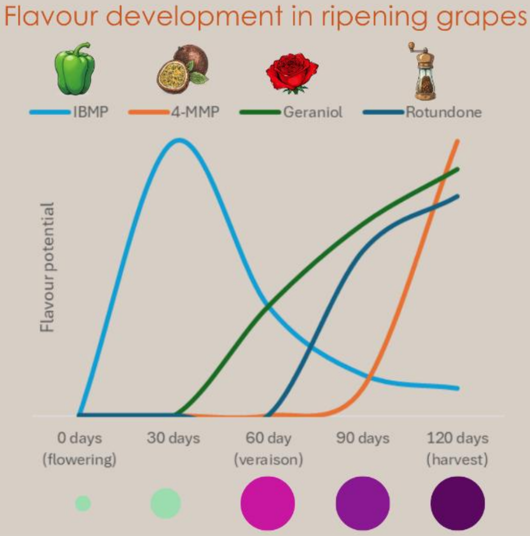
Influencing factors – vineyard ⓘ

Ripeness is a crucial factor. IBMP peaks very early in the ripening cycle of the grape and then declines steadily [10]. Also see Figure 1 below. Vineyard temperature is another factor, where cooler conditions lead to higher levels of IBMP [2]. Sunlight exposure to grape bunches reduces IBMP accumulation. Therefore, training an open canopy/leaf removal can help minimise IBMP levels. 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.

Generally, vine vigour is linked to higher IBMP levels. Soils with plenty of nutrients and a good water retaining capacity (e.g. deep clay soils) are associated with higher levels of IBMP [2]. Likewise, a greater humidity in the pre-veraison month can result in higher IBMP contents [11]. Nitrogen status of the vine does not appear to affect IBMP levels directly [12], but the combination of high nitrogen and irrigation leads to higher IBMP [13].

Mechanical harvesting creates some contact between skin and juice from crushed grapes during transportation to the winery, leading to higher levels of IBMP.

Figure 1



Influencing factors — winery ⓘ

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 [14]. 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 [14]. 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]. Malolactic fermentation does not affect IBMP [11].

Bottle ageing ⓘ

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

Assessment technique ⓘ

IBMP is mostly detected on the nose, and is moderately noticeable on the palate.

Wine styles ⓘ

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

Commercial examples ⓘ

Cloudy Bay Sauvignon Blanc, Kim Crawford 'Spitfire' Small Parcels Sauvignon Blanc 2021, Domaine de la Farge Sancerre 2023, Saint Clair Sauvignon Blanc

Compound class ⓘ

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 asparagus. In wine, it is often at levels below the detection threshold, making this compound less relevant than IBMP. Read more about IPMP in the wine faults booklet.

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 ⓘ

3-isobutyl-2-hydroxypyrazine [5]. This is an odourless compound.

Threshold ⓘ

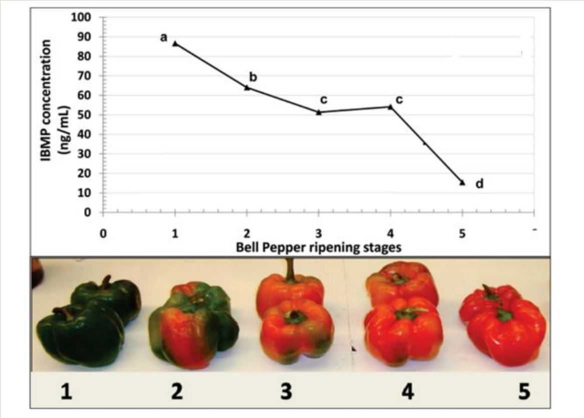
The detection threshold is about 5 ng / litre. This sample contains 35 ng / litre.

Concentrations in white wine ⓘ

Wine style	Average (ng / litre)	Lowest—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 ⓘ

IBMP is the main constituent of the aroma of green bell peppers, first demonstrated in 1969 [15]. 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 [17] and coffee beans [18].



Specific anosmia ⓘ

1%.

Miscellaneous ⓘ

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 ⓘ

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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@art-of-tasting.com).

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

Origins
Origin and formation of the flavour compound are discussed.

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 compound is affected by storage after bottling.

Assessment technique
The most effective method of detecting the flavour compound is presented here. Compounds vary in the extent to which they are detectable on the nose and on the palate.

For flavours that are 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/forerunner 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, where highly concentrated wines may make some compounds more difficult to detect.

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. This rate is based on academic studies and/or data collected during The Art of Tasting courses.

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 8 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.