VITICULTURAL AND OENOLOGICAL INFLUENCES ON VOLATILE THIOLS

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Basic Wine

This table serves as a general indication of the effects of various viticultural and winemaking techniques on the precursors and their aromatic volatile thiols in the must and wine.

A few things need to be considered when consulting this table:

- Researchers sometimes find contradicting results due to the inherent composition of the must and wine. Therefore, tendencies reported in this table might not be applicable to every must/wine situation, however it identifies techniques that could potentially have an effect.
- A higher concentration of precursors does not necessarily result in a higher concentration of volatile thiols in the resulting wine.
- Often interactive effects are observed. For instance, one yeast strain might result in higher concentrations of thiols in a specific grape must, while showing no difference in juice from another vineyard.
- The significance of the increase and decrease shown in this table varies. Sometimes the process had powerful effects, multiplying the concentration of thiols in the wine. For other processes investigated, smaller increases were observed and might not necessarily have a sensorial effect.
- It is important to note that scientific studies report on "statistically significant" increases, which could sometimes translate to small increases only. Recent Winetech funded research results indicate that rather large differences in thiol concentrations need to exist for a person to detect an increase sensorially.
- In some cases, only one of the thiols were measured or the factor studied only had an effect on one or two of the main thiols. The indications in the table are thus not always applicable to all three of the main thiols.
- The summary is a broad generalisation of the results found in the studies and there are always exceptions.

Action	Effect on precursors in the must	Effect on volatile thiol in the wine	Reference(s)
Ripening	Increase		Roland et al., 2010 ; Capone et al., 2011
Moderate water deficit	Increase (Cys-3MH), Decrease (Cys-4MMP)		Choné, 2001
Low nitrogen content	Suppress formation of thiol precursors		Choné, 2001; Choné et al., 2006; Peyrot des Gachons et al., 2005
Nitrogen and sulphur foliar fertilisation		Increase	Bruwer, 2018
Increased vine nitrogen status	Increase	Increase	Helwi et al., 2016
Closed canopy (low UV exposure)		Decrease	Šuklje et al., 2014
Exposed / shaded bunches (row direction)		No effect	Martin et al., 2016
Botrytis cinerea infection	Increase		Sarrazin et al., 2007; Tominaga et al., 2000; Tominaga et al., 2006; Thibon et al., 2009
Inactive dry yeast application in vineyard (on grapes)		Increase	Šuklje et al., 2016
Harvest time of day (excluding temperature effect)		No effect	Grose et al., 2016
Moderate berry damage and oxygen exposure (machine harvest)	Increase	Increase	Capone et al., 2011
Moderate SO_2 and ascorbic acid addition during harvest	Increase		Capone et al., 2011
Excessive SO_2 during harvest and grape processing	Suppress formation of thiol precursors		Capone et al., 2011
Freezing of grape clusters / juice		Increase	Liang et al., 2019; Olejar et al., 2015
Post-harvest UV exposure and increased temperature		Decrease	Parish-Virtue et al., 2019
Skin contact (without extracting too much phenolic compounds)	Increase		Maggu et al., 2007; Murat et al., 2001; Peyrot des Gachons et al., 2002
Higher maceration temperature	Increase		Maggu et al., 2007; Murat et al., 2001; Peyrot des Gachons et al., 2002
Pressing (without extracting too much phenolic compounds)	Increase		Roland et al., 2011; Maggu et al., 2007; Patel et al., 2010
Inactive dry yeast to must		Increase	Gabrielli et al., 2017
Pre-fermentation glutathione addition		Suppress formation of thiols	Alegre et al., 2019
Pre-fermentation addition of grape tannin	Increase	Increase	Larcher et al., 2015
Linoleic acid supplementation prior to fermentation		3MHA decrease, no effect on 3MH	Casu et al., 2016
Lipase (enzyme) supplementation to juice		3MHA decrease, 3MH increase	Tumanov et al., 2018
Pre-fermentation addition of commercial enzyme (Endozym Thiol)		Increase	Chen et al., 2018
SO_2 during processing		Preserve	Coetzee et al., 2013

Action	Effect on volatile thiol in the wine	Reference(s)
Fermentation	Increase	Tominaga, Peyrot des Gachons et al., 1998
Nutrients added during yeast rehydration	Increase	Winter et al., 2011
Inoculation procedure, sequential mixed cultures	Potential to increase depening on yeast strain	Renault et al., 2016
Yeast strain selection (also non-*Saccharomyces* strains)	Increase depending on strain	Anfang et al., 2009 ; Murat et al., 2001; Swiegers et al., 2006 ; Swiegers et al., 2005
Relavely higher fermentation temperature (18°C vs 13°C)	Increase	Masneuf-Pomarède et al., 2006; Swiegers et al., 2006
Bentonite fining (assuming no secondary oxidation effects)	No effect	Parish et al., 2016
Oxidation	Decrease	Coetzee et al., 2016
Copper addition	Decrease	Ugliano et al., 2011
SO_2	Preserve	Nikolantonaki., 2012
Low pH	Faster natural hydrolysis of 3MHA	Herbst-Johnstone, 2013
High pH	Oxidation more prominent leading to decrease	Herbst-Johnstone, 2013
Glutathione addition before bottling	Preserve	Ugliano et al., 2011
Sparging with inert gas	No effect	Walls, 2019
Bottle closures with high O_2 ingress or thiol absorption	Decrease	Lopes et al., 2009; Ugliano et al., 2011; Brajkovich et al., 2005
Bottle ageing	Decrease	Tominaga et al., 2004; Kilmartin et al., 2008; Coetzee et al., 2016
Higher storage temperatures	Decrease	Herbst-Johnstone, 2013

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