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Acetaldehyde Metabolism by Wine Lactic Acid Bacteria and Its Oenological Implications

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Abstract

Acetaldehyde is one of the most important sensory carbonyl compounds formed during vinification. Excess acetaldehyde can adversely affect the flavour of wine and acetaldehyde plays a role in the colour development of red wines. Excess acetaldehyde is usually masked by the addition of sulphur dioxide (SO₂) to the wine (SO₂ is also used as an antimicrobial and antioxidant agent in wine and acetaldehyde bound SO₂ is less effective in these roles). To date there has been no definitive study of the impact of wine LAB on free and bound acetaldehyde. Therefore, this study investigated the metabolism of free and bound acetaldehyde and its oenological implications.

A survey of 11 commercial malolactic starter cultures (mostly *Oenococcus oeni* strains) showed that 9 out of 11 were able to metabolise acetaldehyde (in a resting state) with the corresponding formation of ethanol and acetic acid as products. SO₂ bound acetaldehyde was also metabolised by the two strains tested (*Lactobacillus buchneri* CUC-3 and *Oenococcus oeni* MCW). This is the first evidence that LAB can indeed catabolise SO₂ bound acetaldehyde, therefore releasing free SO₂.

During growth *Oenococcus oeni* EQ54 and *Oenococcus oeni* VFO were able to metabolise free acetaldehyde in wine at pH 3.3 and pH 3.6. In wine containing SO₂ bound acetaldehyde, *Oenococcus oeni* EQ54 and *Oenococcus oeni* VFO were able to metabolise SO₂ bound acetaldehyde at pH 3.6 after a period of sluggish growth. At pH 3.3 there was no metabolism of SO₂ bound acetaldehyde by *Oenococcus oeni* EQ54 and *Oenococcus oeni* VFO during the incubation period.

Results from growth experiments showed that in broth there was inhibition of growth at 300 mg/L concentration of acetaldehyde for all strains. In wine, no significant inhibition or stimulation of the cultures examined was found at any acetaldehyde concentrations up to 300 mg/L.

In a simultaneous resting cell incubation of *Saccharomyces bayanus* Première Cuvée and *Oenococcus oeni* Lol11, acetaldehyde produced by the yeast was metabolised by the wine LAB.

The metabolism of acetaldehyde by wine LAB is expected to influence wine flavour as small amounts of ethanol and acetic acid are produced and acetaldehyde is removed. This removal of acetaldehyde by wine LAB suggests that less SO₂ will need to be added to the wine to mask excess acetaldehyde when malolactic fermentation is performed. Inhibition of wine LAB growth in broth by high levels of acetaldehyde suggests a role for acetaldehyde in stuck or sluggish MLF. Sluggish growth in wine containing SO₂ bound acetaldehyde also suggests a possible role of SO₂ bound acetaldehyde in stuck and sluggish MLF. This is due to the release of free SO₂ through the metabolism of the acetaldehyde moiety of SO₂ bound acetaldehyde.

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