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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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Table of Contents

CHAPTER 1 INTRODUCTION TO THE THESIS.....	1
1.1. WINEMAKING: MEANING BEHIND THE MADNESS	1
1.1.1. <i>From the Vine to the Bottle</i>	1
1.2. WINE MICROORGANISMS.....	2
1.2.1. <i>Wine Yeast</i>	2
1.2.2. <i>Wine Lactic Acid Bacteria</i>	3
1.3. MALOLACTIC FERMENTATION	4
1.3.1. <i>Deacidification of Wine</i>	5
1.3.2. <i>Microbial Stability</i>	5
1.3.3. <i>Flavour Modification</i>	5
1.4. RESEARCH AIMS	7
CHAPTER 2 LITERATURE REVIEW	8
2.1. ACETALDEHYDE PRODUCTION IN WINE	8
2.1.1. <i>Acetaldehyde Formation by Yeast</i>	8
2.1.2. <i>Acetaldehyde Production by Acetic Acid Bacteria</i>	9
2.1.3. <i>Acetaldehyde Production via Auto-oxidation of Ethanol and Phenolic Compounds</i>	9
2.1.4. <i>Acetaldehyde Production by LAB</i>	10
2.2. EFFECT OF ACETALDEHYDE ON THE CHEMICAL AND PHYSICAL PROPERTIES OF WINE	10
2.2.1. <i>Effect of Acetaldehyde on Wine Colour</i>	10
2.2.2. <i>Effect of Acetaldehyde on Wine Sensory Characteristics</i>	11
2.2.3. <i>Effect of Acetaldehyde on Sulphur Dioxide</i>	11
2.3. EFFECT OF ACETALDEHYDE ON WINE MICROORGANISMS.....	12
2.3.1. <i>Effect of Acetaldehyde on Wine Yeast</i>	12
2.3.2. <i>Effect of Acetaldehyde on Wine LAB</i>	13
CHAPTER 3 GENERAL MATERIALS & METHODS.....	15
3.1. PREPARATION OF WINE LAB MEDIA	15
3.1.1. <i>Preparation of Apple MRS (AMRS) Broth/Agar</i>	15
3.1.2. <i>Preparation of 2X Basal Broth (BB)</i>	15
3.1.3. <i>Preparation of Vegetable Juice Glucose (VJG) Broth/Agar</i>	16
3.2. PREPARATION OF WINE YEAST MEDIA.....	16
3.2.1. <i>Preparation of Yeast Media Broth (YM)</i>	16
3.2.2. <i>Preparation of Grape Juice Broth (GJ)</i>	16
3.3. PREPARATION OF BUFFERS	17
3.3.1. <i>Preparation of Tartrate Buffer (50 mM)</i>	17
3.3.2. <i>Preparation of Phosphate Buffer (50 mM)</i>	17
3.4. CHEMICAL ANALYSIS	17
3.4.1. <i>Determination of Free and Total Sulphur Dioxide</i>	17
3.4.2. <i>Bradford Protein Assay</i>	18

3.5. ENZYMATIC ANALYSIS	19
3.5.1. <i>Enzymatic Determination of Acetaldehyde</i>	19
3.5.2. <i>Enzymatic Determination of Ethanol</i>	20
3.5.3. <i>Enzymatic Determination of L-Malic acid</i>	21
3.5.4. <i>Enzymatic Determination of Acetic Acid</i>	23
3.6. DRY WEIGHT ANALYSIS	23
3.7. VINIFICATION.....	24
3.7.1. <i>Media Preparation</i>	24
3.7.2. <i>Culture Preparation</i>	24
3.7.3. <i>Experimental Procedure</i>	24
CHAPTER 4 METABOLISM OF ACETALDEHYDE BY RESTING CELLS OF WINE LAB	25
4.1. METABOLISM OF FREE ACETALDEHYDE BY RESTING CELLS.....	25
4.1.1. <i>Materials and Methods</i>	25
4.1.2. <i>Results</i>	26
4.2. METABOLISM OF SULPHUR DIOXIDE BOUND ACETALDEHYDE BY RESTING CELLS	33
4.2.1. <i>Materials And Methods</i>	33
4.2.2. <i>Results</i>	34
4.3. DISCUSSION.....	35
4.3.1. <i>Metabolism of Free Acetaldehyde by Resting Cells</i>	35
4.3.2. <i>Metabolism of SO₂ Bound Acetaldehyde by Resting Cells</i>	37
CHAPTER 5 METABOLISM OF ACETALDEHYDE BY WINE LAB IN WINE.....	40
5.1. METABOLISM OF FREE ACETALDEHYDE IN WINE	40
5.1.1. <i>Materials and Methods</i>	40
5.1.2. <i>Results</i>	41
5.2. METABOLISM OF SULPHUR DIOXIDE BOUND ACETALDEHYDE BY WINE LAB IN WINE	45
5.2.1. <i>Materials and Methods</i>	45
5.2.2. <i>Results</i>	45
5.3. DISCUSSION.....	49
5.3.1. <i>Vinification</i>	49
5.3.2. <i>Metabolism of Free Acetaldehyde in Wine</i>	49
5.3.3. <i>Metabolism of Bound Acetaldehyde in Wine</i>	50
CHAPTER 6 EFFECT OF ACETALDEHYDE ON GROWTH CHARACTERISTICS OF WINE LAB	53
6.1. GROWTH IN VJG BROTH	53
6.1.1. <i>Materials and Methods</i>	53
6.1.2. <i>Results</i>	55
6.2. GROWTH IN WINE	64
6.2.1. <i>Materials and Methods</i>	64

6.2.2. Results	65
6.3. DISCUSSION	67
6.3.1. Growth in VJG Broth	67
6.3.2. Growth in Wine	69
CHAPTER 7 SIMULTANEOUS INCUBATION OF RESTING CELLS OF YEAST AND LAB.....	71
7.1. PRODUCTION OF ACETALDEHYDE BY RESTING CELLS OF YEAST	71
7.1.1. Materials and Methods.....	71
7.1.2. Results	71
7.2. SIMULTANEOUS INCUBATION USING RESTING CELLS OF YEAST AND WINE LAB72	
7.2.1. Materials and Methods.....	73
7.2.2. Results	73
7.3. DISCUSSION.....	74
7.3.1. Production of Acetaldehyde by Resting Cells of Yeast	74
7.3.2. Simultaneous Incubation Using Resting Cells of Yeast and Wine LAB..	75
CHAPTER 8 ENZYME ACTIVITY	76
8.1.1. Materials and Methods.....	76
8.1.2. Results and Discussion.....	77
CHAPTER 9 GENERAL DISCUSSION	78
CHAPTER 10 SUMMARY AND FUTURE WORK	82
10.1. SUMMARY	82
10.2. FUTURE WORK	83
CHAPTER 11 LITERATURE CITED	84

List of Figures

- Figure 4.1.1** Degradation of acetaldehyde and production of ethanol and acetic acid by resting cells of *Lb. hilgardii* MHP in a tartrate buffer (pH 3.6) at 30°C.
Symbols; ■ acetaldehyde; ● acetic acid; ▲ ethanol. 28
- Figure 4.1.2** Degradation of acetaldehyde and production of ethanol and acetic acid by resting cells of *Lb. delbrueckii* CUC-1 in a tartrate buffer (pH 3.6) at 30°C.
Symbols; ■ acetaldehyde; ● acetic acid; ▲ ethanol. 28
- Figure 4.1.3** Changes in the concentrations of acetaldehyde and ethanol during a resting cell experiment using *Pd. damnosus* CUC-4 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 29
- Figure 4.1.4** Degradation of acetaldehyde and production of ethanol by resting cells of *O. oeni* Lol11 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 29
- Figure 4.1.5** Degradation of acetaldehyde and production of ethanol by resting cells of *O. oeni* 2001 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 30
- Figure 4.1.6** Degradation of acetaldehyde and production of ethanol by resting cells of *O. oeni* VFO in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 30
- Figure 4.1.7** Degradation of acetaldehyde and production of ethanol by resting cells of *O. oeni* EQ54 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 31
- Figure 4.1.8** Degradation of acetaldehyde and production of ethanol by resting cells of *Lb. Buchneri* CUC-3 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 31
- Figure 4.1.9** Degradation of acetaldehyde and production of ethanol by resting cells of *O. oeni* MCW in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 32
- Figure 4.1.10** Degradation of acetaldehyde and production of ethanol by resting cells of *O. oeni* ML34 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 32
- Figure 4.1.11** Degradation of acetaldehyde and production of ethanol by resting cells of *Pd. sp* 44.40 in a tartrate buffer (pH 3.6) at 30°C. Symbols; ■ acetaldehyde; ▲ ethanol. 33

Figure 4.2.1 Degradation of SO ₂ bound acetaldehyde by resting cells of <i>Lb. buchneri</i> CUC-3 and <i>O. oeni</i> MCW in a tartrate buffer (pH 3.6) at 30°C. Dry weights ranged from 3 to 6 mg. Symbols; ♦ MCW; ■ CUC-3; ▲ control.	35
Figure 4.3.1 Heterofermentation with acetaldehyde	39
Figure 5.1.1 Growth and production of acetaldehyde by <i>S. bayanus</i> Première Cuvée during alcoholic fermentation. Symbols; ▲ optical density (OD); ■ acetaldehyde.	42
Figure 5.1.2 Growth and metabolism of acetaldehyde and malic acid by <i>O. oeni</i> EQ54 in a laboratory vinified wine at pH 3.3. Symbols; ▲ OD; ■ acetaldehyde; ● malic acid.	42
Figure 5.1.3 Growth and metabolism of acetaldehyde and malic acid by <i>O. oeni</i> EQ54 in a laboratory vinified wine at pH 3.6. Symbols; ▲ OD; ■ acetaldehyde; ● malic acid.	43
Figure 5.1.4 Growth and metabolism of acetaldehyde and malic acid by <i>O. oeni</i> VFO in a laboratory vinified wine at pH 3.3. Symbols; ▲ OD; ■ acetaldehyde; ● malic acid.	43
Figure 5.1.5 Growth and metabolism of acetaldehyde and malic acid by <i>O. oeni</i> VFO in a laboratory vinified wine at pH 3.6. Symbols; ▲ OD; ■ acetaldehyde, ● malic acid.	44
Figure 5.1.6 Acetaldehyde concentration during alcoholic fermentation by <i>S. bayanus</i> Première Cuvée and MLF by <i>O. oeni</i> EQ54 in wine at pH 3.6.....	44
Figure 5.2.1 Growth of <i>O. oeni</i> EQ54 and changes in acetaldehyde concentration in a laboratory vinified wine at pH 3.3 with sulphur dioxide added. Symbols; ▲ OD; acetaldehyde ■.....	46
Figure 5.2.2 Growth of <i>O. oeni</i> EQ54 and changes in acetaldehyde concentration in a laboratory vinified wine at pH 3.6 with sulphur dioxide added. Symbols; ▲ OD; ■ acetaldehyde.....	47
Figure 5.2.3 Growth of <i>O. oeni</i> VFO and changes in acetaldehyde concentration in a laboratory vinified wine at pH 3.3 with sulphur dioxide added. Symbols; ▲ OD; ■ acetaldehyde.....	47
Figure 5.2.4 Growth of <i>O. oeni</i> VFO and changes in acetaldehyde concentration in a laboratory vinified wine at pH 3.6 with sulphur dioxide added. Symbols; ▲ OD; ■ acetaldehyde.....	48
Figure 5.2.5 Changes in acetaldehyde concentration of a laboratory vinified wine at pH 3.3 and pH 3.6 (Uninoculated controls). Symbols; ▲ acetaldehyde at pH 3.3, ■ acetaldehyde at pH 3.6.....	48

Figure 6.1.1 Growth of <i>O. oeni</i> MCW in VJG broth at various acetaldehyde concentrations. Results are averages of three separate experiments. Symbols; ● 0 mg/L acetaldehyde; ▲ 50 mg/L acetaldehyde; ■ 100 mg/L acetaldehyde; × 300 mg/L acetaldehyde; * 3000 mg/L acetaldehyde.....	57
Figure 6.1.2 Maximum growth rates (μ_{\max}) of <i>O. oeni</i> MCW grown in VJG broth at various acetaldehyde concentrations.....	58
Figure 6.1.3 Maximum growth rates (μ_{\max}) of <i>Lb. delbruecki</i> CUC-1 grown in VJG broth at various acetaldehyde concentrations.....	60
Figure 6.1.4 Maximum growth rates (μ_{\max}) of <i>Pd. damnosus</i> CUC-4 grown in VJG broth at various acetaldehyde concentrations.....	61
Figure 6.1.5 Maximum growth rates (μ_{\max}) of <i>Lb. buchneri</i> CUC-3 grown in VJG broth at various acetaldehyde concentrations.....	63
Figure 6.1.6 Changes in the acetaldehyde concentration in a cell suspension of <i>Pd. damnosus</i> CUC-4 with glucose added at 1 g/L. Symbols; ■ acetaldehyde; ▲ positive control (acetaldehyde only); ● negative control (cell suspension only).....	64
Figure 6.2.1 Growth of <i>O. oeni</i> VFO in wine (pH 3.6) at various acetaldehyde concentrations. Results are averages of three experiments. Symbols; ● 50 mg/L acetaldehyde; ▲ 100 mg/L acetaldehyde; ■ 300 mg/L acetaldehyde.....	66
Figure 6.2.2 Maximum growth rates (μ_{\max}) of <i>O. oeni</i> VFO grown in wine (pH 3.6) at various acetaldehyde concentrations.....	67
Figure 7.1.1 Production of acetaldehyde by resting cells of <i>S. bayanus</i> Première Cuvée with glucose added at 2 g/L ▲, and utilisation of added acetaldehyde by the same yeast (resting cells) in the absence of glucose ■. Dry weights were over 10 mg in both experiments.	72
Figure 7.2.1 Changes in acetaldehyde and ethanol concentrations during simultaneous incubation of resting cells of <i>S. bayanus</i> Première Cuvée and <i>O. oeni</i> Lol11 (resting cell experiment). Symbols; ■ Yeast + Glucose (acetaldehyde); × Yeast + Bacteria + Glucose (acetaldehyde); ▲ Yeast + Glucose (ethanol); * Yeast + Bacteria + Glucose (ethanol).....	74

List of Tables

Table 4.1.1 Acetaldehyde utilisation and product formation by resting cells of wine LAB in tartrate buffer (pH 3.6) at 30°C.....	27
Table 6.1.1 Growth rates of <i>O. oeni</i> MCW at different acetaldehyde concentrations	57
Table 6.1.2 Initial and final acetaldehyde concentrations in VJG broth inoculated with <i>O. oeni</i> MCW	59
Table 6.1.3 Growth rates of <i>Lb. delbrueckii</i> CUC-1 at different acetaldehyde concentrations.....	59
Table 6.1.4 Initial and final acetaldehyde concentrations in VJG broth inoculated with <i>Lb. delbrueckii</i> CUC-1	60
Table 6.1.5 Growth rates of <i>Pd. damnosus</i> CUC-4 at different acetaldehyde concentrations.....	61
Table 6.1.6 Initial and final acetaldehyde concentrations in VJG broth inoculated with <i>Pd. damnosus</i> CUC-4.....	62
Table 6.1.7 Growth rates of <i>Lb. buchneri</i> CUC-3 at different acetaldehyde concentrations.....	62
Table 6.1.8 Initial and final acetaldehyde concentrations in VJG broth inoculated with <i>Lb. buchneri</i> CUC-3.....	63
Table 6.2.1 Growth rates of <i>O. oeni</i> VFO at different acetaldehyde concentrations	66
Table 6.2.2 Initial and final acetaldehyde concentrations in wine (pH 3.6) inoculated with <i>O. oeni</i> VFO.....	67