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**Increasing the *Lactococcus lactis* Biomass through
Aerobic Growth**

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degree of**

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Aravind Giridhar

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ABSTRACT

Starter cultures for dairy fermentations are commonly made by anaerobic fermentation in New Zealand. Anaerobic fermentation involves glycolysis and it is a very inefficient pathway due to the formation of energy rich products such as lactic acid. This pathway only produces 2 moles of ATP per glycolysis and to conserve energy, the amount of biomass produced is less. Aerobic fermentation on the other hand can produce up to 36 moles of ATP per cycle, and the amount of biomass produced will be higher compared to anaerobic fermentation. Lactic acid bacteria do not possess a functional electron transport chain for aerobic respiration to be efficient. It requires the addition of heme, for the electron transport chain to work. The heme addition is a patented process.

The aim of this study was to optimise the aerobic fermentation process for *Lactococcus lactis* for biomass production. An extensive literature search shows that there has been no study in optimising the heme concentration or using other alternatives for heme. Alternatives to heme, that are food grade, are an attractive option, as there is sourcing issues with heme in New Zealand.

A series of shake flask trials were carried out to identify a possible heme replacement. The shake flask trials showed that ammonium ferric citrate is a possible alternative heme replacement. More shake flask trials were then evaluated to optimise the concentration of ammonium ferric citrate. Following that, 1-L fermenter trials were evaluated to optimise heme concentration and to compare the effect of heme and ammonium ferric citrate addition on biomass and activity of the harvested biomass following a freeze and thaw cycle.

It was shown that 44 $\mu\text{g}/\text{mL}$ ammonium ferric citrate resulted in the most biomass of the concentrations tested. For heme, the optimum concentration was 1 $\mu\text{g}/\text{mL}$. It was found

that fermentations using heme resulted in more biomass after 5 h compared to using ammonium ferric citrate. But, cells grown by adding ammonium ferric citrate was equally as active.

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TABLE OF CONTENTS

ABSTRACT.....	iv
ACKNOWLEDGEMENTS.....	vii
TABLE OF CONTENTS.....	viii
LIST OF TABLES.....	x
LIST OF FIGURES.....	xi
1.0 INTRODUCTION.....	1
2.0 LITERATURE REVIEW.....	5
2.1 Starter culture.....	5
2.1.1 Lactic acid bacteria.....	6
2.1.1.1 <i>Lactococcus lactis</i>	7
2.1.2 Nutritional requirements of lactic acid bacteria.....	8
2.2 Production of starter culture.....	8
2.2.1 Fermentation.....	9
2.3 Respiration.....	12
2.3.1 Respiration in LAB.....	14
2.3.2 Heme.....	16
2.3.3 The role of heme in respiration.....	17
2.3.4 Impact of respiration on LAB.....	18
2.4 Improving starter culture production by respiration technology.....	20
2.5 Conclusion.....	22
3.0 MATERIALS AND METHODS.....	23
3.1 <i>Lactococcus</i> strain.....	23
3.2 M17 Media.....	23
3.3 Heme.....	23
3.4 Alternate heme.....	23
3.5 Analytical techniques.....	24
3.5.1 Biomass.....	24
3.5.2 Glucose.....	24
3.6 Fermentation.....	24
3.6.1 Equipment.....	24
3.6.2 Operational Procedure.....	24
3.7.1 Activity testing.....	26

3.7.2	Direct set milk preparation	26
3.7.3	Inoculum preparation for activity testing	27
3.7.4	Operating procedure.....	27
4.0	RESULTS AND DISCUSSION.....	28
4.1	Heme alternatives	28
4.2	Effect of different concentrations of ammonium ferric citrate	30
4.3	Heme Optimisation	34
4.4	Comparison between ammonium ferric citrate and heme.....	36
4.5	Activity Testing	37
5.0	CONCLUSIONS.....	40
6.0	REFERENCES	42
	APPENDIX.....	47
	Appendix 1: Raw data for duplicate runs of heme optimisation	48
	Appendix 2: Activity result graph	50

LIST OF TABLES

Table 4.1: The effect of various heme alternatives on aerobic growth of <i>L.lactis</i> in shake flasks.....	28
Table 4.2: Effect of ammonium ferric citrate concentration on aerobic growth of <i>L.lactis</i> in shake flasks.....	30
Table 4.3: Time taken to reach final pH of 4.605 for <i>L.lactis</i> cultures grown by adding ammonium ferric citrate and heme, and for control.....	36

LIST OF FIGURES

Figure 2.1: <i>Lactococcus lactis</i> (Todar, 2012).....	7
Figure 2.2: Simplified fermentation pathway of lactic acid bacteria (Broojimans, 2008).....	10
Figure 2.3: Conversion of pyruvate to lactate by the action of lactate dehydrogenase (Lechardeur et al. 2011)	11
Figure 2.4: Electron transport chain of lactic acid bacteria.....	15
Figure 2.5: Structure of heme showing the iron centre.....	16
Figure 4.1: Effect of ammonium ferric citrate concentration on aerobic growth of <i>L.lactis</i> in shake flasks.....	30
Figure 4.2: Effect of ammonium ferric citrate concentration on aerobic growth of <i>L.lactis</i> in shake flasks.....	33
Figure 4.3: Effect of different concentrations of heme on biomass of <i>L.lactis</i> grown aerobically.....	33
Figure 4.4: The effect of 44 µg/mL ammonium ferric citrate and 1 µg/mL heme on aerobic growth of <i>L.lactis</i> in a 1-L fermenter.....	35