Increasing the *Lactococcus lactis* Biomass through Aerobic Growth

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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 µg/mL ammonium ferric citrate resulted in the most biomass of the concentrations tested. For heme, the optimum concentration was 1 µg/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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