### Title
Novel strategies for optimization of the cheddar cheese manufacturing process

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THESIS ABSTRACT

The effects of Cheddar cheese quality has been studied previously on pH, composition, ionic strength (NaCl) and temperature; however, physicochemical and biochemical parameters of cheese such as milk composition, processing parameters, residual lactose/lactate and galactose (in cheeses made with starter systems containing *Streptococcus thermophilus* as adjunct) and calcium phosphate levels, have to date received little attention. The objective of this project is to investigate the effects of such parameters during cheese production and maturation on Cheddar cheese quality which could develop future strategies for optimization of the Cheddar cheesemaking process, reducing variation in quality and maximizing Cheddar quality. Curd washing during cheese manufacturing had significant effect on controlling cheese residual sugar and lactate contents hence affected Cheddar cheese pH, which significantly influenced the cheese texture, sensory and volatile profiles of Cheddar cheeses. Cheddar cheese made with curd washing step had flavours described as ‘fruity’, ‘buttery’ and ‘sweet’ compared to non-washed cheese. CaP content in Cheddar can be controlled with different pH at whey drainage has a major impact on cheese texture and functionality. Reduced calcium in Cheddar cheese resulted in a more pungent, onion, rancid, buttery and caramel aromas and a more bitter taste than the standard calcium cheeses. Milk protein level is another very important factor to Cheddar cheese quality which can be standardised/concentrated by ultrafiltration (UF) process. Increasing milk protein level by UF significantly increased cheese yields, cheese firmness and fracture stress while decreased the cheese moisture and primary proteolysis at later stage of ripening. Cheddar cheese made with UF milk was more fruity, buttery and caramel than the standard milk cheeses. Due to modern Cheddar cheese practice, *Sc. thermophilus* strains are often used as an adjunct culture. Hence, during this study, one galactose-positive and one galactose-negative *Sc. thermophilus* strain were selected based on their phenotypes for Cheddar cheese making in combination with standard mesophilic cultures. Higher drain pH was also
used in this study to be comparable with recent commercial cheese making practise. Cheddar cheese made using Gal⁺ and Gal⁻ *Sc. thermophilus* strains as adjunct cultures affected the levels of residual sugars, the profile of volatile compounds and sensory properties of Cheddar cheese.

Overall, the experimental work reported in this thesis generated new knowledge and theories about how to control and optimise Cheddar cheese quality during cheese manufacture and ripening.