Polysaccharide and exopolysaccharide utilisation in processed and natural cheese systems
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Appendix D

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Abstract

Several polysaccharides are of interest in dairy products because of their ability to bind water and other components of the food systems, often leading to major changes in their functional properties. This work aimed to measure and understand the effects of specific polysaccharides in cheeses on the rheological properties related to functionality. The following polysaccharide–cheese systems were used: the microbial polysaccharides xanthan gum (xanthan), high acyl gellan gum (Gellan-H) and low acyl gellan gum (Gellan-L) in processed cheese and an exopolysaccharide (EPS) from a lactic acid bacteria (LAB) in very low fat Mozzarella cheese. Locust bean gum (LBG) was also used with xanthan.

Model processed cheese using rennet casein and soya oil was developed on a small scale (30 g) using a controlled temperature, stirrer speed and time of mixing. Initially, lactose content, moisture losses and sample preparation were standardised to lower the variability in rheological measurements. The effects of xanthan, xanthan+LBG, Gellan-H and Gellan-L on the rheology of the processed cheese were studied. As the polysaccharide concentration increased from 0.0 to 2.0% (wt/wt), the fracture stress (firmness) increased whereas the fracture strain (longness) decreased for gellan gum and the effect depended on the polysaccharide. The crossover temperature (where $G' = G''$), an indicator of viscoelasticity, was increased dramatically by these polysaccharides. Confocal laser scanning microscopy showed polysaccharide clusters in the protein matrix for Gellan-H, xanthan and xanthan+LBG but not very distinct clusters for Gellan-L.
The effect of Gellan-H and Gellan-L on the water mobility and spreading properties of model processed cheese was investigated. Spreading properties were measured by elongational viscosity, and water mobility was measured by nuclear magnetic resonance (NMR) relaxometry. The NMR data revealed that both polysaccharides significantly reduced the water mobility in the cheese but that the reduction was greater for Gellan-H. The rheology data showed that the addition of polysaccharide increased the elongational viscosity for processed cheese containing both Gellan-H and Gellan-L.

In situ exopolysaccharide (EPS)-producing cultures are widely used to improve moisture retention and texture in low fat cheese manufacture but are limited by a low level of EPS production. The aim of this study was to develop an “all-dairy” ingredient with an increased content of EPS and greater functionality of the EPS for dairy applications such as Mozzarella cheese. An EPS-producing *Streptococcus thermophilus* was chosen and its growth was optimised for the development of the bioingredient. The fermented biomass was harvested at the end of the exponential phase and freeze dried. The reduced viable cell count and the retention of ropiness of the powder from the drying process enabled a higher level of EPS inoculation in a preliminary Mozzarella cheese manufacturing trial.

Pilot-scale very low fat model Mozzarella cheese was manufactured with and without added EPS powder and in situ EPS culture (EPS-C). Large strain rheology, elongational viscosity, melt and NMR relaxometry were used to determine the effects of the in situ and added EPS on the functionality of the cheeses. Cheeses made with the EPS ingredient (EPS-P) retained the highest moisture content (66.0%) without any visible
serum exudation. The cheeses made with non-EPS-producing cultures (CTR) and EPS-C had lower moisture contents of 57.5 and 60.2% respectively. Such higher moisture retention of the cheeses made with EPS-P was reflected in the rheological properties of the final cheeses. The cheeses made with EPS-P exhibited greater meltability, lower elongational viscosity and lower modulus of deformability (stiffness) and fracture stress than those made with EPS-C and CTR.

Future work to develop this area of the functional effects of the addition of polysaccharides to cheese would include protein–polysaccharide interactions and better definition of the water affinity of polysaccharide compared with that of protein.
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Table of contents

Abstract ....................................................................................................................................................................... i

Acknowledgements............................................................................................................................................. iv

Table of contents .................................................................................................................................................... v

List of Figures ...................................................................................................................................................... xiv

List of Tables ..................................................................................................................................................... xxiii

Chapter 1  Introduction ..................................................................................................................................1

1.1 Problem definition ..................................................................................................................................1

1.2 Proposed solution ...............................................................................................................................2

1.3 Commercial significance ..................................................................................................................2

1.4 Thesis objectives ..................................................................................................................................3

1.5 Thesis structure ...................................................................................................................................4

Chapter 2  Literature review ........................................................................................................................7

2.1 Processed cheese ..................................................................................................................................7

2.1.1 Main groups ............................................................................................................................... 10

2.2 Legislation in Australia and New Zealand ...................................................................................... 11

2.3 Processed cheese principles and manufacture .............................................................................. 12

2.3.1 Selection of natural cheese .........................................................................................................14

2.3.2 Grinding .......................................................................................................................................17

2.3.3 Blending .......................................................................................................................................17

2.3.4 Processing ..................................................................................................................................17

2.3.5 Packaging ...................................................................................................................................20
2.3.6 Cooling .......................................................................................................................................... 20
2.3.7 Storage .......................................................................................................................................... 20

2.4 Factors affecting the functional properties of processed cheese ............................................ 20
2.4.1 Intact casein ....................................................................................................................................... 21
2.4.2 pH .................................................................................................................................................... 22
2.4.3 Emulsifying salts .................................................................................................................................. 23
2.4.4 Lactose content ........................................................................................................................ 28

2.5 Processing conditions ..................................................................................................................... 28
2.5.1 Melting temperature .............................................................................................................. 28
2.5.2 Melting time ............................................................................................................................... 29
2.5.3 Mixing speed .............................................................................................................................. 30
2.5.4 Cooling the finished product .............................................................................................. 31

2.6 Rheology and functional properties of processed cheese ............................................................. 31
2.6.1 Rheology related to unmelted cheese ........................................................................... 32
2.6.2 Rheology related to melted cheese ................................................................................. 36

2.7 Microstructure measurement of processed cheese ....................................................................... 37
2.7.1 Confocal laser scanning microscopy .............................................................................. 38
2.7.2 Transmission electron microscopy ................................................................................ 38

2.8 Fat globule size determination in processed cheese .................................................................. 39

2.9 Hydrocolloids and processed cheese ............................................................................................ 40
2.9.1 Method of incorporation ...................................................................................................... 41
2.9.2 Characteristics of microbial polysaccharides .................................................................... 42
2.10 Mozzarella cheese ........................................................................................................................ 50
  2.10.1 Manufacture of low moisture Mozzarella cheese ................................................................. 50
2.11 Exopolysaccharides (EPSs) in cheese .......................................................................................... 52
  2.11.1 Lactic acid bacteria (LAB) EPS ............................................................................................ 52
  2.11.2 EPS-producing cultures in cheese manufacture ........................................................................ 53
  2.11.3 EPS starters and its effect on functional properties of Mozzarella cheese ......................... 54

Chapter 3 Common materials and methods ...................................................................................... 58
  3.1 Manufacture of model processed cheese ...................................................................................... 58
    3.1.1 Ingredients ............................................................................................................................... 58
    3.1.2 Processing in the Rapid Visco Analyser ................................................................................ 58
  3.2 Uniaxial compression ...................................................................................................................... 60
    3.2.1 Sample preparation .................................................................................................................. 60
    3.2.2 Uniaxial compression ............................................................................................................. 60
  3.3 Dynamic oscillatory measurement .................................................................................................. 65
  3.4 Sample sections and confocal laser scanning microscopy (CLSM) ............................................. 65
  3.5 Fat globule size determination ....................................................................................................... 66
  3.6 Squeezing flow test ....................................................................................................................... 66
    3.6.1 Squeezing flow using constant force test ............................................................................. 69
  3.7 $T_2$ relaxation measurements ...................................................................................................... 71
  3.8 Chemical analysis of cheese .......................................................................................................... 71
    3.8.1 Fat, protein and moisture content for processed cheese ......................................................... 71
    3.8.2 Fat and protein content for Mozzarella cheese ..................................................................... 72
4.3.8 Complexity in compression testing ..........................................................92

4.4 Conclusions........................................................................................................92

Chapter 5 The synergistic effect of xanthan gum and locust bean gum in model processed cheese .................................................................................................................................94

5.1 Introduction.............................................................................................................94

5.2 Materials and methods ..........................................................................................96

5.2.1 Manufacture of model processed cheese .........................................................96

5.2.2 Experimental design .........................................................................................96

5.2.3 Uniaxial compression .......................................................................................97

5.2.4 Dynamic oscillatory measurement .................................................................97

5.2.5 Sample sections and CLSM ..........................................................................98

5.2.6 Statistical analysis ...........................................................................................98

5.3 Results and discussion ........................................................................................98

5.3.1 Modulus of deformability .............................................................................98

5.3.2 Adhesion area ..................................................................................................101

5.3.3 Fracture strain ................................................................................................103

5.3.4 Microstructure .................................................................................................104

5.3.5 Viscoelasticity as a function of temperature and structural changes .........105

5.4 Conclusions..........................................................................................................109

Chapter 6 Effect of the microbial polysaccharide gellan gum on the functionality of a model processed cheese ..................................................................................................................111

6.1 Introduction..........................................................................................................111
7.2.4 Determination of fat globule size ................................................................. 143
7.2.5 Proton transverse \( (T_2) \) relaxation measurements ............................................. 143
7.2.6 \(^{13}\)C MAS solid-state NMR ................................................................................. 143
7.2.7 Transmission electron microscopy (TEM) .......................................................... 144
7.3 Results and discussion ......................................................................................... 145
7.3.1 Spin–spin relaxation \( (T_2) \) ................................................................................ 146
7.3.2 Constant force measurement ........................................................................... 160
7.3.3 Transmission electron microscopy .................................................................... 164
7.4 Conclusions ......................................................................................................... 166

Chapter 8 Development of a dairy-based exopolysaccharide bioingredient .......... 168
8.1 Introduction ......................................................................................................... 168
8.2 Materials and methods ....................................................................................... 171
8.2.1 Bacterial strains and media ............................................................................ 171
8.2.2 Fermentation ................................................................................................... 171
8.2.3 EPS quantification .......................................................................................... 173
8.2.4 Freeze drying process ....................................................................................... 173
8.2.5 Bacterial enumeration ...................................................................................... 174
8.2.6 Viscosity measurement ..................................................................................... 174
8.3 Results and discussion ....................................................................................... 175
8.3.1 Influence of medium composition on growth and EPS production ................. 175
8.3.2 Effect of pH on EPS production ....................................................................... 177
8.3.3 Effect of pH on viscosity .................................................................................. 178
8.3.4 Effect of medium composition on EPS production .............................................. 180
8.3.5 Effect of freeze drying on bacterial cell count and EPS concentration...... 183
8.3.6 Viscosity of reconstituted freeze-dried medium.................................................. 184
8.3.7 Effect of temperature on reconstituted powder ................................................... 185
8.3.8 Storage conditions ............................................................................................................... 186
8.4 Conclusions....................................................................................................................................... 187

Chapter 9 Exopolysaccharide as a bioingredient in skim milk Mozzarella cheese .... 189
9.1 Introduction ..................................................................................................................................... 189
9.1.1 Objectives................................................................................................................................. 191
9.2 Materials and methods ............................................................................................................... 191
9.2.1 Starter cultures...................................................................................................................... 191
9.2.2 Cheese-making ...................................................................................................................... 191
9.2.3 Cheese yield analysis .......................................................................................................... 195
9.2.4 Moisture analysis .................................................................................................................. 195
9.2.5 Rheological properties related to melt: elongational viscosity ......................... 195
9.2.6 Rheological and fracture properties related to texture .............................................. 196
9.2.7 Proton transverse ($T_2$) relaxation measurements ............................................. 196
9.2.8 Schreiber test ......................................................................................................................... 196
9.2.9 Experimental approach......................................................................................................... 196
9.2.10 Statistical analysis........................................................................................................... 199
9.3 Results and discussion ................................................................................................................ 199
9.3.1 Determination of the amount of starter ................................................................. 199

xii
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3.2</td>
<td>Composition</td>
<td>200</td>
</tr>
<tr>
<td>9.3.3</td>
<td>Rheology</td>
<td>200</td>
</tr>
<tr>
<td>9.3.4</td>
<td>Nuclear magnetic resonance</td>
<td>205</td>
</tr>
<tr>
<td>9.3.5</td>
<td>Moisture content and melt</td>
<td>207</td>
</tr>
<tr>
<td>9.3.6</td>
<td>Squeezing flow at constant temperature (60°C)</td>
<td>211</td>
</tr>
<tr>
<td>9.4</td>
<td>Conclusions</td>
<td>213</td>
</tr>
<tr>
<td>Chapter 10</td>
<td>Overall conclusions</td>
<td>215</td>
</tr>
<tr>
<td>10.1</td>
<td>Future work</td>
<td>219</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>221</td>
</tr>
<tr>
<td>Appendices</td>
<td></td>
<td>253</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1 The manufacturing procedure for processed cheese consists of operations performed in the following order {adapted from (Fox, O'Connor, McSweeney, Guinee, & O'Brien, 1996; Guinee, 1987; Kapoor & Metzger, 2008)} .......................................................... 13

Figure 2 Chemical reactions during cheese processing. NaA – calcium sequestering agent; A – anion: phosphate, polyphosphate, citrate etc.: adapted from (Caric & Kaláb, 1993) .......................................................... 24

Figure 3 Structural unit of gellan gum: \( \rightarrow 4\)-L-rhamnopyranosyl-(\(\alpha-1\rightarrow3\))-D-glucopyranosyl-(\(\beta-1\rightarrow4\))-D-glucuronopyranosyl-(\(\beta-1\rightarrow4\))-D-glucopyranosyl-(\(\beta-1\rightarrow \) with O(2) L-glyceryl and O(6) acetyl substituents on the 3-linked glucose ................. 45

Figure 4 The repeating unit of low acyl gellan gum ......................................................... 46

Figure 5 The repeating unit of high acyl gellan gum ......................................................... 47

Figure 6 Example of flow diagram for the manufacture of low moisture Mozzarella cheese by a traditional process {adapted from (Kindstedt, 1993)} .......................................................... 51

Figure 7 Sample preparation for double compression testing: (A) cylinders lined with polypropylene film and tied with a rubber band at one end; (B) a set cylinder used for double compression testing after trimming .......................................................... 60

Figure 8 Illustrative force versus time curve for compression and tension stroke .......... 63
Figure 9 Illustrative stress versus strain curve for compression: FSN = fracture strain; FSS = fracture stress; FAR = fracture area; MOD = modulus of deformability.

Figure 10 Schematic diagram of the UW melt meter, a modified squeezing flow test device: A/D = analog-to-digital converter; LVDT = linear variable differential transformer.

Figure 11 Photograph of the modified squeezing flow device, the UW melt meter, with two sample wells and the LVDT.

Figure 12 (Left) Sample well in the UW melt meter when the outer ring is in the up position. (Right) Sample specimen formed when the outer ring is in the down position.

Figure 13 (a) Starting position while the sample is resting; (b) the lever is lowered and the upper plate is in contact with the sample; (c) the load governed by the upper plate squeezes the sample (Wang et al., 1998).

Figure 14 Contour plot of moisture losses for the model formulation with a polysaccharide content from 0.5 to 2.5% and a moisture content from 46.0% (14.0% protein) to 52.0% (8.0% protein).

Figure 15 Scatter plots of (A) $G'$ and (B) $G''$ for processed cheeses containing lactose at 0.0, 1.0, 2.0, 3.0 and 3.5%. Values of $G'$ and $G''$ at a frequency of 0.1 Hz were selected for comparison.
Figure 16 Slice formation: (left) molten processed cheese poured on to polypropylene film; (right) two metal strips flanking the molten processed cheese during rolling by a heavy roller. ................................................................. 88

Figure 17 Textures of a range of processed cheeses at protein contents from 8.0 to 14.0% and polysaccharide contents from 0.0 to 2.5% are shown by different coloured dots: ●, very firm elastic gel; ●, firmer, elastic and homogeneous gel; ●, firm elastic and homogeneous gel; ☘, soft protein gel. ........................................................................................................... 89

Figure 18 Strain sweeps carried out at 5°C for processed cheese formulations with protein contents from 8.0 to 14.0% and polysaccharide contents from 0.0 to 2.5%........ 91

Figure 19 Stiffness at different protein and polysaccharide contents in processed cheeses containing (A) xanthan and (B) xanthan+LBG (1:1) . ...................................................... 100

Figure 20 Stickiness at different protein and polysaccharide contents of processed cheeses containing (A) xanthan and (B) xanthan+LBG (1:1). ...................................................... 103

Figure 21 Effect of polysaccharide content on the fracture strain of model processed cheese containing 10.0% protein (this protein content is normally used for sliced cheese), 30% fat and 1.0% xanthan (●) or 1.0% xanthan+LBG (1:1) (●)................. 104

Figure 22 CLSM images of model processed cheeses containing (A) 1.0% (wt/wt) xanthan and (B) 1.0% (wt/wt) xanthan+LBG (1:1). Protein is blue, fat is orange and polysaccharide is dark green. The scale bars represent 75 µm. Polysaccharide structures are visible as discrete entities in the protein matrix................................................................. 105
Figure 23 Temperature sweeps at a frequency of 0.1 Hz and a strain of 0.1%, showing changes in damping factor ($\tan \delta$) values for model processed cheeses containing xanthan and a 1:1 xanthan+LBG blend at the same protein content of 10.0% (wt/wt) and different polysaccharide contents of 0.0, 1.0 and 2.0% (wt/wt). ......................................................... 106

Figure 24 Temperature sweeps at a frequency of 0.1 Hz and a strain of 0.1%, showing changes in (A) $G'$ and (B) $G''$ values for model processed cheeses containing xanthan and a 1:1 xanthan+LBG blend at the same protein content of 10.0% (wt/wt) and different polysaccharide contents of 0.0, 1.0 and 2.0% (wt/wt). ......................................................................................... 108

Figure 25 RVA viscosity profile obtained during the manufacture of model processed cheeses containing 10.0% (wt/wt) protein, 30.00% (wt/wt) fat and 50.00% moisture: (A) Gellan-H; (B) Gellan-L................................................................................................................. 117

Figure 26 Fat globule particle size in the cheese matrix for various concentrations of polysaccharides in model processed cheeses containing 10.0% (wt/wt) protein, 30.00% (wt/wt) fat and 50.00% moisture: (A) Gellan-H; (B) Gellan-L............................................................................................................. 119

Figure 27 CLSM images of model processed cheeses containing 10.0% (wt/wt) protein, 30.00% (wt/wt) fat and 50.00% moisture: (A) no polysaccharide; (B) 1.0% (wt/wt) Gellan-H; (C) 1.0% (wt/wt) Gellan-L. Protein is blue, fat is pink and polysaccharide is green. The scale bars represent 75 µm. Polysaccharide structures are visible as discrete entities in the protein matrix........................................................................................................... 121

Figure 28 Effect of polysaccharide content at various protein contents on the fracture stress (FSS) of RVA model processed cheese: (A) Gellan-H; (B) Gellan-L. ♦ = 8.0%
Figure 29 Effect of polysaccharides on the fracture strain (FSN) of model processed cheeses: (A) Gellan-H; (B) Gellan-L.

Figure 30 Illustrative concave-up and concave-down stress versus strain curves. FSN = Fracture strain, FSS = Fracture stress.

Figure 31 The relationship between slope ratio and concentration of Gellan-H in model processed cheese: ○ = 8.0% (wt/wt) protein; ● = 12.0% (wt/wt) protein. Error bars show the standard error of the mean.

Figure 32 CLSM images of model processed cheeses containing 1.0% (wt/wt) Gellan-H: (A) 14.0% (wt/wt) protein; (B) 12.0% (wt/wt) protein; (C) 8.0% (wt/wt) protein. Protein is blue, fat is red and polysaccharide is dark green. The scale bars represent 75 µm.

Figure 33 Temperature sweeps at a frequency of 0.1 Hz and a strain of 0.1%, showing changes in tan δ values for model processed cheeses containing (A) Gellan-H and (B) Gellan-L at the same protein content of 10.0% (wt/wt) and different polysaccharide contents of 0.0, 1.0 and 2.0% (wt/wt).

Figure 34 Temperature sweeps at a frequency of 0.1 Hz and a strain of 0.1%, showing changes in tan δ values for model processed cheeses at two different protein contents of (A) 8.0% (wt/wt) and (B) 12.0% (wt/wt), at polysaccharide contents of 0.0 and 1.0% (wt/wt) each for Gellan-H and Gellan-L.
Figure 35 Spin–spin relaxation ($T_2$) of the water component of model processed cheeses. .................................................. 147

Figure 36 Spin–spin relaxation ($T_2$) of the water component of model processed cheeses containing 10.0% (wt/wt) protein, 30.00 % (wt/wt) fat and 50.00% moisture: (A) Gellan-H; (B) Gellan-L ........................................................................................................ 149

Figure 37 Spin–spin relaxation ($T_2$) of the fat component of model processed cheeses containing 10.0% (wt/wt) protein, 30.00 % (wt/wt) fat and 50.00% moisture: (A) Gellan-H; (B) Gellan-L ........................................................................................................ 152

Figure 38 Fat globule particle size in the cheese matrix for various polysaccharide contents in model processed cheeses containing 10.0% (wt/wt) protein, 30.00% (wt/wt) fat and 50.00% moisture: (A) Gellan-H; (B) Gellan-L .......................................................... 154

Figure 39 Height under constant force (0.55 N) at 25°C of control model processed cheeses containing 2.0% Gellan-H and two different protein contents: ●, 8.0% protein; ○, 12.0% protein ................................................................. 156

Figure 40 $^{13}$C CP/MAS NMR spectra under constant force (0.55 N) at 25°C of model processed cheeses containing 2.0% Gellan-H and two different protein contents: —, 8.0% protein; —, 12.0% protein ................................................................. 158

Figure 41 Spin–spin relaxation ($T_2$) of the fat component for control model processed cheeses with different protein contents: ●, 8.0% protein; ○, 14.0% protein ......................... 160
Figure 42  Height under constant force (0.55 N) at 25°C of control model processed cheeses (30% fat and 12.0% protein) containing Gellan-H and Gellan-L......................................................161

Figure 43 Overall BSGC means under constant force (0.55 N) at 25°C for model processed cheeses containing Gellan-H and Gellan-L and three different protein contents, 8.0, 10.0 and 12.0%. ..........................................................................................................................162

Figure 44 Overall mean rates of deformation under constant force (0.55 N) at 25°C for model processed cheeses containing Gellan-H and Gellan-L and three different protein contents, 8.0, 10.0 and 12.0%. .......................................................................................................................................163

Figure 45 TEM images of model processed cheeses (10.0% protein) containing: (A) no polysaccharide; (B) 1.0% (wt/wt) Gellan-L; (C) 1.0% (wt/wt) Gellan-H. F = fat; P = protein; G-L = Gellan-L polysaccharide filaments in the protein matrix; G-H = Gellan-H polysaccharide filaments in the protein matrix; UG = un-hydrated polysaccharide; CL = Calcium lactate crystals........................................................................................................................................165

Figure 46 Viscosity measured at 100 s⁻¹ in RSM (10% total solids) as a function of pH: ●, 5.0; ○, 6.0; ▼, 7.0. Values are the average of three fermentations carried out in duplicate. ........................................................................................................................................179

Figure 47 Viable cell count (mean of three replicates) produced during fermentation of RSM by the S. thermophilus strain at pH 6 and 37°C. .................................................................................................................................181

Figure 48 EPS concentration (mean of three replicates) produced during fermentation of RSM by the S. thermophilus strain at pH 6 and 37°C. .................................................................................................................................182
Figure 49 Viscosity of 9.1% total solids RSM with 2.0% WPH fermented at a controlled 
pH of 6.0 for 18 h (○) and reconstituted freeze-dried powder (▼). The viscosity of non-
fermented medium is illustrated as (●). ................................................................. 185

Figure 50 Viscosity of reconstituted freeze-dried powder (10.0% total solids) measured 
at 100 s⁻¹ at different temperatures from 30 to 80°C. Error bars represent the standard 
error of the mean of viscosity measurements. ......................................................... 186

Figure 51 Main effects plots of (A) Fracture stress (FSS) and (B) Modulus of 
deformability (Mod) for very low fat model Mozzarella cheeses made using three 
different treatments in three vats on three days....................................................... 202

Figure 52 Main effects plot of fracture strain (FSN) for very low fat model Mozzarella 
cheeses made using three different treatments in three vats on three days. ........... 204

Figure 53 Spin–spin relaxation ($T_2$) of the water component of Mozzarella cheeses 
containing CTR, EPS-P and EPS-C. Mean values of repeats were used to plot the graph. 
........................................................................................................................................ 206

Figure 54 Interval plot of the moisture content for very low fat model Mozzarella 
cheeses made using three different treatments: control (CTR); EPS culture (EPS-C); EPS 
powder (EPS-P). The bars show pooled standard deviations and the red dots are the 
moisture contents for three repeats. ............................................................................. 208

Figure 55 Changes in Schreiber melt of very low fat model Mozzarella cheeses: (A) for 
the three treatments (control (CTR); EPS culture (EPS-C); EPS powder (EPS-P)); (B) 
fitted plot showing the correlation between moisture content and melt....................... 210
Figure 56 Mean BSGC values at 60°C for very low fat model Mozzarella cheeses made using three different treatments: control (CTR); EPS culture (EPS-C); EPS powder (EPS-P). (A) BSGC3 = BSGC at a strain rate of $3 \times 10^{-3}$ s$^{-1}$; (B) BSGC5 = BSGC at a strain rate of $5 \times 10^{-3}$ s$^{-1}$. 

212
List of Tables

Table 1 Main functions and effects of dairy and non-dairy ingredients in processed cheese products {adapted from (Guinee et al., 2004)} ................................................................. 9

Table 2 Some characteristics of processed cheese types {adapted from (Caric & Kaláb, 1993)} ....................................................................................................................................................................... 10

Table 3 The 21 additive functional classes listed in the FSANZ Food Code, Section 1.3.1, Schedule 5: adapted from FSANZ (2011) ................................................................................................ 11

Table 4 Typical compositions of some New Zealand commercial processed cheeses (adapted from Fonterra Product Bulletins) ........................................................................................................... 12

Table 5 A general guideline for selection of young, medium mature and mature natural cheeses in processed cheese manufacture {adapted from (Berger et al., 1993)} .......... 16

Table 6 Chemical, mechanical and thermal parameters commonly used in cheese processing {adapted from (Caric & Kaláb, 1993)} ............................................................................................................. 19

Table 7 Physicochemical properties of some emulsifying salts and their influence on processed cheese properties: adapted from (Kapoor & Metzger, 2008) .................. 26

Table 8 Relationships between intact and relative casein contents and quantity of emulsifying salts (polyphosphate with an average 60% P₂O₅: adapted from (Berger et al., 1993)) .................................................................................................................................................................................................... 27
Table 9 Rheological and fracture properties of cheese and their common sensory terms: partly adapted from (van Vliet, 1991; Zoon, 1991) and (Fox, Guinee, Cogan, & McSweeney, 2000)............................................................................................................................................. 33

Table 10 Rheological properties obtained from a large strain fracture deformation {adapted from O'Callaghan & Guinee (2004)} ..................................................................................................................... 35

Table 11 Influence of starter culture pair on the moisture and melt properties of low fat Mozzarella cheese {adapted from (Perry et al., 1997; 1998)} ..................................................................................................................... 55

Table 12 Influence of individual capsular-producing and EPS-producing starter cultures on the moisture content of low fat Mozzarella cheese { adapted from Low et al. (1998)} ...................................................................................................................................................................................... 56

Table 13 RVA profile in terms of time, temperature and speed; the time between readings was 4 sec............................................................................................................................................. 59

Table 14 The standard model cheese formulation used for the experimentation work.77

Table 15 Chemical analysis of the standard model processed cheese formulation calculated using software ...................................................................................................................................................................................... 78

Table 16 Formulation of model processed cheese at pH 5.7; polysaccharide was swapped with lactose and protein was swapped with moisture ..................................................................................................................... 79

Table 17 Average chemical composition of experimental model processed cheese samples analysed in duplicate...................................................................................................................................................................................... 80
Table 18 Formulation of model processed cheese at pH 5.7; the fat content was swapped with lactose content ...............................................................................................................................................81

Table 19 Summary of observations from a visual grading of some of the RVA processed cheeses ........................................................................................................................................................................86

Table 20 Textural and microstructural properties of the processed cheeses and interpretations of the various tests used to measure the textural properties..............................109

Table 21 Bacterial count, pH and time of coagulation for S. thermophilus production carried out in different media at 42°C (mean of three replicates ± standard deviation) ........................................................................................................................................................................................................176

Table 22 Bacterial count and amount of EPS produced during fermentation of RSM by S. thermophilus at various pHs at 37°C (mean of three replicates ± standard deviation).178

Table 23 Enumeration of S. thermophilus and quantity of EPS in media (supplemented with WPH) before and after freeze drying (mean of three replicates ± standard deviation). ..................................................................................................................................................................................183

Table 24 Storage trial: enumeration of S. thermophilus and quantity of EPS before and after freeze drying (mean of three replicates ± standard deviation) ..................................................187

Table 25 Processing sequence of Mozzarella cheese-making using 10 L vats ..................193

Table 26 Protocol for very low fat Mozzarella cheese-making .................................................. 194
Table 27 Effect of ST10 freeze-dried powder addition on the pH drop (mean of two replicates) at different stages of cheese-making ............................................................ 197

Table 28 Effect of control starters (non-EPS-producing ST1 and ST55) on the pH drop (mean of two replicates) at different stages of cheese-making ........................................... 198

Table 29 Effect of EPS-producing starter (ST10) on the pH drop (mean of two replicates) at different stages of cheese-making ................................................................. 198

Table 30 Latin square design for Mozzarella cheese-making experiments ..................... 199

Table 31 Composition of experimental cheeses ................................................................. 200

Table 32 P values of three repeats for fracture strain, fracture stress and modulus of deformability .................................................................................................................. 201