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Factors contributing to biofilm formation of *Yersinia enterocolitica*

A thesis presented in partial fulfilment of the requirements

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Abstract

Biofilms of pathogenic bacteria are recognised as a threat to food safety. The aim of the present study was to investigate the potential of *Yersinia enterocolitica* to form biofilms in the pork processing environment and identify the resistance of these biofilms to sanitation. The biofilm formation by *Y. enterocolitica* was monitored at conditions simulating pork processing environment under daily cleaning routine using an impedance method established in this study. Results showed that *Y. enterocolitica* had the potential to form biofilm and become resistant to sanitation in a pork processing environment. An investigation into the factors influencing biofilm formation of *Y. enterocolitica* indicated that the Ca^{2+} ion increased the level of biofilm formation. In addition, the presence of the virulence plasmid pYV is essential for the biofilm Ca^{2+} response. Further analysis of the bacterial cell surface properties and extracellular polymeric substance (EPS) composition suggested that the pYV⁺ cell surfaces are more negatively charged and more hydrophobic than the pYV⁻ cells although no significant difference was observed with the addition of Ca^{2+} . The pYV⁺ cells appear to produce more exopolysaccharide than the pYV⁻ cells regardless of Ca^{2+} concentration. Ca^{2+} was able to increase the yield of extracellular DNA while the presence of pYV appeared to be dispensable in terms of extracellular DNA release. Analysis of cell wall protein revealed one protein expressed in the pYV⁺ cells but absent in the pYV⁻ cells.

List of publications

Wang H, Tay M, Palmer J, Flint S (2016) Biofilm formation of *Yersinia enterocolitica* and its persistence following treatment with different sanitation agents. Food Control 73: 433-437.

Wang H, Palmer J, Flint S (2015) A rapid method for the nonselective enumeration of *Yersinia enterocolitica*, a foodborne pathogen associated with pork. Meat Science 113: 59–61.

List of conference presentations

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Table of contents

Abstract.....	i
List of publications	ii
List of conference presentations	ii
Acknowledgements.....	iii
Table of contents	iv
List of figures.....	ix
List of tables	xii
List of abbreviations.....	xiii
Chapter One. Introduction.....	1
Chapter Two. Literature review	3
2.1 <i>Yersinia</i>	3
2.2 Yersiniosis.....	3
2.2.1 Geological distribution.....	4
2.2.2 Food vehicles	5
2.3 <i>Y. enterocolitica</i>	5
2.3.1 Taxonomy.....	5
2.3.2 Taxonomic distribution of <i>Y. enterocolitica</i> infection	6
2.3.3 The prevalence of <i>Y. enterocolitica</i> in meat plants	6
2.3.4 The virulence plasmid	7
2.3.5 Reservoirs and transmission route	7
2.3.6 Factors influencing growth and survival in foods.....	8
2.3.7 Research gap.....	9
2.4 Foodborne pathogens and biofilms in food.....	10
2.4.1 The definition of biofilm	10
2.4.1 Biofilm in the food industry	11
2.5 Environmental conditions influencing biofilm formation	11
2.5.1 Ions.....	12
2.5.2 Temperature	14

Table of Contents

2.5.3 pH.....	14
2.5.5 Organic coating	14
2.6 Fundamental factors of the bacterial surface influencing attachment and biofilm formation.....	15
2.6.1 Factors involved in initial attachment- surface charge, hydrophobicity and cell surface protein	15
2.6.2 Factors involved in biofilm maturation- exopolysaccharides and extracellular DNA	16
2.7 Research objective	17
Chapter Three. Methods and materials.....	18
3.1 Source of isolates	18
3.1.1 Plasmid curing.....	18
3.1.2 PCR Confirmation.....	19
3.2 Culture preparation.....	19
3.3 Preparation of meat juice	19
3.4 Microtiter plate assay.....	20
3.5 Coupon assay.....	20
3.5.1 Attachment test	21
3.5.2 Biofilm development.....	21
3.6 Detection method	22
3.6.1 Impedance enumeration	22
3.6.2 Bead-beating recovery.....	22
3.7 Scanning electron microscopy	23
3.8 Cell surface properties analysis.....	23
3.8.1 Cell surface hydrophobicity	23
3.8.2 Cell surface charge	24
3.9 Extracellular polymeric substances analysis	24
3.9.1 Alkaline extraction of EPS	25
3.9.2 Quantification of exopolysaccharides in EPS.....	25
3.9.3 Quantification of nucleic acid in EPS	26
3.10 Membrane protein analysis	26

Table of Contents

3.10.1 Membrane protein extraction	26
3.10.2 SDS-PAGE	27
3.11 Transcriptional analysis	28
3.11.1 RNA isolation.....	28
3.11.2 RNA sequencing	28
Chapter Four. Establishment of an impedance method for rapid enumeration of <i>Y. enterocolitica</i> biofilm	31
4.1 Introduction.....	31
4.2 Procedures	31
4.2.1 Development of an impedance calibration	31
4.2.2 Validation of impedance method	32
4.2.3 Biofilm development.....	33
4.2.4 Comparison between the impedance method and the bead-beating recovery technique for the detection of biofilm cells of <i>Y. enterocolitica</i>	33
4.2.5 Statistical analysis	33
4.3 Results	34
4.4 Discussion.....	37
Chapter Five. <i>Y. enterocolitica</i> biofilm formation at simulated meat processing conditions and its persistence following treatment with different sanitation agents... 41	41
5.1 Introduction.....	41
5.2 Procedures	42
5.2.1 Microtitreplate biofilm assay.....	42
5.2.2 Biofilm growth on stainless steel under a simulated meat processing regime	43
5.2.3 Statistical analysis	45
5.3 Results	45
5.3.1 Pathogenic biotype 4 form stronger biofilms in MJ than in TSB after 24 hrs at 24 °C	45
5.3.2 Biofilms Grown under a simulated meat processing regime	46
5.4 Discussion.....	50
Chapter Six. The influence of ions, temperature and plasmid pYV on <i>Y. enterocolitica</i> biofilm formation.....	53

Table of Contents

6.1 Introduction.....	53
6.2 Procedure	54
6.2.1 Biofilm formation of <i>Y. enterocolitica</i> at 24 °C in peptone water supplemented with ions	54
6.2.2 Preparation of a pYV ⁻ population of <i>Y. enterocolitica</i> strain ERL032123	54
6.2.3 Biofilm formation of pYV ⁺ and pYV ⁻ <i>Y. enterocolitica</i> strain ERL032123 at room temperature and 37 °C in peptone water supplemented with Ca ²⁺	56
6.2.4 Statistical analysis	57
6.3 Results	57
6.4 Discussion	60
Chapter Seven. Investigation of Ca ²⁺ induced, plasmid mediated biofilm formation by <i>Y. enterocolitica</i> at 37 °C.....	63
7.1 Introduction.....	63
7.2 Procedures	64
7.2.1 Surface charge	64
7.2.2 Hydrophobicity.....	64
7.2.3 Cell wall protein profile analysis	65
7.2.4 EPS analysis	65
7.2.5 Gene expression analysis by RNA sequencing.....	66
7.2.6 Statistical analysis	66
7.3 Results	67
7.3.1 Surface charge	67
7.3.2 Hydrophobicity.....	68
7.3.3 Profile of cell wall proteins	68
7.3.4 Exopolysaccharide content in EPS	69
7.3.5 Nucleic acid content in EPS.....	70
7.3.6 Gene expression.....	71
7.4 Discussion	76
Chapter Eight. Final discussion and conclusions	82
References	88
Appendix 1. M-values of 16 <i>Y. enterocolitica</i> strains in TSB at 30 °C over 18 hrs	108

Table of Contents

Appendix 2. Raw data for linear regression of the scatter plot for strain ERL032123 .	110
Appendix 3. Raw data for linear regression of the scatter plot for strain ERL104253 .	111
Appendix 4. Raw data for linear regression of the scatter plot for strain ERL10460 ...	112
Appendix 5. Raw data for biofilm formation by different biotypes of <i>Y. enterocolitica</i> in TSB and MJ at 24 °C.	113
Appendix 6. Raw data for biofilm of biotype 4, strain ERL032123 formed in TSB and MJ under control treatment using 0.85% NaCl solution at 24 °C.	114
Appendix 7. Raw data for biofilm of strain ERL032123 treated with 50 ppm Sodium hypochlorite in TSB at 24 °C.....	115
Appendix 8. Raw data for biofilm of strain ERL032123 treated with 200 ppm QAC in TSB at 24 °C.....	116
Appendix 9. Ion content in MJ	117
Appendix 10. Raw data for biofilm formation and planktonic growth of <i>Y. enterocolitica</i> strain ERL032123 (pYV+) at 24 °C in the presence of different ions.	118
Appendix 11. Raw data for biofilm formation of <i>Y. enterocolitica</i> strain ERL032123 (pYV ⁺) at 24 °C.and 37 °C with the presence of Ca ²⁺	120
Appendix 12. Raw data for biofilm formation of <i>Y. enterocolitica</i> strain ERL032123 (pYV ⁻) at 24 °C and 37 °C at different concentrations of Ca ²⁺	121
Appendix 13. Raw data for surface Zeta potential of pYV ⁺ and pYV ⁻ cells at pH 7 after incubation in the presence and absence of Ca ²⁺ at 37 °C.	122
Appendix 14. Raw data for hydrophobicity of pYV ⁺ and pYV ⁻ cells after incubation in the presence and absence of Ca ²⁺ at 37 °C.....	123
Appendix 15. Raw data for exopolysaccharide measurement in the EPS of pYV ⁺ and pYV ⁻ cell cultures after incubation in the presence and absence of Ca ²⁺ at 37 °C.	124
Appendix 16. Raw data for nucleic acid measurement in the EPS of pYV ⁺ and pYV ⁻ cell cultures after incubation in the presence and absence of Ca ²⁺ at 37 °C.....	125
Appendix 17. The immediate attachment to coupon surfaces (1 hr) of pYV ⁺ and pYV ⁻ cells after incubation in the presence and absence of Ca ²⁺ at 37 °C.....	126
Appendix 18. The motility of all 16 strains.	127
Appendix 19. A rapid method for the nonselective enumeration of <i>Yersinia enterocolitica</i> , a foodborne pathogen associated with pork.	131
Appendix 20. Biofilm formation of <i>Yersinia enterocolitica</i> and its persistence following treatment with different sanitation agents.....	135

List of figures

Figure 2.1. Yersiniosis notifications by year, 1997–2015 (ESR, 2016).

Figure 2.2. The cartoon diagram of the five stages of biofilm development: 1 initial attachment, 2 irreversible attachment, 3 early vertical development, 4 maturation, 5 finally dispersal (<https://aqua-tech.ca/2016/01/biofilm-in-spas/>).

Figure 4.1. Growth curves of 16 strains of *Y. enterocolitica* in TSB at 30 °C using impedance. The straight line at the bottom is un-inoculated TSB; The “S” shape lines include ERL032122, ERL032123, ERL032124, ERL032125, ERL072344, ERL114165, ERL072345, ERL072346, ERL072347, ERL073947, ERL082059, ERL093846, ERL10460, ERL104253, ERL032126, ERL112277.

Figure 4.2. Linear Regression of the scatter plot for strain ERL032123: $y = -0.4506x + 9.6181$ $r^2 = 0.997$.

Figure 4.3. Linear Regression of the scatter plot for strain ERL104253: $y = -0.5321x + 9.3275$ $r^2 = 0.9918$.

Figure 4.4. Linear Regression of the scatter plot for strain ERL10460: $y = -0.4822x + 9.7797$ $r^2 = 0.9759$.

Figure 5.1. Biofilm formation by different biotypes of *Y. enterocolitica* in TSB and MJ at 24 °C after 24 hrs. Error bars represent mean \pm standard deviation.

Figure 5.2. Persistence of biofilm of biotype 4, strain ERL032123 formed in TSB and MJ under control treatment using 0.85% NaCl solution at 24 °C. Error bars represent mean \pm standard deviation.

Figure 5.3. Biofilm of *Y. enterocolitica* strain ERL032123 treated with 50 ppm Sodium hypochlorite in TSB at 24 °C. Error bars represent mean \pm standard deviation.

Figure 5.4. Biofilm of *Y. enterocolitica* strain ERL032123 treated with 50 ppm Sodium hypochlorite in MJ at 24 °C. Error bars represent mean \pm standard deviation.

Figure 5.5. Biofilm of *Y. enterocolitica* strain ERL032123 treated with 200 ppm QAC in TSB at 24 °C. Error bars represent mean \pm standard deviation.

Figure 5.6. Biofilm of *Y. enterocolitica* strain ERL032123 treated with 200 ppm QAC in MJ at 24 °C. Error bars represent mean \pm standard deviation.

Figure 6.1. The different colony shape before (Picture A) and after (Picture B) the loss of pYV.

Figure 6.2. Digital photo of the gel. A- Lane2: PCR product of VirF gene from strain 032122, Lane3: PCR product of VirF gene from strain 032123, Lane5: PCR product of VirF gene from strain 032124; B- Lane2: PCR product of VirF gene from the pYV⁻ mutant of strain 032122, Lane3: PCR product of VirF gene from the pYV⁻ mutant of strain 032123, Lane5: PCR product of VirF gene from the pYV⁻ mutant of strain 032124.

Figure 6.3. Biofilm formation (A) and planktonic growth (B) by *Y. enterocolitica* strain ERL032123 (pYV⁺) at 24 °C in the presence of different ions and concentrations. Error bars represent mean \pm standard deviation.

Figure 6.4. Biofilm formation index of *Y. enterocolitica* strain ERL032123 (pYV⁺) at 24 °C and 37 °C with the presence of Ca²⁺. Error bars represent mean \pm standard deviation.

Figure 6.5. Biofilm formation index of *Y. enterocolitica* strain ERL032123 (pYV⁻) at 24 °C and 37 °C at different concentrations of Ca²⁺. Error bars represent mean \pm standard deviation.

Figure 6.6. SEM microscopy of pYV⁺ and pYV⁻ cells attached to coupons after incubation in the presence and absence of Ca²⁺ at 37 °C, (A)-pYV⁺ without Ca²⁺ (B)-pYV⁺ with Ca²⁺ (C)-pYV⁻ without Ca²⁺ (D)- pYV⁻ with Ca²⁺.

Figure 7.1. Zeta potential of pYV⁺ and pYV⁻ cells at pH 7 after incubation in the presence and absence of Ca²⁺ at 37 °C. Error bars represent mean \pm standard deviation.

Figure 7.2. Hydrophobicity of pYV⁺ and pYV⁻ cells after incubation in the presence and absence of Ca²⁺ at 37 °C. Error bars represent mean ± standard deviation.

Figure 7.3. Cell wall protein profiles of pYV⁺ and pYV⁻ cells after incubation in the presence and absence of Ca²⁺ at 37 °C by SDS-PAGE

Figure 7.4. Exopolysaccharide content in the EPS of pYV⁺ and pYV⁻ cell cultures after incubation in the presence and absence of Ca²⁺ at 37 °C. Error bars represent mean ± standard deviation.

Figure 7.5. Nucleic acid content in the EPS of pYV⁺ and pYV⁻ cell cultures after incubation in the presence and absence of Ca²⁺ at 37 °C. Error bars represent mean ± standard deviation.

List of tables

Table 3.1. *Y. enterocolitica* Isolates from food used in this study (Provided by ESR, Porirua, New Zealand).

Table 3.2. Citric acid-Sodium phosphate buffer – pH range 2–8.

Table 3.3. Recipes of working buffer for membrane protein extraction.

Table 4.1. Comparison of *Y. enterocolitica* strains ERL032123, ERL104253 and ERL10460 measured by impedance and plate counting.

Table 4.2. Comparison between impedance and bead-beating recovery for the enumeration of biofilm cells of *Y. enterocolitica* strains ERL104253 and ERL10460.

Table 5.1. The treatment procedures and sampling points during the cleaning regime.

Table 7.1. Differential expressions of the genes on pYV after addition of Ca^{2+} ; green shows the up-regulated genes, red shows the down-regulated genes.

List of abbreviations

eDNA: extracellular DNA

EPS: extracellular polymeric substances

ERL: enteric reference laboratory

ESR: environmental science and research

HIC: hydrophobic interactive chromatography

MJ: meat Juice

PCR: polymerase chain reaction

pYV: plasmid of *Yersinia* virulence

pYV⁺: pYV positive

pYV⁻: pYV negative

QAC: quaternary ammonium compounds

SDS-PAGE: sodium dodecyl sulfate polyacrylamide gel electrophoresis

SEM: scanning electron microscopy

TSA: trypticase soy agar

TSB: tryptic soy broth

Yops: *Yersinia* outer membrane proteins

Ysc: Yop secretion