



UNIVERSITI PUTRA MALAYSIA

***ASSESSMENT OF FOUR COMMERCIAL DISINFECTANTS ON
Listeria monocytogenes BIOFILM***

NINA FOULADYNEZHAD

FSTM 2014 38



**ASSESSMENT OF FOUR COMMERCIAL DISINFECTANTS ON
Listeria monocytogenes BIOFILM**

By

NINA FOULADYNEZHAD

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

February 2014

All material contained within the thesis, including without limitation text, logos icons, photographs and all other artwork, is copyright material of Universiti Putra Malaysia unless otherwise stated. Use may be made of any material contained within the thesis for non-commercial purposes from the copyright holder. Commercial use of material may only be made with the express, prior, written permission of Universiti Putra Malaysia.

Copyright © Universiti Putra Malaysia



Dedicated to my beloved parents for their endless love and supports



© COPYRIGHT UPM

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

ASSESSMENT OF FOUR COMMERCIAL DISINFECTANTS ON *Listeria monocytogenes* BIOFILM

By

NINA FOULADYNEZHAD

February 2014

Chairman: Professor Son Radu, PhD
Faculty: Food Science and Technology

Listeria monocytogenes is a Gram-positive and rod-shaped foodborne pathogen. Listeriosis which is caused by *L. monocytogenes* is a life-threatening disease in immunocompromised individuals, pregnant women, fetuses, newborns, and the elderly. The aim of this study was to investigate biofilm forming ability of *L. monocytogenes* isolates. Microtitre assay was used to measure the amount of biofilm production by ten *L. monocytogenes* isolates from minced chicken / beef, beef sausages and chicken burgers patties. In this study the efficiency of four selected commercial disinfectants (D1, D2, D3 and D4) on the inhibiting of *L. monocytogenes* biofilm was assessed by determining the sessile minimum inhibitory concentration (SMIC). The removing curve efficiency of each disinfectant at five different concentration levels (100, 50, 25, 12.5, and 6.25%) was also defined. Results showed that all ten *L. monocytogenes* isolates were able to form biofilm over 24 h at 20°C on polystyrene surface (the common surface in food industries) *in vitro*. Some strains are better biofilm formers compared to others. All strains showed a slight growth in the quantities of attached cells over 48 and 72 h. No reduction was observed in the amount of biofilm after 72 h. All disinfectants (D1, D2, D3, and D4) in five tested concentrations (100, 50, 25, 12.5, and 6.25%) were able to inhibit the *L. monocytogenes* biofilm. The efficiency of disinfectants in term of inhibiting biofilm formation from the higher to lower was D1, D2, D4, and D3, respectively. Disinfectant (D4) at low concentrations (25, 12.5, and 6.25%) was more effective in inhibiting *L. monocytogenes* biofilm compared to concentration (50%). It might be as a result of enhancing the penetrating ability of disinfectant into bacterial cell wall at low concentration levels. Results showed that all four commercial disinfectants were able to effectively inhibit formation of *L. monocytogenes* biofilm. However, they are not effective in removing biofilm from the surface especially in low concentration levels. Disinfectant D1 showed the highest efficiency on inhibiting *L. monocytogenes* biofilm formation (up to 95%) at all concentration levels (100, 50, 25, 12.5, and 6.25%). Sessile minimum inhibitory concentration (SMIC) for D1 was found to 6.25%. Sodium dodecylbenzenesulfonate, and trichlorocyanuric acid were effective compounds of D1. The efficiency of D1 declined after the formation of biofilm to considerable level. Implementation of disinfectants at poultry and meat processing factories can reduce the risk of *L. monocytogenes* biofilm formation and subsequently decrease human health hazards. To sum up, *L. monocytogenes* have ability to form biofilm in 24 h and the formation

of biofilm raising the resistant of *L. monocytogenes* hence reduce the efficiency of disinfectants in to considerable level in cleaning procedure.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENILAIAN KESAN EMPAT DISINFECTAN KOMERSIAL TERHADAP
PEMBENUKAN *Listeria monocytogenes* BIOFILEM**

Oleh

NINA FOULADYNEZHAD

Februari 2014

Chairman: Professor Son Radu, PhD
Faculty: Sains dan Teknologi Makanan

Listeria monocytogenes merupakan patogen makanan gram-positif berbentuk rod. Listeriosis yang disebabkan oleh *L. monocytogenes* adalah berbahaya terhadap kesihatan manusia terutamanya individu-individu yang berimunokompromi seperti wanita-wanita mengandung, janin, bayi yang baru lahir dan orang-orang tua. Tujuan kajian ini adalah untuk mengkaji keupayaan pencilan-pencilan *L. monocytogenes* dalam pembentukan biofilem. Ujian Mikrotiter digunakan untuk mengukur jumlah biofilem yang dibentuk oleh sepuluh pencilan *L. monocytogenes* daripada ayam atau daging cincang, sosej daging dan burger ayam. Keputusan menunjukkan semua pencilan *L. monocytogenes* mempunyai keupayaan untuk membentuk biofilm selepas 24 jam pada 20°C atas permukaan polisterena secara *in vitro*. Selepas jam ke-48 dan ke-72, peningkatan bilangan sel dalam biofilem yang dibentuk oleh semua pencilan pada permukaan polisterena adalah rendah. Beberapa pencilan daripada sepuluh pencilan yang diujikaji adalah lebih berupaya untuk membentuk biofilm. Selain itu, kecekapan empat disinfektan komersil terpilih (D1, D2, D3 dan D4) pada lima kepekatan yang berbeza (100%, 50%, 25%, 12.5% dan 6.25%) dalam perencatan biofilm *L. monocytogenes* telah diujikaji dengan menentukan sessile kepekatan perencatan minimal (SMIC) dan kecekapan lengkung buang setiap disinfektan. Kesemua disinfektan dalam lima kepekatan yang diuji berupaya menghalang pembentukan biofilem *L. monocytogenes* selepas 24 jam. Disinfektan paling berkesan dalam menghalang pembentukan biofilm adalah D1 diikuti D2, D4 dan D3. Disinfektan D1 pada semua kepekatan iaitu 100, 50, 25, 12.5 dan 6.25% menunjukkan efisiensi yang tertinggi, mencapai 95%, dalam menghalang pembentukan biofilm *L. monocytogenes*. Sessile kepekatan perencatan minimum (SMIC) D1 adalah 6.25%. Natrium dodecylbenzenesulfonat dan asid trichlorocyanurik adalah bahan aktif dalam disinfektan D1. Disinfektan D3 pada kepekatan rendah (25, 12.5 dan 6.25%) adalah lebih efektif dalam menghalang biofilem *L. monocytogenes* daripada yang kepekatan tinggi iaitu 50%. Hal ini mungkin disebabkan oleh tekanan yang dihasilkan oleh disinfektan ataupun penembusan yang baik pada dinding sel bakteria pada kepekatan disinfektan yang rendah. Pelaksanaan disinfektan di ladang ternakan dan kilang-kilang pemprosesan daging boleh mengurangkan risiko pembentukan biofilem *L. monocytogenes* dan seterusnya mengurangkan tahap bahaya terhadap kesihatan manusia. Kesimpulannya, penghalangan pembentukan biofilm *L. monocytogenes*

denagn menggunakan disinfektan adalah lebih efektif daripada menghapuskan biofilem yang terbentuk pada jam ke-24.



ACKNOWLEDGEMENTS

I would like to express the deepest appreciation to my committee chair, Professor Dr. Son Radu, who has the attitude and substance of a genius: he continually and convincingly conveyed a spirit of adventure in regard to research, providing me all the necessary facilities, and an excitement in regard to teaching. Without his guidance and persistent help this dissertation would not have been possible.

I would like to thank to my committee member Associate Professor Dr. Yaya Rukayadi, and Associate Professor Dr. Abdul Karim Sabo Mohamed. I am extremely grateful and indebted to both of them for their expert, sincere and valuable guidance and encouragement extended to me.

I owe million thanks to Dr Leili Afsah-Hejri who helped and supported me in writing this thesis. A part from the effort of myself, finishing this project without her support and guidance would have been a distance reality. I would also thank my dearest laboratory mates without whom the laboratory is just too boring and unpleasant. Not forgetting to acknowledge all staffs of Faculty of Food Science and Technology who helped me during passing 2 years.

Last but not least, my deepest sense of gratitude to my family especially my beloved parents for their unconditionally love and support which always give me courage to walk on the journey of life with confident. I learned from them, to never give up until achieving the goal.

Replace

I certify that a Thesis Examination Committee has met on 10th February 2014 to conduct the final examination of Nina Fouladynezhad on her thesis entitled “Assessment of four commercial disinfectants on *Listeria monocytogenes* biofilm” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the degree of Master of Science.

Member of the Thesis Examination Committee were as follows:

Farinazleen Mohamad Ghazali, PhD

Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Cheah Yoke Kqueen, PhD

Associate Professor
Faculty of Medical and Health Sciences
Universiti Putra Malaysia
(Internal Examiner)

Zunita Zakaria, PhD

Associate Professor
Faculty of Veterinary Medicine
Universiti Putra Malaysia
(Internal Examiner)

NAME

Professor / Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date

This Thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Son Radu, PhD

Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Abdul Karim Sabo Mohamed, PhD

Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

Yaya Rukayadi, PhD

Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

BUJANG BIN KIM HUAT, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work
- quotations, illustrations and citations have been duly referenced
- the thesis has not been submitted previously or concurrently for any other degree at any institutions
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be owned from supervisor and deputy vice –chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No.: Nina Fouladynezhad GS27878

Declaration by Members of Supervisory committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: 

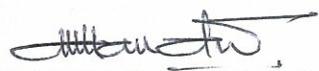
Name of

Chairman of

Supervisory

Committee:

Professor Dr San Radu

Signature: 

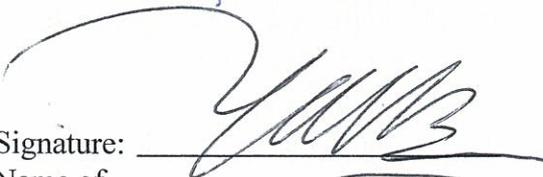
Name of

Member of

Supervisory

Committee:

AP Dr. Abdulkarim S. Mohammed

Signature: 

Name of

Member of

Supervisory

Committee:

ASSOC. Prof. B. YAYA RUKAYADI

TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	iii
ACKNOWLEDGEMENTS	v
APPROVAL	vi
DECLARATION	viii
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
LIST OF ABBREVIATIONS	xv
 CHAPTER	
1 INTRODUCTION	1
1.1 General introduction	1
1.2 Objectives	2
2 LITERATURE REVIEW	3
2.1 <i>Listeria monocytogenes</i>	3
2.1.1 Classification of the genus <i>Listeria</i>	4
2.1.2 Presence and growth of <i>L. monocytogenes</i> in food processing environments	4
2.1.3 Food-borne Listeriosis	5
2.1.4 Listeriosis outbreaks	5
2.2 Biofilm	6
2.2.1 Formation of biofilm	6
2.2.2 Quantification of the biofilm	7
2.2.3 <i>Listeria monocytogenes</i> biofilm	8
2.2.4 Biofilm properties	9
2.2.5 Influence of biofilms in infection diseases and industry problems	10
2.3 Control of <i>Listeria monocytogenes</i> in food industries	11
2.3.1 The efficiency of chemical components in controlling <i>L. monocytogenes</i> in food industries	12
2.3.2 Importance of disinfectant and sanitizing treatment in food industry	13
2.4 Effective component of disinfectants used in food industries	15
2.4.1 Calcium carbonate	16
2.4.2 Sodium hypochlorite	16
2.4.3 Acidified sodium chlorite	17
2.4.4 Iodine	17

2.4.5	Benzalkonium chloride	18
2.4.6	Chlorine dioxide	19
2.4.7	Quaternary ammonium compounds	19
3	ASSESSING BIOFILM FORMATION BY <i>LISTERIA MONOCYTOGENES</i>	21
3.1	Introduction	21
3.2	Materials and Methods	22
3.2.1	Media and chemicals	22
3.2.2	Bacterial strain and culture conditions	22
3.2.3	Preparation of <i>L. monocytogenes</i> cultures to study formation of biofilm	23
3.2.4	Microtitre plate assay	24
3.2.5	Statistical Analysis	25
3.3	Results and Discussion	25
3.4	Conclusion	28
4	SESSILE MINIMUM INHIBITORY CONCENTRATION OF FOUR COMMERCIAL DISINFECTANTS	30
4.1	Introduction	30
4.2	Material and methods	32
4.2.1	Media and chemicals	32
4.2.2	Bacterial strain and culture conditions	32
4.2.3	Preparation of microtitre plate to test <i>L. monocytogenes</i> biofilm formation	32
4.2.4	Determination of sessile minimum inhibitory concentration (SMIC) of disinfectants on <i>L. monocytogenes</i> in biofilm	34
4.2.5	Statistical analysis	35
4.3	Results and discussion	38
4.4	Conclusion	45
5	REMOVING CURVE EFFICIENCY OF FOUR MALAYSIAN COMMERCIAL DISINFECTANTS ON <i>LISTERIA MONOCYTOGENES</i> BIOFILM	46
5.1	Introduction	46
5.2	Materials and methods	47
5.2.1	Media and chemicals	47
5.2.2	Bacterial strain and culture conditions	48

5.2.3	Preparation of microtitre plate for <i>L. monocytogenes</i> biofilm formation	48
5.2.4	Determination removing curve efficiency of disinfectants on <i>L. monocytogenes</i> in biofilm	48
5.2.5	Statistical Analysis	49
5.3	Results and discussion	53
5.4	Conclusion	58
6	GENERAL DISCUSSION AND CONCLUSION	59
	REFERENCES	62
	BIODATA OF STUDENT	74
	LIST OF PUBLICATIONS	75

LIST OF TABLES

Table		Page
3.1	The information about the source and the brand of each ten strain.	23
3.2	The significant of independent variable (time 24, 48 and 72h) effect is shown by p-value and F crit.	27
4.1	pH and Ingredient of each disinfectant.	32
4.2	The significance of each independent variable (type of strain and disinfectant) and their interaction are shown by F-ratio and p-value.	35
4.3	Effect of concentration level and type of strain on inhibiting efficiency	35
4.4	The effect of different concentration level of on inhibiting efficiency of each disinfectant	36
4.5	Effect of concentration level of disinfectants on inhibiting of biofilm formation	37
5.1	pH and Ingredient of each disinfectant.	48
5.2	Effect of independent variable (type of strain and disinfectant) and their interaction on removing efficiency.	50
5.3	Effect of concentration level and type of strain on removing curve efficiency	50
5.4	Effect of different concentration level of on removing efficiency of each disinfectant	51
5.5	Effect of concentration level of disinfectants on removing efficiency of strains	52

LIST OF FIGURES

Figure		Page
3.1	Mean value of biofilm formation by <i>L. monocytogenes</i> in polystyrene microtitre wells (OD ₅₉₅ at 24, 48 and 72 h)	26
4.1	Inhibitory effect of D1 on biofilm formation by <i>L. monocytogenes</i> isolates	39
4.2	Inhibitory effect of D2 on biofilm formation by <i>L. monocytogenes</i> isolates	40
4.3	Inhibitory effect of D3 on biofilm formation by <i>L. monocytogenes</i> isolates	42
4.4	Inhibitory effect of D4 on biofilm formation by <i>L. monocytogenes</i> isolates	43
5.1	Efficiency of D1 on removing <i>L. monocytogenes</i> biofilm from the polystyrene surface	54
5.2	Efficiency of D2 on removing <i>L. monocytogenes</i> biofilm from the polystyrene surface	55
5.3	Efficiency of D3 on removing <i>L. monocytogenes</i> biofilm from the polystyrene surface	56
5.4	Efficiency of D4 on removing <i>L. monocytogenes</i> biofilm from the polystyrene surface	57

LIST OF ABBREVIATIONS

ATCC	American Type Culture Collection
BHI	Brain Heart Infusion
bp	Base pair
CDC	Centres for Disease Control and Prevention
CFU	Colony Forming Unit
DNA	Deoxyribonucleic Acid
EDTA	Ethylenediaminetetra-acetic acid
ISO	International Standards Organization
MAR	Multiple Antibiotic Resistance
MH	Mueller Hinton
NCCLS	National Committee for Clinical Laboratory Standards
OD	Optical Density
PCR	Polymerase Chain Reaction
RTE	Ready-to-eat
SMIC	Sessile Minimal Inhibitory Concentration
TSA	Trypticase Soy Agar
TSB	Tryptic Soy Broth
U	Unit
USDA	United States Department of Agriculture
UV	Ultraviolet
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 General introduction

Listeria monocytogenes is a Gram-positive, facultative anaerobic, non-spore-forming, rod-shaped bacterium. *L. monocytogenes* is widely distributed in environments and usually can be found in water, soil, animal fecal matter and sewage (Vaid et al., 2010). Among the eight species of *Listeria* namely *L. monocytogenes*, *L. seeligeri*, *L. innocua*, *L. welshimeri*, *L. grayi*, *L. marthii*, *L. rocourtiae*, and *L. ivanovii*), two are pathogenic: *L. monocytogenes* (pathogenic for human and animals) and *L. ivanovii* (pathogenic for animals).

Listeria monocytogenes, is considered a serious food-borne pathogen in immunocompromised individuals such as cancer and HIV patients, elderly and pregnant women. Ingestion of *L. monocytogenes* can cause listeriosis in human and animals (Chen et al., 2010; Pagadala et al., 2012). Listeriosis can lead to gastroenteritis, septicemia, perinatal infections, stillbirth, abortion, meningitis and meningoencephalitis in immunocompromised individuals (Barbuddhe et al., 2012). Listeriosis affects a wide variety of mammals including monogastric, ruminants (mostly sheep) and human with mortality rate of 20-30% (Chaturongkasumrit et al., 2011).

Listeria monocytogenes attachment to inert surfaces of food processing equipment leads to biofilm formation. Biofilm production is a way to help microorganism to survive and grow for an extended period of time (Swaminathan and Gerner-Smidt, 2007). The biofilm that is produced on the surface of food processing lines and instruments can be transferred to food products, causing hazards to public health and contaminate environment (Chaturongkasumrit et al., 2011). Therefore in the food processing industry, the most significant usage of sanitizers and disinfectant is to prevent the aggregation of microbial cells and consequently biofilm formation. However, just some of the sanitizers would be effective against bacterial biofilms (Cruz and Fletcher, 2012).

Commonly the efficiency of disinfectant in food industry is evaluated by the effect on planktonic form, while the bacteria in biofilm form are 1000 times much more resistance than planktonic form and are able to stay longer in food processing surfaces. Biofilms consist of complex communities of microorganisms attach to wet surfaces and held together by use of extracellular polymeric substances. The ability of *L. monocytogenes* to attach to various kinds of surfaces and form biofilms made it a big concern in food processing environment. The sessile minimum inhibitory concentration (SMIC) is used to define the efficiency of a disinfectant against bacteria biofilms.

This study was conducted first of all to determine the ability of *L. monocytogenes* to form biofilm and secondly to measure the efficiency of different concentration of disinfectants in inhibition of biofilm formation and removing curve efficiency.

1.2 Objectives

The objectives of this study were as follows:

- i. To assess the amount of biofilm formation by ten different strains of *L. monocytogenes* isolated from minced chicken and minced beef, sausages (chicken) and burgers (beef).
- ii. To determine the sessile minimum inhibitory concentration (SMIC) of four commercial disinfectants on *L. monocytogenes* biofilm formation.
- iii. To evaluate the efficiency of four commercial disinfectants on removing *L. monocytogenes* biofilm (Formed in 24 h) from the polystyrene surface.



REFERENCES

- Aarnisalo, K., Lundén, J., Korkeala, H. & Wirtanen, G. (2007). Susceptibility of *Listeria monocytogenes* strains to disinfectants and chlorinated alkaline cleaners at cold temperatures. *Food Science and Technology*, 40(6): 1041–1048.
- Abdallah, M., Chataigne, G., Ferreira-Theret, P., Benoliel, C., Drider, D., Dhulster, P. & Chihib, N. E. (2014). Effect of growth temperature, surface type and incubation time on the resistance of *Staphylococcus aureus* biofilms to disinfectants. *Applied Microbiology and Biotechnology*, 1-11.
- Abee, T., Kovács, Á. T., Kuipers, O. P. & Van der Veen, S. (2011). Biofilm formation and dispersal in Gram-positive bacteria. *Current Opinion in Biotechnology*, 22(2): 172–179.
- Abreu, A. C., Borges, A., Mergulhão, F. & Simões, M. (2014). Use of phenyl isothiocyanate for biofilm prevention and control. *International Biodeterioration and Biodegradation*, 86: 34-41.
- Akita, S., Akino, K., Yakabe, A., Tanaka, K., Anraku, K., Yano, H. & Hirano, A. (2010). Basic fibroblast growth factor is beneficial for postoperative color uniformity in split thickness skin grafting. *Wound Repair and Regeneration*, 18(6): 560–566.
- An, S., Ding, Y. H. & Zhang, L. H. (2010). The impact and molecular genetics of bacterial biofilms. *Environmental Molecular Microbiology*, 211.
- Andersen, S. & Laurberg, P. (2009). The Nature of Iodine in Drinking Water. In *Comprehensive handbook of iodine—nutritional, biochemical, pathological and therapeutic aspects*, ed. by V.R. Preedy, G.N. Burrow, & R.R. Watson, pp. 125-134. San Diego, London: Academic Press Burlington.
- Araújo, P., Lemos, M., Mergulhão, F., Melo, L. & Simões, M. (2011). Antimicrobial resistance to disinfectants in biofilms. *Science Against Microbial Pathogens: Communicating Current Research and Technological Advances*, 826-834.
- Badireddy, A. R., Marinakos, S. M., Chellam, S. & Wiesner, M. R. (2013). Lipophilic nano-bismuth inhibits bacterial growth, attachment, and biofilm formation. *Surface Innovations*, 1(3): 181-189.
- Barbuddhe, S. B., Malik, S. V. S., Kumar, J. A., Kalorey, D. R. & Chakraborty, T. (2012). Epidemiology and risk management of listeriosis in India. *International Journal of Food Microbiology*, 154(3): 113–118.
- Belessi, C.-E. A., Gounadaki, A. S., Psomas, A. N. & Skandamis, P. N. (2011). Efficiency of different sanitation methods on *Listeria monocytogenes* biofilms formed under various environmental conditions. *International Journal of Food Microbiology*, 145: 46–52.

- Bergamini, C. M., Gambetti, S., Dondi, A., & Cervellati, C. (2004). Oxygen, reactive oxygen species and tissue damage. *Current pharmaceutical design*, 10(14): 1611–1626.
- Blackwell, H., Frei, R., Breitbach, A., Lynn, D. M., & Broderick, A. H. (2012). Inhibition and dispersion of bacterial biofilms with 2-aminobenzimidazole derivatives. *U.S. Patent Application*, 13: 669-683.
- Boyle, M. A., O'Donnell, M. J., Miller, A., Russell, R. J. & Coleman, D. C. (2012). Control of bacterial contamination of washbasin taps and output water using Ecasol: a one-year study. *Journal of Hospital Infection*, 80(4): 288–292.
- Bridier, A., Briandet, R., Thomas, V. & Dubois-Brissonnet, F. (2011). Resistance of bacterial biofilms to disinfectants: a review. *Biofouling*, 27(9): 1017-1032.
- Brinez, W. J., Roig-Sagues, A. X., Herrero, M. & Lopez, B. G. (2006). Inactivation of *Listeria innocua* in milk and orange juice by ultrahigh-pressure homogenization. *Journal of Food Protection*, 69(1): 86–92.
- Bruellhoff, K., Fiedler, J., Möller, M., Groll, J. & Brenner, R. E. (2010). Surface coating strategies to prevent biofilm formation on implant surfaces. *International Journal of Artificial Organs*, 33(9): 646-653.
- Brugère-Picoux, J. (2008). Ovine listeriosis. *Small Ruminant Research*, 76(1): 12–20.
- Bruno-Bárcena, J. M., Azcárate-Peril, M. A. & Hassan, H. M. (2010). Role of antioxidant enzymes in bacterial resistance to organic acids. *Applied and Environmental Microbiology*, 76(9): 2747-2753.
- Bucci, V., Nadell Carey D. & Xavier, J. B. (2011). The evolution of bacteriocin production in bacterial biofilms. *The American Naturalist*, 178(6): 162–173.
- Buffet-Bataillon, S., Tattevin, P., Bonnaure-Mallet, M. & Jolivet-Gougeon, A. (2012). Emergence of resistance to antibacterial agents: the role of quaternary ammonium compounds. Critical Review in *International Journal of Antimicrobial Agents*, 39(5): 381–389.
- Caballero Gómez, N., Abriouel, H., Grande, M. J., Pérez Pulido, R. & Gálvez, A. (2012). Effect of enterocin AS-48 in combination with biocides on planktonic and sessile *Listeria monocytogenes*. *Food Microbiology*, 30(1): 51–58.
- Carmona-Ribeiro, A. M., Barbassa, L. & De Melo, L. D. (2011). Antimicrobial biomimetics. *Biomimetic Based Applications*, 13(4): 227–284.
- Carpentier, B. & Cerf, O. (1993). Biofilms and their consequences, with particular reference to hygiene in the food industry. *The Journal of Applied Bacteriology*, 75(6): 499–511.
- Cerf, O., Carpentier, B. & Sanders, P. (2010). Tests for determining in-use concentrations of antibiotics and disinfectants are based on entirely different

concepts: “Resistance” has different meanings. *International Journal of Food Microbiology*, 136(3): 247–254.

Chae, M. S., Schraft, H., Truelstrup Hansen, L. & Mackereth, R. (2006). Effects of physicochemical surface characteristics of *Listeria monocytogenes* strains on attachment to glass. *Food Microbiology*, 23(3): 250-259.

Chang, Y., Gu, W. & McLandsborough, L. (2012). Low concentration of ethylenediaminetetraacetic acid (EDTA) affects biofilm formation of *Listeria monocytogenes* by inhibiting its initial adherence. *Food Microbiology*, 29(1): 10–17.

Chaturongkasumrit, Y., Takahashi, H., Keeratipibul, S., Kuda, T. & Kimura, B. (2011). The effect of polyesterurethane belt surface roughness on *Listeria monocytogenes* biofilm formation and its cleaning efficiency. *Food Control*, 22(12): 1893–1899.

Chen, B.Y., Pyla, R., Kim, T.J., Silva, J. L. & Jung, Y.S. (2010). Prevalence and contamination patterns of *Listeria monocytogenes* in catfish processing environment and fresh fillets. *Food Microbiology*, 27(5): 645–652.

Chmielewski, R. A. N. & Frank, J. F. (2006). A predictive model for heat inactivation of *Listeria monocytogenes* biofilm on buna-N rubber. *Food Science and Technology*, 39(1): 11–19.

Chorianopoulos, N. G., Tsoukleris, D. S., Panagou, E. Z., Falaras, P. & Nychas, G.J. E. (2011). Use of titanium dioxide (TiO₂) photocatalysts as alternative means for *Listeria monocytogenes* biofilm disinfection in food processing. *Food Microbiology*, 28(1): 164–170.

Clauss, H. & Lorber, B. (2011). Listeriosis and Nocardiosis. *Principles and Practice of Cancer Infectious Diseases*, 37: 435–442.

Coenye, T. & Nelis, H. J. (2010). In vitro and in vivo model systems to study microbial biofilm formation. *Journal of Microbiological Methods*, 83(2): 89–105.

Cos, P., Toté, K., Horemans, T. & Maes, L. (2010). Biofilms: an extra hurdle for effective antimicrobial therapy. *Current Pharmaceutical Design*, 16(20): 2279–2295.

Crerar, S. K., Castle, M., Hassel, S. & Schumacher, D. (2011). Recent Experiences with *Listeria monocytogenes* in New Zealand and development of a food control risk-based strategy. *Food Control*, 22(9): 1510–1512.

Cruz, C. D. & Fletcher, G. C. (2012). Assessing manufacturers’ recommended concentrations of commercial sanitizers on inactivation of *Listeria monocytogenes*. *Food Control*, 26(1): 194–199.

Den Bakker, H. C., Bundrant, B. N., Fortes, E. D., Orsi, R. H. & Wiedmann, M. (2010). A population genetics-based and phylogenetic approach to understanding the

evolution of virulence in the genus *Listeria*. *Applied and Environmental Microbiology*, 76(18): 6085–6100.

- Denyer, S. P. & Stewart, G. S. A. B. (1998). Mechanisms of action of disinfectants. *International Biodeterioration & Biodegradation*, 41(3–4): 261–268.
- Di Bonaventura, G., Piccolomini, R., Paludi, D., D'orio, V., Vergara, A., Conter, M. & Ianieri, A. (2008). Influence of temperature on biofilm formation by *Listeria monocytogenes* on various food-contact surfaces: relationship with motility and cell surface hydrophobicity. *Journal of Applied Microbiology*, 104(6): 1552–1561.
- Djordjevic, D., Wiedmann, M. & McLandsborough, L. A. (2002). Microtiter plate assay for assessment of *Listeria monocytogenes* biofilm formation. *Applied and Environmental Microbiology*, 68(6): 2950–2958.
- Duan, J., Zhao, Y. & Daeschel, M. (2011). Ensuring food safety in specialty foods production. *Extension Service, Oregon State University*, 1- 24.
- Ellis, K. V. (1991). Water disinfection: a review with some consideration of the requirements of the third world. *Critical Reviews in Environmental Science and Technology*, 20(5-6): 341–407.
- Feliciano, L., Li, J., Lee, J. & Pascall, M. A. (2012). Efficacies of sodium hypochlorite and quaternary ammonium sanitizers for reduction of norovirus and selected bacteria during ware-washing operations. *PloS one*, 7(12): 502-573.
- Flemming, H. C., Leis, A. & Wingender, J. (2004). Biofilms and the role of extracellular polymeric substances. *Advances in Biofilm Science and Engineering*: 1, 86.
- Florjanič, M. & Kristl, J. (2011). The control of biofilm formation by hydrodynamics of purified water in industrial distribution system. *International Journal of Pharmaceutics*, 405(1–2): 16–22.
- Gomes, F., Teixeira, P., Cerca, N., Azeredo, J. & Oliveira, R. (2011). Effect of farnesol on structure and composition of *Staphylococcus epidermidis* biofilm matrix. *Current Microbiology*, 63(4): 354-359.
- Gougouli, M., Angelidis, AS. & Koutsoumanis, K. (2008) A study on the kinetic behavior of *Listeria monocytogenes* in ice cream stored under static and dynamic chilling and freezing conditions. *Journal of Dairy Science*; 91(2): 523-530.
- Gray, L. (2005). What is iodine? In *The Element Iodine*. pp 4-30. New York: Marshall Cavendish.
- Guo, S. & DiPietro, L. A. (2010). Factors affecting wound healing. *Journal of Dental Research*, 89(3): 219–229.

- Guo, K., Freguia, S., Dennis, P. G., Chen, X., Donose, B. C., Keller, J. & Rabaey, K. (2013). Effects of surface charge and hydrophobicity on anodic biofilm formation, community composition, and current generation in bioelectrochemical systems. *Environmental Science & Technology*, 47(13): 7563-7570.
- Guzman, M., Dille, J. & Godet, S. (2012). Synthesis and antibacterial activity of silver nanoparticles against gram-positive and gram-negative bacteria. *Nanomedicine: Nanotechnology, Biology and Medicine*, 8(1): 37-45.
- Habimana, O., Meyrand, M., Meylheuc, T., Kulakauskas, S. & Briandet, R. (2009). Genetic features of resident biofilms determine attachment of *Listeria monocytogenes*. *Applied and Environmental Microbiology*, 75(24): 7814-21.
- Hajaya, M. G. & Pavlostathis, S. G. (2012). Fate and effect of benzalkonium chlorides in a continuous-flow biological nitrogen removal system treating poultry processing wastewater. *Bioresource Technology*, 118: 73-81.
- Hald, T. (2012). EFSA Panel on biological hazards (BIOHAZ); scientific opinion on the evaluation of the safety and efficacy of Listex™ P100 for the removal of *Listeria monocytogenes* surface contamination of raw fish. *European Food Safety Authority*, 10(3): 2615-58.
- Harrison, J., Turner, R. & Ceri, H. (2009). Combination of copper cations with peroxides or quaternary ammonium compounds for the treatment of biofilms. *US Patent Application*, 12: 428-747.
- Harvey, J., Keenan, K. P. & Gilmour, A. (2007). Assessing biofilm formation by *Listeria monocytogenes* strains. *Food Microbiology*, 24(4): 380-392.
- Hegstad, K., Langsrud, S., Lunestad, B. T., Scheie, A. A., Sunde, M. & Yazdankhah, S. P. (2010). Does the wide use of quaternary ammonium compounds enhance the selection and spread of antimicrobial resistance and thus threaten our health? *Microbial Drug Resistance*, 16(2): 91-104.
- Hoelzer, K., Pouillot, R. & Dennis, S. (2012). *Listeria monocytogenes* growth dynamics on produce: a review of the available data for predictive modeling. *Foodborne Pathogens and Disease*, 9(7): 661-673.
- Hoelzer, K., Pouillot, R., Gallagher, D., Silverman, M. B., Kause, J. & Dennis, S. (2012). Estimation of *Listeria monocytogenes* transfer coefficients and efficacy of bacterial removal through cleaning and sanitation. *International Journal of Food Microbiology*, 157(2): 267-277.
- Hoelzer, K., Pouillot, R., Gallagher, D., Silverman, M. B., Kause, J. & Dennis, S. (2012). Estimation of *Listeria monocytogene* transfer coefficients and efficacy of bacterial removal through cleaning and sanitation. *International Journal of Food Microbiology*, 157(2): 267-277.
- Hoelzer, K., Sauders, B. D., Sanchez, M. D., Olsen, P. T., Pickett, M. M., Mangione, K. J. & Rice, D. H. (2011). Prevalence, distribution, and diversity of *Listeria*

monocytogenes in retail environments, focusing on small establishments and establishments with a history of failed inspections. *Journal of Food Protection*, 74(7): 1083–1095.

Ibusquiza, P. S., Herrera, J. J. R. & Cabo, M. L. (2011). Resistance to benzalkonium chloride, peracetic acid and nisin during formation of mature biofilms by *Listeria monocytogenes*. *Food Microbiology*, 28(3): 418–425.

Ingianni, A., Quartuccio, M., Madeddu, M. A., Sanna, A., Dessì, S. & Pompei, R. (2007). Isolation and Identification of *Listeria monocytogenes* in Processed Meat by a Combined Cultural-molecular Method. *American Journal of Infectious Diseases*, 3(3): 159-164.

Jadhav, S., Shah, R., Bhave, M. & Palombo, E. A. (2013). Inhibitory activity of yarrow essential oil on *Listeria* planktonic cells and biofilms. *Food Control*, 29(1): 125–130.

Jakhmola, A., Anton, N. & Vandamme, T. F. (2012). Inorganic nanoparticles based contrast agents for X-ray computed tomography. *Advanced Healthcare Materials*, 1(4): 413–431.

Janakiraman, V. (2008). Listeriosis in pregnancy: diagnosis, treatment, and prevention. *Reviews in Obstetrics and Gynecology*, 1(4): 179.

Jaramillo, D. E., Arriola, A., Safavi, K. & Chávez de Paz, L. E. (2012). Decreased bacterial adherence and biofilm growth on surfaces coated with a solution of benzalkonium chloride. *Journal of Endodontics*, 38(6): 821-825.

Jemmy, T. & Stephan, R. (2006). *Listeria monocytogenes*: food-borne pathogen and hygiene indicator. *Revue Scientifique et Technique*, 25(2): 571-580.

Jin, M., Shan, J., Chen, Z., Guo, X., Shen, Z., Qiu, Z. & Xue, B. (2013). Chlorine dioxide inactivation of enterovirus 71 in water and its impact on genomic targets. *Environmental Science & Technology*, 47(9): 4590–4597.

Kadam, S. R., den Besten, H. M., van der Veen, S., Zwietering, M. H., Moezelaar, R. & Abee, T. (2013). Diversity assessment of *Listeria monocytogenes* biofilm formation: Impact of growth condition, serotype and strain origin. *International Journal of Food Microbiology*, 165(3): 259-264.

Kaiser, H. J. & Tienes, B. M. (2010, February 4). Low odor, hard surface sporicides and chemical decontaminants. *U.S. Patent Application*, 12: 658-234.

Kalmokoff, M.L., Austin, J.W., Wan, X.-D., Sanders, G., Banerjee, S. & Farber, J.M. (2001). Adsorption, attachment and biofilm formation among isolates of *Listeria monocytogenes* using model conditions. *Journal of Applied Microbiology* 91: 725–734.

- Keeratipibul, S. & Techaruwichit, P. (2012). Tracking sources of *Listeria* contamination in a cooked chicken meat factory by PCR-RAPD-based DNA fingerprinting. *Food Control*, 27(1): 64–72.
- Kishen, A. & Haapasalo, M. (2010). Biofilm models and methods of biofilm assessment. *Endodontic Topics*, 22(1): 58–78.
- Kuda, T., Nakamura, S., An, C., Takahashi, H. & Kimura, B. (2012). Effect of soy and milk protein-related compounds on *Listeria monocytogenes* infection in human enterocyte Caco-2 cells and A / J mice. *Food Chemistry*, 134(4): 1719–1723.
- Lee, W. H., Wahman, D. G., Bishop, P. L. & Pressman, J. G. (2011). Free chlorine and monochloramine application to nitrifying biofilm: comparison of biofilm penetration, activity, and viability. *Environmental Science & Technology*, 45(4): 1412-1419.
- Lekroengsin, S., Keeratipibul, S. & Trakoonlerswilai, K. (2007). Contamination profile of *Listeria* spp. in three types of ready-to-eat chicken meat products. *Journal of Food Protection*, 70(1): 85–89.
- Lepointeur, M., Royer, G., Bourrel, A. S., Romain, O., Duport, C., Doucet-Populaire, F. & Decousser, J. W. (2013). Prevalence of resistance to antiseptics and mupirocin among invasive coagulase-negative *staphylococci* from very preterm neonates in NICU: the creeping threat?. *Journal of Hospital Infection*, 83(4), 333-336.
- Li, Y., Hao, G., Galvani, C. D., Meng, Y., De La Fuente, L., Hoch, H. C. & Burr, T. J. (2007). Type I and type IV pili of *Xylella fastidiosa* affect twitching motility, biofilm formation and cell–cell aggregation. *Microbiology*, 153(3): 719–726.
- Littleton, P. (2010). 14 Cleaning and disinfection in the fish canning industry. *Fish Canning Handbook*, 262.
- Longhi, C., Scoarughi, G. L. & Poggiali, F. (2008) Protease treatment affects both invasion ability and biofilm formation in *Listeria monocytogenes*. *Microbial Pathogenesis*, 45(1):45–52.
- Luber, P., Crerar, S., Dufour, C., Farber, J., Datta, A. & Todd, E. C. D. (2011). Controlling *Listeria monocytogene* in ready-to-eat foods: Working towards global scientific consensus and harmonization–Recommendations for improved prevention and control. *Food Control*, 22(9): 1535–1549.
- Marian, M. N., Sharifah Aminah, S. M., Zuraini, M. I., Son, R., Maimunah, M., Lee, H. Y. & Wong, W. C. (2012). MPN-PCR detection and antimicrobial resistance of *Listeria monocytogenes* isolated from raw and ready-to-eat foods in Malaysia. *Food Control*, 28(2): 309–314.
- Martin, R. W. (2011). Composition and method for enhanced sanitation and oxidation of aqueous systems. *U.S. Patent Application*, 7: 794-607.

- McWhorter, T. E., Kazlas, P., Anand, M., Hobbs, J. P., Rosenblatt, A. A., Shay, R. H. & Keramati, B. (2012). Storage-stable aqueous solutions of chlorine dioxide and methods for preparing and using them. *U.S. Patent Application*, 13: 365-902.
- Mendonça, G. F., Senra, M. R., Esteves, P. M. & De Mattos, M. C. S. (2011). Trichloroisocyanuric acid in 98% sulfuric acid: A superelectrophilic medium for chlorination of deactivated arenes. *Applied Catalysis A: General*, 401(1–2): 176–181.
- Mikulsen, M. & Diduck, A. P. (2013). A fresh perspective on food safety in Canada: risk communication, public involvement, and the impact of the 2008 listeriosis outbreak. *Environmental Hazards*, 12(2): 148–165.
- Mishra, N., Puri, V. M. & Demirci, A. (2012). Inactivation and injury of *Listeria monocytogenes* under combined effect of pressure and temperature in UHT whole milk. *Journal of Food Process Engineering*, 36(3): 374-384.
- Moltz, A.G. & Martin, S.E. (2005). Formation of biofilm by *Listeria monocytogenes* under various growth conditions. *Journal of Food protection*, 68: 92-97.
- Morey, A. (2012). Efficacy of liquid smoke as an ingredient in hotdogs against *Listeria monocytogenes* and its Effects on the microbial shelf-life and quality attributes. PhD Thesis, Auburn University.
- Nyati, H., Beumer, R., van der Veen, S., Hazeleger, W. & Abee, T. (2012). Influence of Organic Material and Biofilms on Disinfectant Efficacy Against *Listeria monocytogenes*. *International Journal of Food Studies*, 1(1): 122-131.
- Nagarajan, B. (2010). *A study on microbial disinfection of drinking water using nano silver*, PhD Thesis, Bharath university.
- Nilsson, R. E., Ross, T. & Bowman, J. P. (2011). Variability in biofilm production by *Listeria monocytogenes* correlated to strain origin and growth conditions. *International Journal of Food Microbiology*, 150(1): 14–24.
- O'connell, T., Maurer, K.-H., Weber, T. & Prüsser, I. (2010). Compositions comprising perhydrolases and alkylene glycol diacetates. *U.S. Patent Application*, 12, 697:360.
- Oliveira, M. M. M. de, Brugnera, D. F., Cardoso, M. das G., Alves, E., & Piccoli, R. H. (2010). Disinfectant action of *Cymbopogon* sp. essential oils in different phases of biofilm formation by *Listeria monocytogenes* on stainless steel surface. *Food Control*, 21(4): 549–553.
- Ölmez, H. & Temur, S. D. (2010). Effects of different sanitizing treatments on biofilms and attachment of *Escherichia coli* and *Listeria monocytogenes* on green leaf lettuce. *Food Science and Technology*, 43(6): 964–970.

- Osaili, T. M., Alaboudi, A. R. & Nesiari, E. A. (2011). Prevalence of *Listeria* spp. and antibiotic susceptibility of *Listeria monocytogenes* isolated from raw chicken and ready-to-eat chicken products in Jordan. *Food Control*, 22(3–4): 586–590.
- Pagadala, S., Parveen, S., Rippen, T., Luchansky, J. B., Call, J. E., Tamplin, M. L. & Porto-Fett, A. C. S. (2012). Prevalence, characterization and sources of *Listeria monocytogenes* in blue crab (*Callinectes sapidus*) meat and blue crab processing plants. *Food Microbiology*, 31(2): 263–270.
- Pandit, A. B., Jyoti, K. K., Bhalchandra, P. A. & Kumar, J. K. (2012). Chemical Disinfection. In *Drinking Water Disinfection Techniques*, pp. 21-59. New York. CRC Press.
- Panicheva, S., Sampson, M. N., Panichev, V., Dibello, G. N., Rogers, M. J., Stapleton, R. & Short, S. L. (2012). Stabilized hypochlorous Acid solutions. *US Patent Application* 13: 423-822.
- Park, M.K., Park, J. W. & Oh, J.H. (2012). Optimization and application of a dithiobis-succinimidyl propionate-modified immunosensor platform to detect *Listeria monocytogenes* in chicken skin. *Sensors and Actuators B: Chemical*, 171: 323–331.
- Peterson, S. B., Irie, Y., Borlee, B. R., Murakami, K., Harrison, J. J., Colvin, K. M. & Parsek, M. R. (2011). Different methods for culturing biofilms in vitro. *Biofilm Infections*, 251-266.
- Purkrtová, S., Turoňová, H., Pilchová, T. & Demnerová, K. (2010). Resistance of *Listeria monocytogenes* Biofilms to Disinfectants. *Czech Journal of Food Sciences*, 28(4): 326–332.
- Reilly, A., Tlustos, C., O'Connor, J. & O'Connor, L. (2009). Food Safety: A Public Health Issue of Growing Importance. *Introduction to Human Nutrition*, 324-335.
- Riazi, S. & Matthews, K. R. (2011). Failure of foodborne pathogens to develop resistance to sanitizers following repeated exposure to common sanitizers. *International Biodeterioration & Biodegradation*, 65(2): 374–378.
- Rivas, L., Dykes, G. A., & Fegan, N. (2007). A comparative study of biofilm formation by Shiga toxinogenic *Escherichia coli* using epifluorescence microscopy on stainless steel and a microtitre plate method. *Journal of Microbiological Methods*, 69(1): 44-51.
- Rodrigues, D., Cerca, N., Teixeira, P., Oliveira, R., Ceri, H., & Azeredo, J. (2011). *Listeria monocytogenes* and *Salmonella enterica* Enteritidis biofilms susceptibility to different disinfectants and stress-response and virulence gene expression of surviving cells. *Microbial Drug Resistance*, 17(2): 181-189.
- Rodríguez, F. L., Ibáñez, M. N., Rodríguez, J. P., & Rivero, S. S. (2008). The Credibility of the European monetary System: A Review. *Cuadernos de Economía*, 31(86): 5–34.

- Ruple, A., Slovis, N. M. & Jones, B. (2011). What Is Infection Control and Biosecurity?. In *Veterinary Infection Prevention and Control*, ed. L. Caveney., B. Jones, and K. Ellis, pp.3. London: Willey-Blackwell.
- Saá Ibusquiza, P., Herrera, J. J. R., Vázquez-Sánchez, D., Parada, A. & Cabo, M. L. (2012). A new and efficient method to obtain benzalkonium chloride adapted cells of *Listeria monocytogenes*. *Journal of Microbiological Methods*, 91(1): 57-61.
- Saharay, M., Yazaydin, A. O. & Kirkpatrick, R. J. (2013). Dehydration-induced amorphous phases of calcium carbonate. *The Journal of Physical Chemistry B*, 117(12): 3328–3336.
- Schets, F., Italiaander, R., Van den Berg, H. & De Roda Husman, A. (2010). Rainwater harvesting: quality assessment and utilization in The Netherlands. *Journal of Water and Health*, 8(2): 224–235.
- Schlech, W.F., Lavigne, P.M., Bortolussi, R.A., Halldane, E.V., Wort, A.J., Hightower, A.W., Johnson, S.E., King, S.H. & Nicholls, E.S. (1983). Epidemic listeriosis: evidence for transmission by food. *Journal of Medicine*. 308: 203-206.
- Shaw, A. R., Casson, L. W., Hunter, G. L. & Rothermel, M. C. (2011). Sustainable disinfection: incorporating life-cycle assessment and life-cycle costing into disinfection design and operation. *Proceedings of the Water Environment Federation*, 3: 157-171.
- Shi, L., Li, N., Liu, J., Qian, Y., Yang, B. & Lin, S. (2013). Sodium chlorite-iodine-methyl acetoacetate oscillatory reaction investigated by UV-vis spectrophotometry. *Indian Journal of Chemistry*, 52(2): 226–231.
- Simões, L. C., & Simões, M. (2013). Biofilms in drinking water: problems and solutions. *RSC Advances*, 3(8): 2520–2533.
- Simões, M., Simões, L. C., & Vieira, M. J. (2010). A review of current and emergent biofilm control strategies. *Food Science and Technology*, 43(4): 573–583.
- Skovager, A., Larsen, M. H., Castro-Mejia, J. L., Hecker, M., Albrecht, D., Gerth, U. & Ingmer, H. (2013). Initial adhesion of *Listeria monocytogenes* to fine polished stainless steel under flow conditions is determined by prior growth conditions. *International Journal of Food Microbiology*, 165(1): 35-42.
- Slater, S. (2011). The discovery of thyroid replacement therapy. Part 1: In the beginning. *Journal of Royal Society of Medicine*, 104(1): 15–18.
- Smith, P. A., Roberts, T. C. & Romesberg, F. E. (2010). Broad-spectrum antibiotic activity of the arylomycin natural products is masked by natural target mutations. *Chemistry & Biology*, 17(11): 1223–1231.
- Stepanović, S., Ćirković, I. & Ranin, L. (2004). Biofilm formation by *Salmonella* spp. and *Listeria monocytogenes* on plastic surface. *Letters in Applied Microbiology*, 38(5): 428–432.

- Stojicic, S., Shen, Y., & Haapasalo, M. (2013). Effect of the source of biofilm bacteria, level of biofilm maturation, and type of disinfecting agent on the susceptibility of biofilm bacteria to antibacterial agents. *Journal of Endodontics*, 39(4): 473-477.
- Suh, B. (2011). Benzalkonium chloride compositions for inhibiting the hydrolytic activity of endogenous matrix metalloproteinases in dental restorations. *U.S. Patent Application*, 6: 494, 551.
- Sulur, V. S., Srinivasan, M., Chulliel, N. N., Ghosh, K., & Sankar, H. (2010). Medicinal antidiaper rash cream incorporating a biopolymer and a process to make it. *U.S. Patent Application* 13(2): 264, 992.
- Swaminathan, B. & Gerner-Smidt, P. (2007). The epidemiology of human listeriosis. *Microbes and Infection*, 9(10): 1236–1243.
- Takahashi, H., Suda, T., Tanaka, Y. & Kimura, B. (2010). Cellular hydrophobicity of *Listeria monocytogenes* involves initial attachment and biofilm formation on the surface of polyvinyl chloride. *Letters in Applied Microbiology*, 50(6): 618–625.
- Teo, E. Y., Ong, S.Y., Khoon Chong, M. S., Zhang, Z., Lu, J., Moochhala, S. & Ho, B. (2011). Polycaprolactone-based fused deposition modeled mesh for delivery of antibacterial agents to infected wounds. *Biomaterials*, 32(1): 279–287.
- Tezel, U. & Pavlostathis, S. G. (2011). Role of quaternary ammonium compounds on antimicrobial resistance in the environment. *Antimicrobial Resistance in the Environment*, 349–387.
- Tomás-Callejas, A., López Velasco, G., Artés, F., & Artés Hernández, F. (2012). Acidified sodium chlorite optimisation assessment to improve quality of fresh cut tatsoi baby leaves. *Journal of the Science of Food and Agriculture*, 92(4): 877–885.
- Toreki, W. & Olderman, G. (2009). Disinfectant with durable activity based on alcohol-soluble quaternary ammonium polymers and copolymers. *U.S. Patent Application*, 8:343-523
- Toté, K., Berghe, D. Vanden, Deschacht, M., De Wit, K., Maes, L. & Cos, P. (2009). Inhibitory efficacy of various antibiotics on matrix and viable mass of *Staphylococcus aureus* and *Pseudomonas aeruginosa* biofilms. *International Journal of Antimicrobial Agents*, 33(6): 525–531.
- Truelstrup Hansen, H., Lisbeth, R., & Vogel, B. F. (2011). Desiccation of adhering and biofilm *Listeria monocytogenes* on stainless steel: survival and transfer to salmon products. *International Journal of Food Microbiology*, 146(1): 88–93.
- Vaid, R., Linton, R. H. & Morgan, M. T. (2010). Comparison of inactivation of *Listeria monocytogenes* within a biofilm matrix using chlorine dioxide gas, aqueous chlorine dioxide and sodium hypochlorite treatments. *Food Microbiology*, 27(8): 979–984.

- Van Houdt, R., & Michiels, C. W. (2010). Biofilm formation and the food industry, a focus on the bacterial outer surface. *Journal of Applied Microbiology*, 109(4): 1117–1131.
- Veluz, G. A., Pitchiah, S. & Alvarado, C. Z. (2012). Attachment of *Salmonella* serovars and *Listeria monocytogenes* to stainless steel and plastic conveyor belts. *Poultry science*, 91(8): 2004-2010.
- Walton, J. (2012). Detergent effects on disinfectant susceptibility of *Escherichia coli* and *listeria monocytogenes* attached to stainless steel. *American Eurasian Journal Agriculture & Environmental Science*, 12(1): 23-29.
- Yasuda, K., Ohmizo, C. & Katsu, T. (2003). Potassium and tetraphenylphosphonium ion-selective electrodes for monitoring changes in the permeability of bacterial outer and cytoplasmic membranes. *Journal of Microbiological Methods*, 54(1): 111–115.
- Zarei, M., Maktabi, S. & Ghorbanpour, M. (2012). Prevalence of *Listeria monocytogenes*, *Vibrio parahaemolyticus*, *Staphylococcus aureus*, and *Salmonella* spp. in seafood products using multiplex polymerase chain reaction. *Foodborne Pathogens and Disease*, 9(2): 108-112.
- Zhang, L., Moosekian, S. R., Todd, E. C. D. & Ryser, E. T. (2012). Growth of *Listeria monocytogenes* in different retail delicatessen meats during simulated home storage. *Journal of Food Protection*, 75(5): 896-905.
- Zhao, Q. & Burns, S. E. (2012). Microstructure of single chain quaternary ammonium cations intercalated into montmorillonite: A molecular dynamics study. *Langmuir*, 28(47): 16393–16400.
- Zhao, T., Podtburg, T. C., Zhao, P., Chen, D., Baker, D. A., Cords, B. & Doyle, M. P. (2013). Reduction by competitive bacteria of *Listeria monocytogenes* in biofilms and *Listeria* bacteria in floor drains in a ready-to-eat poultry processing plant. *Journal of Food Protection*, 76(4): 601-607.