BACTERIAL ATTACHMENT TO MEAT SURFACES

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

in

Food Technology

at Massey University, Palmerston North, New Zealand

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2003

ABSTRACT

The aim of this study was to optimise the hygienic efficiency of slaughter and dressing operations. Three strategic approaches, namely reducing and removing or killing the bacteria attached to meat surfaces, were considered. The second option of removal was selected for development, as current technology inevitably results in bacterial contamination, while killing bacteria on meat surfaces requires drastic treatments that may adversely affect quality parameters.

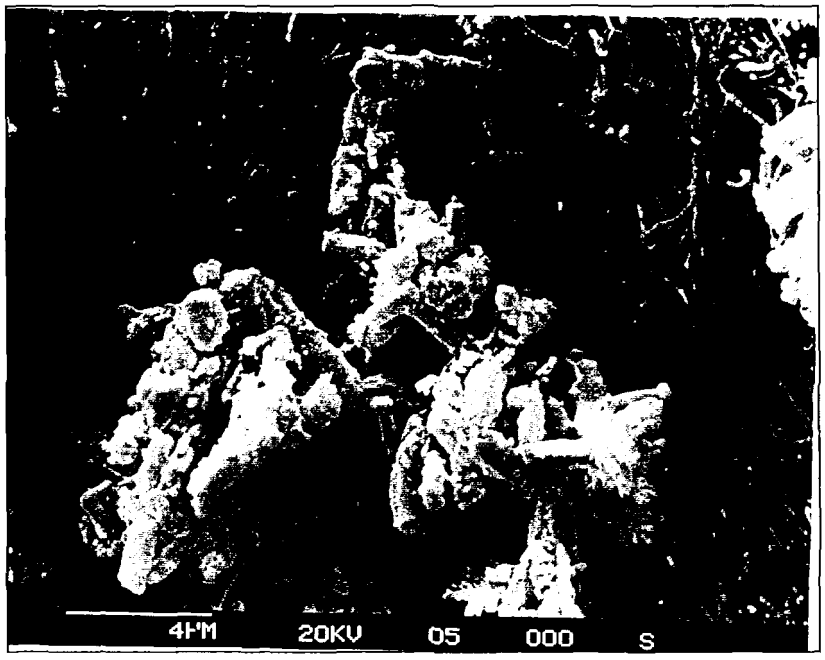
The initial attachment mechanism between bacteria and the carcass surface (reversible attachment) was studied using the collagen film model system. Bacterial attachment to the collagen model was compared with attachment to cut beef muscle and uncut beef muscle using viable count procedure. Scanning electron microscopy and direct microscopic count procedure using an epifluorescence microscope was also developed using both collagen films mounted on microscope slides and collagen coated microscope slides. The collagen film viable count system was the method selected to model bacterial attachment to meat because of ease and consistency of quantification.

There was no positive correlation between attachment and many bacterial cell surface factors such as charge, hydrophobicity, protein and polysaccharide surface molecules. Different eluents were used to identify the principal component interfering with single attachment mechanisms on electrostatic interaction and hydrophobic interaction chromatographic columns and on collagen film. Three components interfering with the isolated attachment mechanisms were identified. They were Tween, sodium chloride (NaCl) and mannose. Further column studies indicated that cell surface proteins play a more important role in cell surface negative charge and hydrophobicity than do surface polysaccharides.

A wash solution was formulated using the components Tween, NaCl and mannose to reverse what were believed to be the major attachment mechanisms. Further trials

with Tween, NaCl and mannose and increasing their concentrations and the application of increased vigorous rinsing also proved ineffective for washing the cells from meat surfaces. This result also supports the hypothesis that bacterial attachment to meat surface is very complex and multifactorial. Elution studies using 10 % Tri sodium orthophosphate pH 12.0 killed the cells rather than removing them and further work will be directed towards the killing.

FRONTISPIECE



Scanning electron micrograph of ***E. coli*** **E6** attaching to cut beef muscle surface. The cells are in clumps and appear to be preferentially colonising the muscle fibres Magnification = 7000 x.

ACKNOWLEDGEMENTS

Firstly, I would like to thank FRST for funding this project.

I would like to sincerely thank my excellent and dedicated supervisors for their continued advice, assistance, guidance and support during this project.

I offer special thanks to my chief supervisor, Dr John Brooks, Associate Professor, Food Technology Department, Massey University, Palmerston North, New Zealand. His incisive analysis of the project, meticulous scholarship and high standards have been instrumental in the completion of this work. His expectations for perfection have helped bring the best out of me. I am indebted to him as he was always keen to meet, discuss and question the project with me and provided much sound advice and encouragement.

My thanks are due to my cosupervisor, Dr Graham Bell, from AgResearch, Meat Industrial Research Institute, Hamilton, New Zealand who combines the attributes of an excellent scientist with those of a proficient teacher. His role has been vital in the concept, design and execution of this project. I was able to draw strength and character from this tireless teacher. His kind words of encouragement and patience have been a shining beacon above troubled waters and also have gone a long way to encourage me at times of despair.

Thanks to Dr Steve Flint, NZDRI, Palmerston North, New Zealand for his mild mannered, unassuming and warm personality combined with his expertise in the field of biofilms has been a constant source of encouragement. His guidance has been very valuable.

Thanks to AgResearch, MIRINZ Food Safety group.

Special thanks to Guill LeRoux, Team Leader, Food Science and Food Safety, for his support and strong words of guidance which spurred me on during the project.

Thanks to Mr. John Mills, Lab Manager, for his support and encouragement which enabled me to do this project in his laboratory which is well organised, sophisticated and comfortable.

I gratefully acknowledge AgResearch, MIRINZ, Food Science/ Food Safety Platform for providing an excellent laboratory and the support of technicians, Robyn Clemens, Raewyn Hosking, Andrea Rogers, and Jocelyn Mohring.

Thanks to fellow PhD student, Yi Li and M.Sc., student, Sandy Moorhead who shared there experience with me, and others who have worked in the laboratory over the past three years and whose friendship made this study more enjoyable.

Thanks to all those staff members in the MIRINZ Platform of Food Science and Food Safety, who provided much useful discussion, particularly in the meetings.

Many thanks to all the staff of MIRINZ who encouraged me throughout this study – in particular I would like to thank John Kerby for his support. The support of the library and information technology people was much appreciated.

I am indebted to AgResearch - MIRINZ for supporting this study in which I have learnt much that I believe will benefit AgResearch and the Meat Industry in future years.

Others who deserve my thanks and thoughts are:

Nick Penney and Kevin Gilbert, who introduced me to meat plants and helped me to understand meat processing procedures.

Shelley Falconer, Researcher, Meat Science, who determined protein concentrations using the BCA procedure.

Dr. Mustafa Farouk, Meat processing technologist, who contributed his expertise and knowledge in the selection of meat samples.

Kevin Taukiri, a kind butcher, from Ruakura Abattoir, who assisted me in cutting and collecting meat samples following a minor knife accident in the laboratory.

Dr. Skealt, Fonterra, Palmerston North, for allowing me to use the equipment Zeta Sizer for charge- related measurements.

Dr.Doug Hopcroft and Raymond Bennet (Crunch) (HortResearch, Palmerston North) who provided expert assistance in electron microscopy.

I wish to place on record my sincere thanks to those who have been involved in various stages in the completion of this project.

Thanks to my friend Vanitha Subbian, Financial Administrator, Land Transport Safety Authority, Palmerston North, who helped me to get into the academic area when I arrived in New Zealand.

Thanks to Mrs. Aruna Shekar, Lecturer, University of Auckland, who helped me to build contacts to find the projects.

Thanks to Dr John Bronlund, Institute of Technology and Engineering, Massey University, who assisted me to get into this project with the help of my university supervisor.

Thanks to Dr. Nanthi Bolan, Senior Lecturer, Massey University, Palmerston North, who helped me in registering for PhD study.

Thanks to Dr. Ken Milne, Chairman, Doctoral Research committee, Massey University, Palmerston North, who provided his valuable advice to continue with PhD study.

Heartfelt thanks to Dr Anand Kumar, Technical Specialist, Pfizer, Australia for his support to finish this study.

Thanks to Karthik, Charted Accountant, Portfolio Analyst, FRST, Wellington, who encouraged me a lot during my study and career development.

Thanks to Anita and Dr. ChandraSekar, Wellington hospital, for his continuous encouragement provided during the period of this study.

Thanks to P. K. Ajith Kumar, Academic Staff Member, Bay of Plenty Polytechnic, Tauranga, for his advice in formatting this thesis.

Thanks to my friend Mrs. Bhavani Sreedharan, Lecturer, Massey University, Palmerston North, who is very sweet and encouraged my study.

Thanks to my friend Dr. Shanthi Parkar, Research Scientist, Hort Research who was in biofilms and often provided advice on this subject.

Thanks to Fiona Gleeson, Secretary, for formatting my thesis.

Thanks to Biometrician Neil Cox, for his help in performing statistical analysis.

Finally I would like to thank my family:

This work could not have succeeded without the support of my cooperative husband Narendran and cute, understanding little fellow, my son Yashwanth, who tolerated long days at work and frequent absence from him.

Thanks to Dr. T.N. Swaminathan (my father-in-law) both for his continuous encouragement provided throughout this study and for his financial support in our difficult times. Big thanks to my brother- in- law Mahendran and heart- sister Radha for their well wishes. Thanks to Mrs. Leela Swaminathan, my mother- in- law who was taking care of my family while I was in the final year of this study.

Extra special thanks to my lovely parents for all their love and emotional support. I couldn't have done this without knowing you were there for me. My brothers, Chandra Sekar and Raja Sekar – Thanks for all your good wishes, love, and support.

LIST OF PRESENTATIONS

This work has been featured in the following presentations at scientific conferences:

1. Narendran, V., Brooks, J.D, Bell, R.G. (2001). Collagen film as a model for bacterial attachment to meat surfaces. NZIFST Conference, Dunedin, October 2001.

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LIST OF FLOWCHARTS

ABBREVIATIONS

APC	-	Aerobic plate count
Ab-DEFT	-	Antibody- direct epifluorescent filter technique
BSA	-	Bovine serum albumin
CF	-	Collagen Film
CCS	-	Collagen coated slide
CPC	-	Cetyl pyridinium chloride
DF	-	Diluent fluid
DEFT	-	Direct epifluorescent filter technique
EIC	-	Electrostatic Interaction chromatography
ETEC	-	Entero toxigenic *Escherichia coli*
FCU	-	Femoris culna ulnaris
FISH	-	Fluorescent in situ hybridisation
GMP	-	Good manufacturing practices
HIC	-	Hydrophobic Interaction chromatography
HCGR	-	High concentration gentle rinse
HCVR	-	High concentration vigorous rinse
LCGR	-	Low concentration gentle rinse
LCVR	-	Low concentration vigorous rinse
LPS	-	Lipo polysaccharides
MRGR	-	Multiple rinse gentle rinse

MRVR	-	Multiple rinse vigorous rinse
MIRINZ	-	Meat Industrial Research Institute
MATH	-	Microbial adhesion to hydrocarbons
NaCl	-	Sodium chloride (salt)
PW	-	Prewetting
PB	-	Phosphate buffer
PBS	-	Phosphate buffered saline
REA	-	Restriction endonuclease analysis
SEM	-	Scanning electron microscopy
SRGR	-	Single rinse gentle rinse
SRVR	-	Single rinse gentle rinse
STD-DF	-	Standard diluent fluid
TSM	-	Tween, Salt (NaCl) and Mannose
TEM	-	Transmission Electron Microscopy
TVC	-	Total Viable Count
TSP	-	Trisodium ortho phosphate

DEFINITIONS

ADHESION: Adhesion is a physicochemical process of interaction between molecules that are situated in the outermost layer of the inert surface and of the microorganisms, and molecules of the surrounding fluid. This term is used when the process is permanent and irreversible.

ATTACHMENT: Attachment is defined as a physicochemical process of interaction between molecules that are situated in the outermost layer of the inert surface and of the microorganisms, and molecules of the surrounding fluid. This term is used when the process is temporary and reversible.

CARCASS: is the body of any slaughtered animal or bird often, but not always, after bleeding and dressing.

CUT BEEF MUSCLE: Meat which has only muscle and is free from subcutaneous fat and fascia.

EVISCERATION: is the removal of the viscera from a carcass.

FRESH MEAT: is meat that has not been treated in any way other than refrigeration, with or without preservative packaging to maintain its fitness for human consumption.

INITIAL MICROFLORA: is the association of microorganisms present on an eviscerated carcass after skin removal (if appropriate) but prior to washing, grading, chilling and further processing.

MEAT: is the edible part (musculature and edible offal) of an animal or bird slaughtered for human consumption.

MICROBIAL CONTAMINATION: refers to microorganisms directly or indirectly transferred onto a carcass or edible offal, hence contaminating microflora means those microorganisms present as a consequence of such transmission.

RIGOR: The postmortem changes that occur during conversion of muscle to meat resulting in stiffening of a body after death.

SPOILAGE: describes changes that render meat objectionable to consumers: hence spoilage microflora describes an association of microorganisms whose development on meat renders that meat objectionable to consumers.

SPOILAGE POTENTIAL: is a measure of the propensity of microorganisms to render meat objectionable to consumers through the production of offensive metabolic by products.

SLAUGHTER: is the killing of an animal or bird for human consumption generally but not necessarily performed within premises (abattoir) that are approved and registered for that purpose.

UNCUT BEEF MUSCLE: Meat which is completely surrounded by fascia which is a membranous connective tissue covering.