The Microflora of Raw Milk and the Impact of Milk on their Survival at Low pH

MASSEY
UNIVERSITY

A Thesis Presented in Partial Fulfilment of the
Requirements for the Degree

of

Doctorate of Philosophy

in

Food Technology

at

Massey University,

Palmerston North, New Zealand.

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27 May 2015

Abstract

Milk is an excellent food source as it contains a plentiful supply of nutrients and minerals. Although normally consumed after pasteurisation, there is growing evidence that raw milk provides health benefits beyond nutrition alone. Epidemiological studies of children have shown that those who regularly consume raw milk appear to have a lower incidence of asthma and non-specific allergy than those who consume processed commercial milk. The gastrointestinal tract is a key location for immune development as interaction with microflora can occur at the mucosal surface. Milk may have a role to play in the early stages of this process either due to the microbes it harbours or to the physical and chemical properties of milk itself.

The aim of this study was to identify bacterial isolates unique to raw milk, that would not survive pasteurisation; and to determine whether milk allowed for a greater survival of these bacteria during ingestion. Bacterial isolates were cultured from either raw or pasteurised milk and tested for their ability to survive pasteurisation. A subset of thermosensitive isolates were identified for further analysis representing those species likely to be present in raw milk but not processed. This thermosensitive subset was challenged for their ability to tolerate acid conditions (pH 2.5) both in the presence and absence of milk to determine the likelihood of their survival during ingestion. A high throughput acid tolerance test was developed to screen raw milk bacteria for acid tolerance. Data supports the hypothesis that milk significantly increased the survival of raw milk bacteria exposed to pH 2.5 and that specific components found specifically in milk were, at least in part responsible for this effect. In conclusion, a unique subset of bacteria found only in raw bovine milk, and not in processed milk, has been identified that when ingested with milk are able to come through an acid challenge not dissimilar to that of the stomach and survive. This opens the possibility that these bacteria present in raw milk are able to enter the lower GI tract and interact with the immune system via Peyers patches.

Acknowledgements

I would like to extend my deepest appreciation to my PhD supervisors, Dr Helen Withers and Assoc. Prof. Steve Flint for their support during this project. In particular, Dr Withers has taught me a much about what is required as a top scientist, and push me towards becoming one also. Assoc. Prof. Flint has been great support, and believed in me throughout the project, and helped motivate me when times were difficult. Without both their help and determination, this project would not have been possible. I consider myself extremely fortunate to have such a well-suited and highly regarded supervisory panel.

The work in this thesis was primarily conducted in the Food Assurance and Meat Quality team at Agresearch in Palmerston North. I have had a lot of assistance, and support from this team, both past and present members. It is these workmates that help out in the hard times, or be the ones to start cultures, or remove agar plates from the incubator when I was not able. Their help is very appreciated. I also wish to extend my gratitude to those that I have worked with outside of our team. To the other members of the Hopkirk Institute (with whom I worked at the completion), as well as the members of the former MIRINZ Institute in Hamilton (with whom I worked when I started this project) there are too many to name, I will miss your camaraderie. To John Koolaard, of the Bioinformatics and Statistics team, Agresearch was most helpful in helping me through the statistical analysis required for the high-throughput sequencing work. Also, the team at the Manawatu Microscopy and Imaging Centre, who performed the Electron microscopy work and provided an insightful microscopy course. And, to the members of the New Zealand Microbiological Society, thank-you for listening to my presentations and given their feedback at the yearly conferences in the past three years.

Finally, I would not be where I am today without the help, support from my friends and family, especially from my wife, Elizabeth, who has only ever known me as a PhD student. She has pushed me when I needed it and her drive and work ethic is a strong positive influence on me.

Table of Contents

List of Presentations

de Vegt, P., Withers H., & Flint S.H. (2010), *The Effect of Milk Microflora on the Host-Microbe Interaction of the Gut*, 12-Month Confirmation , Massey University, Palmerston North

de Vegt, P., Withers H., & Flint S.H. (2011), , *The Effect of Milk Microflora on the Host-Microbe Interaction of the Gut*, Introductory Presentation, Hopkirk Institute, Palmerston North.

de Vegt, P., Withers H., & Flint S.H., (2011) Poster *Impact of milk on bacteria isolated from raw milk at low pH*, New Zealand Microbiological Society Conference, Palmerston North.

de Vegt, P., Withers H., & Flint S.H., (2012) *PhD Project Review,* AFM Review Meeting, Hopkirk Institute, Palmerston North

de Vegt, P., Withers H., & Flint S.H., Food Technology (2012) *How milk affects the survival of milk microflora in extreme acid stress*, Food for Thought Colloquium, Institute of Food Nutrition and Human Health, Palmerston North.

de Vegt, P., Withers H., & Flint S.H., (2012) *How milk affects the survival of milk microflora in extreme acid stress,* New Zealand Microbiological Society Conference, Dunedin.

List of Figures

List of Tables

Abbreviations

aOR	adjusted Odds Ratio
APC	Antigen Presenting Cell
APT	All Purpose Tween
CFU	Colony Forming Units
CI	Confidence Interval
CM	Casein Micelle
DC	Dendritic Cell
DGGE	Denaturing Gradient Gel Electrophoresis
EDTA	Ethylenediaminetetraacetic acid
GAD	glutamic acid decarboxylate
GI	Gastrointestinal
GLMM	Generalised Linear Mixed Model
Ig	immunoglobulin
IL	Interleukin
IFN-α	Interferon-alpha
LB	Luria Bertani
LSD	Least Significant Difference
M	Molar (mol / L)
M-PCA	Milk-Plate Count Agar
mM	milli-Molar
MRD	Maximum Recovery Diluent
OR	Odds Ratio
PCA	Plate Count Agar
r16S	ribosomal 16S
SD	Standard Deviation
SSCP	Single Strand Conformational Polymorphism
T_H1	T-Helper type 1
T_H2	T-Helper type 2
TSA	Tryptic Soy Agar
TSB	Tryptic Soy Broth
UHT	Ultra-high Temperature
WPC	Whey Protein Concentrate