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UNIVERSITY OF PRETORIA
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Effect of irrigation water quality on the microbiological safety of fresh vegetables

by

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submitted in partial fulfilment of the requirements for the degree

Doctor of Philosophy (PhD)

in the

Department of Food Science

Faculty of Natural and Agricultural Sciences

University of Pretoria

Pretoria

Republic of South Africa

January 2010

DECLARATION

I declare that the thesis which I hereby submit for the degree of PhD at the University of Pretoria is my own work and has not previously been submitted by me for a degree at any other university or institution of higher education.

Oluwatosin Ademola Ijabadeniyi

January 2010

DEDICATION

This thesis is dedicated to Almighty God, Jesus Christ and Holy Spirit for being my strength and helper.

ACKNOWLEDGEMENTS

My sincere appreciation and gratitude go to all individuals and institutions that have rendered help and support during the course of my PhD programme.

First and foremost, I should like to mention my promoter, Prof. E.M. Buys, for her thorough supervision and guidance during the course of my PhD. Special mention must also be made of Prof. A. Minnaar, who offered special inputs and advice.

Other academic staff in the Department of Food Science including Prof. J.R.N. Taylor, Dr H.L. de Kock, Dr K.G. Duodu and Dr N. Emmambux gave me valuable advice during my research proposal and progress report. My sincere gratitude also goes to Mr M. van der Linde and Dr L. Debusho for their assistance with logistic regression analysis and general linear modelling.

In addition, I should also like to my thank my parents, Mr and Mrs Ijabadeniyi, my brother Yomi Ijabadeniyi and my sisters, Bunmi Olusi, Kemi Animashaun, Seun Ijabadeniyi and Tope Ijabadeniyi for their prayers for me. All my friends and brethren here in South Africa and abroad deserve my acknowledgements but I am limited by space to mention them all by name.

Finally, I want to say a special thank you to my wife, Abosede Ijabadeniyi, for her understanding, her prayers and moral support during the course of my doctoral programme.

Acknowledgement must also be made to the Water Research Commission (WRC) for funding and bursaries. This study was part of an ongoing solicited research project (K5/1773) funded by the WRC and co-funded by the Department of Agriculture.

ABSTRACT

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Department: Food Science
Degree: PhD

Irrigation water is perhaps the leading pre-harvest source of contamination of fresh vegetables in the world. In this thesis, the effect of source water from the Olifants River and the Wilge River on the bacterial quality of water in the Loskop Canal that they feed and also the subsequent contribution to the bacterial contamination of fresh vegetables was determined for a period of twelve months. Also effect of attachment time on the survival of *Listeria monocytogenes* and the effect of chlorine on *L. monocytogenes* attached to vegetables were determined. Finally, a step-wise logistic regression analysis was made to determine whether various predictor variables could be used to predict the occurrence of *L. monocytogenes*, *Salmonella* spp and intestinal *Enterococcus* in irrigation water and vegetables (i.e., cauliflower and broccoli).

COD and turbidity were higher in the Olifants River and the Wilge River than in the Loskop Canal that they feed, according to the water guidelines set by the World Health Organisation (WHO) and the Republic of South Africa (RSA). The level of the COD and turbidity were significantly different in terms of the two rivers in comparison with the canal. Levels of faecal coliforms and *Escherichia coli* were also higher than the WHO standard. *Staphyloccocus aureus*, intestinal *Enterococcus, Salmonella, L. monocytogenes* were recovered from the two rivers and the canal. Apart from *L. monocytogenes*

that was not recovered from cauliflower, all bacterial pathogens recovered from the surface water were recovered from the vegetables. This study also indicated that *L. monocytogenes* could attach to both surface and subsurface structures of both tomatoes and spinach within 30 min, and that even after 72 h, it still remained viable. It also indicated that chlorine treatment is more effective against surface *L. monocytogenes* compared with subsurface inoculated *L. monocytogenes.*

Finally, the logistic regression analysis of the sampled data showed that COD was statistically reliable to indicate a high probability of *L. monocytogenes*, turbidity reliable to indicate a high probability of intestinal *Enterococcus* and faecal coliforms and coliforms reliable to indicate a high probability of *Salmonella* in irrigation water. Low aerobic colony count (ACC) was statistically significant for the prediction of the three pathogens on vegetables.

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