IMPACT OF HEAT ADAPTATION ON SOME FOODBORNE PATHOGENS

BY

WAFAA MONGY MOHAMED ABD EL-HALIM

B. Sc. Agri. Sc. (Food Science and Technology), Ain Shams University, 2013

A Thesis Submitted in Partial Fulfillment

Of

The Requirements for Degree of

MASTER OF SCIENCE
in
Agricultural Sciences
(Food Science and Technology)

Department of Food Science

Faculty of Agriculture

Ain Shams University

2019

Approval sheet

IMPACT OF HEAT ADAPTATION ON SOME FOODBORNE PATHOGENS

By

WAFAA MONGY MOHAMED ABD EL-HALIM

B. Sc. Agri. Sc. (Food Science and Technology), Ain Shams University, 2013

This thesis for M.Sc. Degree has been approved by:

Dr. Mahmoud Abd Allah Mohamed Saleh **…………..………….**

Head Researches of Food science Technology, Food Technology Research Institute

Dr. Alaa Abd El-Rashid Mohamed **…………………...…**

Prof. of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Dr. Amal Ahmed Mohamed Hassan **……..………………….**

Prof. of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Dr. Mohamed Farag Khallaf **….…………………..**

Prof. Emeritus of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Date of examination: 31 / 10 / 2019

IMPACT OF HEAT ADAPTATION ON SOME FOODBORNE PATHOGENS

BY

WAFAA MONGY MOHAMED ABD EL-HALIM

B. Sc. Agri. Sc. (Food Science and Technology), Ain Shams University, 2013

Under the supervision of:

Dr. Mohamed Farag Khallaf

Prof. of Food Science and Technology, Department of Food Science and Technology, Faculty of Agriculture, Ain Shams University (Principal supervisor)

Dr. Amal Ahmed Mohamed Hassan

Prof. of Food Science and Technology, Department of Food Science and Technology, Faculty of Agriculture, Ain Shams University

ABSTRACT

Wafaa Mongy Mohamed Abd EL-Halim: Impact of Heat Adaptation on Some Foodborne Pathogens. M.Sc. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2015.

The fundamental causes of foodborne disease are inappropriate food processing. When bacteria are subjected to thermal and pH stresses during growth, sublethal stresses can occur that may lead to differences in their subsequent tolerance to thermal treatments. In this work, the effect of prior heat and acid shock on the thermotolerance of three pathogenic bacteria (*Staphylococcus aureus*, *Salmonella typhimurium* and *Listeria monocytogenes*) in both of a model system and a food system were studied. The bacterial strains under study were grown at 37°C ,i.e., the optimum temperature (control), sublethally heated at 47°, 52°, 57° and 60°C for various times, or sub-fatal acid treatment (at pH 4.5 or 5.5) for various times, then heat treated at 68°C for 15 min. The D_{68}-values were calculated for the three strains, the estimated average of the D_{68}-values for the control was 4.83 min for *Staphylococcus aureus*, 5.41 min for *Salmonella typhimurium* and 5.20 min for *Listeria monocytogenes*, while the D_{68}-values for heat shocked treatments ranged from 5.43 to 10.23 min for *S. aureus*, 6.18 to 9.2 min for *S. typhimurium* and 5.41 to 9.72 min for *L. monocytogenes*. The D_{68}-values for acid shock cells also calculated for the three strains, the estimated average of the D_{68}-values of acid shocked cells for *S. aureus* ranged from 12.20 to 30.30 min, and for *S. typhimurium* 13.58 to 26.5 min and 14.64 to 26.5 for *L. monocytogenes.* The detection of cellular proteins of the three strains after heat or acid shock was examined to identify new proteins that were induced in response to stress, which in turn gave cells resistance to subsequent lethal stress. The current results also, indicated new bands that in *S. aureus* were 8-16, in *S. typhimurium* 7-15 and in *L. monocytogenes* 9 - 14 new bands were induced, by applying heat shock treatments with molecular weights ranged from 9 to 225 KDa. After acid shock treatment the results, also, indicated new bands that in *S. aureus* 3-6, in *S. typhimurium* 4-11 and in *L. monocytogenes* 1-11 bands were induced with molecular weights ranged from 17 to 145 KDa. The induced heat and acid shock proteins further confirmed increased of thermotolerance. The cell walls of the strains were examined by using Scanning Electron Microscope (SEM), to detect the changes caused by thermal shock and the ability of cells to repair the injury. Moreover, selected heat shock treatments caused severe destruction in cell wall (i.e., rupture, irregular and leakage of cell contents), while heat shocked cells after incubating at 37°C for overnight in enriched medium became similar to that of normal one. The enhanced of heat resistance of the three strains should be thought-about in case of planning effective thermal processes to confirm the microbiological food safety.

Key Words: Heat shock, Acid shock, thermotolerance, *S. aureus*, *S. typhimurium*, *L. monocytogenes*, Scanning Electron Microscope (SEM), heat shock proteins and acid shock proteins.

ACKNOWLEDGEMENT

All praises and thanks are due to ALLAH, who blessed me with kind professors and colleagues, and gave me the support to produce this Thesis.

I would like to express my deepest appreciation and sincere love to my major professor, Prof. Dr. Mohamed Farag Khallaf, Prof. of Food Science and Technology, Department of Food Science Technology, Faculty of Agriculture, Ain Shams University. I would like to call him my second father. He was a good example of the guidance, advice and support throughout my graduate program. Thanks to you Dr. Mohamed Farag for everything, for the valuable advice and guidance that put me on the right track. Thanks for your continuous efforts to make me better. Thanks for your patience with me as long as he helped me.

Also, I do not have to deny the privilege of my dear Prof. Dr. Amal Ahmed Hassan, Prof. of Food Science and Technology, Department of Food Science Technology, Faculty of Agriculture, Ain Shams University for her continuous support and access to academic thinking during my research. Her enthusiasm in research and invaluable advices kept me motivated and focused. She has contributed significantly to my arrival at this stage. I would like to thank her very much for all efforts and advice. She did not stop at any time for providing me help and she had a lot of difficulties to show and reach this Thesis to perfection. Thanks Prof. Dr. Amal for being such a motivation in shaping the future for me.

Last but not least, I would like to extend my sincere thanks and appreciation to Dr. Medhat Al-Bayoumi, the distinguished and respected man, Director of the Color Laboratory. He provided me with necessary tools to conduct my research and laboratory experiments. Thank you for your contribution to this work.

I am eternally grateful to my mother; she has sacrificed so much for me. Thank you for your endless love, support and encouragement throughout my life. I would also like to thank my father, for helping and supporting me in all stages of my life. He has never let me down and he has always been beside me.

CONTENTS

LIST OF TABLE

LIST OF FIGURES