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# **Actinidin Treatment and *Sous Vide* Cooking: Effects on Tenderness and *In Vitro* Protein Digestibility of Beef Brisket**

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

Master of Food Technology

at Massey University, Manawatū,

New Zealand

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2017





# Abstract

Actinidin from kiwifruit can tenderise meat and help to add value to low-value meat cuts. Compared with other traditional tenderisers (e.g. papain and bromelain) it is a promising way, due to its less intensive tenderisation effects on meat. But, as with other plant proteases, over-tenderisation of meat may occur if the reaction is not controlled. Therefore, the objectives of this study were (1) finding a suitable process to control the enzyme activity after desired meat tenderisation has been achieved; (2) optimising the dual processing conditions- actinidin pre-treatment followed by *sous vide* cooking to achieve the desired tenderisation in shorter processing times. The first part of the study focused on the thermal inactivation of actinidin in freshly-prepared kiwifruit extract (KE) or a commercially available green kiwifruit enzyme extract (CEE). The second part evaluated the effects of actinidin pre-treatment on texture and *in vitro* protein digestibility of *sous vide* cooked beef brisket steaks.

The results showed that actinidin in KE and CEE was inactivated at moderate temperatures (60 and 65 °C) in less than 5 min. However, the enzyme inactivation times increased considerably (up to 24 h at these temperatures) for KE/CEE-meat mixtures, compared with KE/CEE alone. The thermal inactivation kinetics were used as a guide for optimising actinidin application parameters during the second phase of the study.

For the final experiments, beef steaks were injected with 5 % (w/w, extract/meat) of CEE solution (3 mg/mL) followed by vacuum tumbling (at 4 °C for 15 min) and cooking

(at 70 °C for 30 min) under *sous vide* conditions. This cooking time was considerably less than usual *sous vide* cooking times used in the meat industry. The actinidin-treated meat had no change in pH and colour, but showed a lower instrumental shear force; and improved sensory scores for tenderness, juiciness and flavour than the untreated meat steaks when tested by a sensory panel. Improved tenderness agreed well with the Transmission Electron Microscopy (TEM) results that showed considerable breakdown of the myofibrillar structure, particularly around the Z line. The addition of actinidin enhanced the rate of breakdown of muscle proteins, as shown by Tricine-sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE), and led to an increase in both protein solubility and ninhydrin-reactive free amino N release, during simulated gastric digestion. These results demonstrate the positive effects of actinidin on meat tenderness and meat protein digestibility during gastric digestion *in vitro*.

# Acknowledgements

I would like to express my most honest appreciation to all the people who help me to complete this project. A special gratitude I give to my chief supervisor Dr Lovedeep Kaur, whose contribution in instructing, suggesting and supporting, helped me to coordinate my project and finish my report in time. I also appreciate my co-supervisor Dr Mike Boland, who provided many valuable suggestions and guidance along the way.

I am also thankful to Drs Maryann Pire, Kevin Taukiri and Mustafa Farouk from AgResearch (Hamilton, NZ) for their help in carrying out the sensory analysis; Feng Ming Chian (PhD student) from Riddet Institute (Palmerston North, NZ) for help with digestion experiments; Jordan Taylor from Massey University Manawatu Microscopy and Imaging Centre (Palmerston North, NZ) for help with microstructure imaging; and Aden Fareh (PhD) from Massey University (Palmerston North, NZ) for help with collagen solubility experiments.

Furthermore I would also like to acknowledge with much appreciation the staff of the lab, who gave the permission and instruction to use all required equipment and the necessary materials to complete the task, and staff of the Riddet Institute and Massey Institute of Food Science and Technology, who gave me comments and encouragement to carry on my project. I am thankful to FIET research programme for providing me the scholarship to complete my Masters project. Last but not least, a special thank goes to my

family, who supported the funding and gave me the opportunity to study at Massey University.

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# Abbreviations

<b>ANZFSC</b>	Australia New Zealand Food Standards Code
<b>CA</b>	Commercial availability
<b>CBZ</b>	N- $\alpha$ -carbobenzoxy-L-lysine P-nitrophenyl ester hydrochloride
<b>CEE</b>	Commercial enzyme extract
<b>DTT</b>	DL-Dithiothreitol
<b>EA</b>	Enzyme activity
<b>FDA</b>	Food and Drug Administration of United States
<b>GRAS</b>	Generally Recognised as Safe
<b>KE</b>	Kiwifruit extract
<b>MPI</b>	Ministry for Primary Industries
<b>SGF</b>	Simulated gastric fluid
<b>SF</b>	Simulated salivary fluid
<b>SSF</b>	Slice shear force
<b>SDS-PAGE</b>	Tricine-sodium dodecyl sulfate-polyacrylamide gel electrophoresis
<b>TEM</b>	Transmission Electron Microscope
<b>WBSF</b>	Warner-Bratzler shear force