MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Characterization of a Partially Purified Carom (*Trachyspermum ammi*) Extract and Its Influence on Starch Functionality and Digestibility

A thesis presented in partial fulfilment of the requirements for the degree of Master of Food Technology (MFoodTech) at Massey University (Manawatu Campus), New Zealand

Ramesh Kumar

2016

ABSTRACT

The interactions between starches and the components in spices and herbs have been poorly studied so far. This study investigated the preliminary effects of thirty-six different spices and herbs on pasting properties of rice starch. It largely concentrated on the characterization of a partially purified carom extract (from the dried fruit of the *Trachyspermum ammi* plant) and its influence on the structural, thermal, pasting properties and digestibility of native rice starch. Rheology, differential scanning calorimetry, size exclusion chromatography coupled with a multi-angle laser light scattering, zeta potential, hot-stage optical microscopy, scanning electron microscopy (SEM), and in-vitro starch digestion analysis were carried out to characterise the carom extract and starch-carom system. The results showed that carom, cumin, fennel, mulberry leaf, perilla leaf, neem and coriander seed extracts showed peak and final viscosity-suppressing effect, while mesona, rosemary, green tea, thyme, and clove extracts showed peak viscosity-enhancing effect on rice starch during starch pasting. The water-soluble fraction of carom had the highest degree of viscosity-suppressing effect as compared to other spices and herbs. With increasing concentration of carom, the peak and final viscosities of rice starch decreased; the onset, peak, and end temperatures of rice starch increased; and granular swelling of potato starch was restricted and delayed. The viscosity-suppressing effect was not caused by pH or small molecular carom compounds such as mineral salts and phytochemicals. A protein polymer in carom extract with an M_w of ~2.08 $\pm$ 0.10 x 10^5 Da and isoelectric point of ~3.5 was found responsible for the suppression effect. The protein fraction completely denatured at ~83^{o}C. Micrographs of SEM showed that carom protein appeared as raisin-like clusters. The ability of carom protein to suppress the peak viscosity of starch was also observed in potato, tapioca, glutinous rice, waxy maize, waxy rice, rice, sweet potato, maize, wheat, and pea starches, suggesting that the effect was independent of the source and ratio of amylose to amylopectin. It was proposed that the protein molecules could be interacting with the starch granular surface and/or starch molecules. *In-vitro* starch digestion study showed that dialysed carom extract with rice starch caused an unusual increment in glucose release. The lower viscosity of the starch-carom gels and/or a carom enzyme stimulatory effect were proposed to be responsible for increasing the rapid breakdown of starch.

ACKNOWLEDGMENTS

This thesis and research project would not have been possible without the help and guidance of several people whom I am in debt to. Firstly, I would like to express my sincere gratitude to my supervisors A/Prof Kelvin Goh and Dr Lara Matia-Merino for their continuous support and encouragement during my research work. Their patience, inspiration, and immense knowledge were awe-inspiring. From the inception of this project until its completion, their invaluable comments, idea, and guidance were the key for successful completion of this thesis.

I would specially like to thank A/Prof Goh, who dedicated allot of his precious time throughout my research work to guide, educate, instigate and motivate me in every aspect. He was a jovial, creative, and immensely knowledgeable supervisor whom I truly respect and admire. I consider myself very fortunate and gifted to have carried out my research work under his supervision. I am extremely grateful to Dr Lara ("profesora increíble"), for I truly admire her "conocimiento" (knowledge), passion, enthusiasm, and "awesomeness". She was an excellent supervisor who was caring, cheerful, good-humoured, and efficient. She is a great role model for me and many other students.

My journey in New Zealand was unforgettable and treasurable. I have to thank my friends: Wen Sheng, Grace, Matthew, Eileen, Seng Guan, Ling Li, Jia Shin, Shao Min, Wartison, and Standley for adding merriment and glee to my life. I was fortunate to stay with Allan and Heather McClean, who were one of the most thoughtful, kind and accommodating people. I am truly grateful to the McClean family. The most important group of people are the helpful staff of Massey University, which includes Mrs Michelle Tamehana, Mr Steve Glasgow, Mrs Niki Murray, Ms Fliss Jackson, Mrs Kathy Hamilton, Mrs Christine Ramsay, Dr Oni Yuliarti, Miss Khoo Poh Li, and Mrs Yvonne Parkes. I am extremely thankful to all of them for their contribution and help in this project, especially Michelle, Steve, Poh Li, and Niki. Last by not least, I am indebted to our "starch expert" Mr Allan Hardacre who shared his expertise and provided guidance in various aspect of this project.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES