

**THE EFFECT OF VACUUM COOLING ON
PHYSICO - CHEMICAL QUALITIES AND
BIOACTIVE COMPOUNDS OF BABY COS
LETTUCE AND THE PREDICTION OF
VACUUM COOLING OPTIMUM
PARAMETERS USING AN
ARTIFICIAL NEURAL
NETWORK**

PRATSANEE KONGWONG

**DOCTOR OF PHILOSOPHY
IN FOOD SCIENCE AND TECHNOLOGY**

**GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
FEBRUARY 2018**

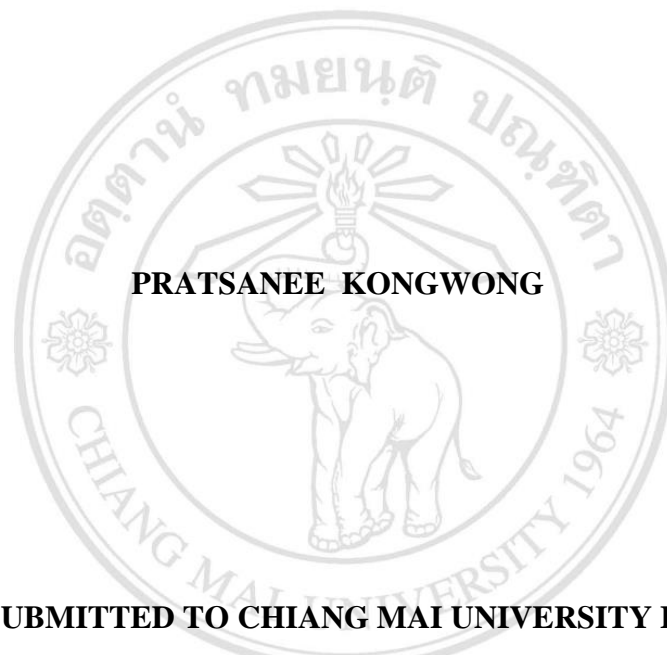
**THE EFFECT OF VACUUM COOLING ON
PHYSICO - CHEMICAL QUALITIES AND
BIOACTIVE COMPOUNDS OF BABY COS
LETTUCE AND THE PREDICTION OF
VACUUM COOLING OPTIMUM
PARAMETERS USING AN
ARTIFICIAL NEURAL
NETWORK**

PRATSANEE KONGWONG

**DOCTOR OF PHILOSOPHY
IN FOOD SCIENCE AND TECHNOLOGY**

**GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
FEBRUARY 2018**

**THE EFFECT OF VACUUM COOLING ON PHYSICO -
CHEMICAL QUALITIES AND BIOACTIVE COMPOUNDS
OF BABY COS LETTUCE AND THE PREDICTION
OF VACUUM COOLING OPTIMUM PARAMETERS
USING AN ARTIFICIAL NEURAL NETWORK**



PRATSANEE KONGWONG

**A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN FOOD SCIENCE AND TECHNOLOGY**

GRADUATE SCHOOL, CHIANG MAI UNIVERSITY

FEBRUARY 2018

**THE EFFECT OF VACUUM COOLING ON PHYSICO-CHEMICAL
QUALITIES AND BIOACTIVE COMPOUNDS OF BABY COS
LETTUCE AND THE PREDICTION OF VACUUM
COOLING OPTIMUM PARAMETERS USING
AN ARTIFICIAL NEURAL NETWORK**

PRATSANEE KONGWONG

THIS THESIS HAS BEEN APPROVED TO BE A PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN FOOD SCIENCE AND TECHNOLOGY

Examination Committee:

Sujitra Ratanamarnu Chairman

(Asst. Prof. Dr. Sujitra Ratanamarno)

Pichaya Poonlarp Member

(Asst. Prof. Dr. Pichaya Poonlarp)

Danai Boonyakiat Member

(Prof. Dr. Danai Boonyakiat)

M. Scampicchio Member

(Prof. Dr. Matteo Scampicchio)

Damorn Bundhurat Member

(Asst. Prof. Dr. Damorn Bundhurat)

Advisory Committee:

Pichaya Poonlarp Advisor

(Asst. Prof. Dr. Pichaya Poonlarp)

Danai Boonyakiat Co-advisor

(Prof. Dr. Danai Boonyakiat)

M. Scampicchio Co-advisor

(Prof. Dr. Matteo Scampicchio)

Damorn Bundhurat Co-advisor

(Asst. Prof. Dr. Damorn Bundhurat)

6 February 2018

Copyright © by Chiang Mai University

ACKNOWLEDGEMENT

I would like to thank Asst. Prof. Dr. Pichaya Poonlarp for giving me the opportunity to pursue my Ph.D. studies and for her guidance, wisdom, and inspiration throughout the course of this study. I would like also to give a sincere thanks to my co-advisor Prof. Dr. Danai Boonyakiat and Asst. Prof. Dr. Damorn Bundhurat for their help and valuable suggestions and for serving as examination committee of the thesis. I also wish to express my appreciation to Prof. Dr. Matteo Scampicchio, for his insight and leadership during the time that I was working with him in Italy. It was a great pleasure to work together as a team.

My full gratitude goes to Mr. Chipichit Chuamuangphan and Mr. Noppol Chanhom for their help in the design and instrumentation of the experimental set-ups and I also wish to express my thanks to the officers of The Royal Project Produce Center Mae Hia, Chiang Mai, Thailand. I would really appreciate the help of Miss. Ksenia Morozova and Mrs. Giovanna Ferrentino during the Coularray analysis and writing my scientific papers at the Free university of Bozen-Bolzano, Italy. It was my great pleasure to work with my colleagues in Italy.

I am grateful for the financial support from the Royal Golden Jubilee Ph.D. scholarship awarded by the Thailand Research Fund under Office of the Prime Minister, the Royal Thai Government since 2013. And the financial support through the Province of Bolzano (Leistungsvereinbarung 2013–2016, Nr. 1472 of 07.10.2013)

I wish to extend my appreciation Miss. Warissara Wanakamol and Miss. Thanchanok Yosen for her help with administrative matters and experimental assistant. I would like to thank Miss. Kanjapach Upalasin, for her continued support and friendship throughout my studies.

I would like to thank my parents for their support and encouraging me to follow my own path in life. Very warm special thanks are to my husband and my son for their love, care, support, inspiration and encouragement.

Pratsanee Kongwong