

**ANTI-INFLAMMATORY AND ANTI-INVASIVE  
ACTIVITIES AGAINST CANCER CELLS OF  
PHYTOCHEMICALS IN RED JASMINE  
RICE (*Oryza sativa* L.)**



**DOCTOR OF PHILOSOPHY**

**IN BIOCHEMISTRY**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved

**GRADUATE SCHOOL  
CHIANG MAI UNIVERSITY  
NOVEMBER 2015**

**ANTI-INFLAMMATORY AND ANTI-INVASIVE  
ACTIVITIES AGAINST CANCER CELLS OF  
PHYTOCHEMICALS IN RED JASMINE  
RICE (*Oryza sativa* L.)**



**A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL  
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY  
IN BIOCHEMISTRY**

**GRADUATE SCHOOL, CHIANG MAI UNIVERSITY  
NOVEMBER 2015**

ANTI-INFLAMMATORY AND ANTI-INVASIVE ACTIVITIES  
AGAINST CANCER CELLS OF PHYTOCHEMICALS  
IN RED JASMINE RICE (*Oryza sativa* L.)

KOMSAK PINTHA

THIS THESIS HAS BEEN APPROVED TO BE A PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY  
IN BIOCHEMISTRY

Examination Committee:

Advisory Committee:

*M. Suttajit* .....Chairman (Prof. Emeritus Dr.Maitree Suttajit)  
*P. Dejkiengkraikul* .....Member (Assoc.Prof.Dr.Pornngarm Dejkiengkraikul)  
*W. Chanmahasathien* .....Member (Asst.Prof.Dr.Wisinee Chanmahasathien)  
*Suphachai Yodkeeree* .....Member (Dr.Supachai Yodkeeree)  
*P. Pitchakarn* .....Member (Dr.Pornsiri Pitchakarn)

*P. Dejkiengkraikul* .....Advisor (Assoc.Prof.Dr.Pornngarm Dejkiengkraikul)  
*W. Chanmahasathien* .....Co-advisor (Asst.Prof.Dr.Wisinee Chanmahasathien)  
*Suphachai Yodkeeree* .....Co-advisor (Dr.Supachai Yodkeeree)

19 November 2015

Copyright © by Chiang Mai University

## ACKNOWLEDGEMENT

I wish to express my deepest gratitude and deep appreciation to Assoc. Prof. Dr. Pornngarm Dejkriengkraikul, my thesis advisor, for her special efforts, clemency, precious advices, excellent encouragement and unforgettable support.

I would like to express my deepest appreciation to Asst. Prof. Dr. Wisinee Chanmahasathien and Dr. Supachai Yodkeeree my co-advisor, for their assistance, kindness, excellent encouragement and their greatest experimental training during my studies in this university.

I am grateful to all staff members and colleagues in the Department of Biochemistry, Faculty of Medicine, Chiang Mai University for their kindness, assistance, encouragement and friendship and special thanks to every person in Assoc. Prof. Dr. Pornngarm's laboratory including Dr. Pornsiri pitchakarn, Ms. Wanisa Punfa, Ms. Pilaiporn Tipprapant, Mr. Sonthaya Umsumarng Ms. Siriya Mapoung and Mrs. May Thuu Mon for their special encouragement, kindness and friendship.

I would like to gratefully acknowledge the Higher Education Research Promotion and National Research University Project of Thailand, Office of the Higher Education Commission, the Agricultural Research Development Agency (Public Organization) (ARDA) and the Faculty of Medicine, Chiang Mai University, Thailand.

Finally, I am particular grateful to my family members, all of whom were especially supportive and extremely helpful, for their understanding, love, encouragement, assistance and attentiveness. I offer my regards to all of those who associated with any respect during the achievement of my thesis.

Komsak Pintha