TECHNOLOGICAL AND MICROBIOLOGICAL STUDIES ON PRESERVATION OF SOME FOODS USING NON-CONVENTIONAL METHODS

By

ABDEL-FATTAH ABDEL-KEREEM ABDEL-FATTAH
B.Sc. Agric. Sc. (Food Technology), Ain Shams University, 2000
M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2005

A thesis submitted in partial fulfillment
of
the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Science
(Food Science and Technology)

Department of Food Science
Faculty of Agriculture
Ain Shams University

2010

Approval Sheet

TECHNOLOGICAL AND MICROBIOLOGICAL STUDIES ON PRESERVATION OF SOME FOODS USING NON-CONVENTIONAL METHODS

By

ABDEL-FATTAH ABDEL-KEREEM ABDEL-FATTAH

B.Sc. Agric. Sc. (Food Technology), Ain Shams University, 2000
M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2005

This thesis for Ph.D. degree has been approved by:

Prof. Dr. Samy I. El-Syiad .....
Prof. of Food Science and Technology, Faculty of Agriculture, Assiut University

Prof. Dr. Nadia R. Abdel Rahman .....
Prof. Emeritus of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Prof. Dr. Hamdy M. Ebeid .....
Prof. of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Prof. Dr. Ahmed Y. Gibriel .....
Prof. Emeritus of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Date of Examination: 11 / 7 / 2010

TECHNOLOGICAL AND MICROBIOLOGICAL STUDIES ON PRESERVATION OF SOME FOODS USING NON-CONVENTIONAL METHODS

By

ABDEL-FATTAH ABDEL-KEREEM ABDEL-FATTAH
B.Sc. Agric. Sc. (Food Technology), Ain Shams University, 2000
M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2005

Under the supervision of:

Prof. Dr. Ahmed Y. Gibriel

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

Prof. Dr. Hamdy M. Ebeid

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

Prof. Dr. Hany I. Khalil

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

دراسات تكنولوجية وميكروبيولوجية على حفظ بعض الأغذية بإستخدام طرق غير تقليدية

رسالة مقدمة من

عبد الفتاح عبد الكريم عبد الفتاح

بكالوريوس علوم زراعية (صناعات غذائية) ، جامعة عين شمس ، 2000
ماجستير علوم زراعية (علوم وتكنولوجيا الأغذية) ، جامعة عين شمس ، 2005

للحصول على
درجة دكتور فلسفة في العلوم الزراعية
(علوم وتكنولوجيا الأغذية)

قسم علوم الأغذية
كلية الزراعة
جامعة عين شمس

2010

صفحة الموافقة على الرسالة

دراسات تكنولوجية وميكروبيولوجية على حفظ بعض الأغذية باستخدام طرق غير تقليدية

رسالة مقدمة من

عبد الفتاح عبد الكريم عبد الفتاح

بكالوريوس علوم زراعية (صناعات غذائية) ، جامعة عين شمس ، 2000

ماجستير علوم زراعية (علوم وتكنولوجيا الأغذية) ، جامعة عين شمس ، 2005

للحصول على

درجة دكتور فلسفة في العلوم الزراعية

(علوم وتكنولوجيا الأغذية)

وقد تمت مناقشة الرسالة والموافقة عليها

اللجنة:

أ.د. سامى إبراهيم الصياد .....

أستاذ علوم وتكنولوجيا الأغذية ، كلية الزراعة ، جامعة أسيوط

أ.د. نادية رفعت عبد الرحمن .....

أستاذ علوم وتكنولوجيا الأغذية المتفرغ ، كلية الزراعة ، جامعة عين شمس

أ.د. حمدى مصطفى عبيد .....

أستاذ علوم وتكنولوجيا الأغذية ، كلية الزراعة ، جامعة عين شمس

أ.د. أحمد يوسف جبريل .....

أستاذ علوم وتكنولوجيا الأغذية المتفرغ ، كلية الزراعة ، جامعة عين شمس

تاريخ المناقشة: 11 / 7 / 2010

جامعة عين شمس
كلية الزراعة

رسالة دكتوراة

اسم الطالب : **عبد الفتاح عبد الكريم عبد الفتاح**

عنوان الرسالة : **دراسات تكنولوجية وميكروبيولوجية على حفظ بعض الأغذية بإستخدام طرق غير تقليدية**

اسم الدرجة : **دكتورفلسفة في العلوم الزراعية (علوم وتكنولوجيا الأغذية)**

لجنة الإشراف:

أ.د. أحمد يوسف جبريل

أستاذ علوم وتكنولوجيا الأغذية المتفرغ ، قسم علوم الأغذية ، كلية الزراعة ، جامعة عين شمس (المشرف الرئيسي)

أ.د. حمدى مصطفى عبيد

أستاذ علوم وتكنولوجيا الأغذية ، قسم علوم الأغذية ، كلية الزراعة ، جامعة عين شمس

أ.د. هانى إدريس خليل

أستاذ علوم وتكنولوجيا الأغذية ، قسم علوم الأغذية ، كلية الزراعة ، جامعة عين شمس

تاريخ البحث: 6 / 2 / 2006

الدراسات العليا

ختم الإجازة

أجيزت الرسالة بتاريخ
11 / 7 /2010

موافقة مجلس الكلية

/ / 2010

موافقة مجلس الجامعة

/ / 2010

ABSTRACT

Abdel-Fattah Abdel-Kereem Abdel-Fattah: Technological and Microbiological Studies on Preservation of Some Foods Using Non-Conventional Methods. Unpublished Ph.D. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2010.

The main objective of this study was to use some natural agents: Monascus crude red pigments, chitosan with two different molecular weights [high molecular weight chitosan (CHH), MW=746 KDa; and low molecular weight chitosan (CHL), MW=300 KDa] and nisin in the commercial form (nisaplin); as a coloring, antimicrobial, antioxidant and preservative agents. Evaluate their effects in a single form or in combination for use in food production and food preservation. The optimum conditions to produce Monascus crude red pigments at a higher ratio from fungus *Monascus purpureus* DSMZ 1379 on liquid and solid media was applied to produce two sources of crude red pigments (Dry biomass and dry fermented red rice). The antimicrobial activity of Monascus pigment sources, chitosans and nisaplin against some food spoilage and pathogenic microorganisms and their antioxidant activity were studied. Application of this natural agents alone or in combination with different concentration were used for preparation of beef burger and cupcakes and determining if such natural preservatives improve the physical, chemical, microbiological and sensory qualities of this product. The production of crude red pigments produced by *M. purpureus* in submerged fermentation were found to be optimum, when the fungus grown on yeast extract glucose medium at 28 °C and incubation period for 17 days to produce 537.33 mg crude red pigments/g dry biomass. Solid state fermentation at maximum production of pigments was found at 35% humidity, 28 °C and after 17 days incubation period. It was proved that, solid cultivation on broken rice was better than submerged fermentation

where it gave 671.39 mg crude red pigments / g dry fermented red rice. Monascus crude pigment extracts markedly inhibited growth of most bacteria tested; the effect was strengthened as the concentration of crude extracts increased. The antibacterial effects on all tested bacterial strains showed bacteriostatic effect, the extracts showed strong antibacterial activity for Gram-positive bacteria than for Gram-negative bacteria. The minimum inhibitory concentrations (MICs) values of Monascus extracts with bacterial strains ranged from 1.5 to 2.5%. The crude pigments extracted from dry biomass generally showed stronger antimicrobial activity compared with crude pigments extracted from dry fermented red rice. Monascus extracts inhibited growth of most yeast and fungi tested strains. Chitosans generally showed stronger antimicrobial activity against bacterial, yeast and fungal strains, the effect strengthened as the concentration of chitosan increased. Chitosans markedly showed stronger antibacterial activity for Gram-positive bacteria than for Gram-negative bacteria in the ratio ranged between (0.8 - 1.0%). The minimum inhibitory concentrations (MICs) values of chitosans with bacterial strains ranged from 0.8 to 1.0%. The antibacterial effects on all tested bacterial strains showed bactericidal effect. Chitosans inhibited growth of most yeasts tested; chitosan (CHH), generally showed stronger antimicrobial activity compared with (CHL). The antimicrobial activity of nisaplin indicated that, the antibacterial effects against *B. subtilis*, *B. cereus*, *S. typhimurium, Staph. aureus*, *Staph. epidermidis, Pseud. fluorescens* and *L. monocytogenes* showed bactericidal effect, while the effect against *E. coli* O157:H7 and *E. coli* was bacteriostatic. Nisaplin did not inhibit the mycelia growth of fungi strains.

The antioxidant activity of dry biomass and dry fermented red rice extracts showed moderate antioxidant activities of 54.97 and 54.94%, respectively at concentration 0.25% and high antioxidant activities of 73.53 and 72.72%, respectively at 3.0 %. The scavenging abilities of crude extracts from dry biomass and fermented red rice on DPPH radicals were 48.93 and 39.07%, respectively at 0.25%, and

85.46 and 81.50% at 3.0%. Overall, dry biomass generally showed strongly antioxidant activity more than dry red rice. Chitosan (CHL) exhibited stronger antioxidant activities of 59.2% at 0.1% and showed reducing powers of 2.62 at 1.0%. At 1.0%, scavenging abilities of chitosans (CHH and CHL) on DPPH radicals were 91.08% and 95.36%, respectively. Overall, chitosans at different molecular weights were good in antioxidant activity, scavenging ability on DPPH radicals and reducing power. With regard to antioxidant properties assayed, slight difference was observed for chitosans (CHH and CHL), however chitosan (CHL) generally showed strongly antioxidant activity more than chitosan (CHH).

Beef burger samples containing different concentrations of dry biomass or dry fermented red rice in a single form or combined with chitosan (CHL, MW: 300 KDa) and nisaplin compared with negative control (without preservatives) and positive control (with 100 ppm sodium nitrite as preservative) were prepared and cold stored at (4±2°C for 12 days). Cupcake samples containing different types and amounts of chitosans (CHH or CHL) in a single form or combined with nisaplin compared with negative control samples (without preservatives) and positive control samples (with 0.05 % potassium sorbate as preservatives) were prepared and stored at room temperature (22±2 °C for 21 days). Chemical, physical, microbiological analysis and sensory evaluation were discussed, initially and periodically during storage of this products.

The results suggest that, Monascus extracts, chitosan and nisaplin can be practical to protect food and consumers from the risk of contamination by pathogenic and food spoilage microorganisms, to extend food shelf-life, to reduce food waste and to use in hurdle technologies at low temperature.

Key words: - *Monascus purpureus* pigments- Chitosan - Antimicrobial activity – Antioxidant activity - Toxicity- Beef burger- cupcakes.

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 sincere appreciation and deepest gratitude to **Prof. Dr. Ahmed Yousif Gibriel,** Professor of Food Science and Technology, Faculty of Agriculture, Ain Shams University for his close supervision, great helps, valuable suggestion, and continuous encouragement during the whole of this study.

Deepest thanks and sincere appreciation to **Prof. Dr. Hamdy M. Ebeid**, Professor of Food Science and Technology, Faculty of Agriculture, Ain Shams University for his guidance, constructive criticism, plentiful advice and every possible help he kindly offered throughout the course of this work.

I wish to express my deepest sincere appreciation to **Prof. Dr. Hany I. Khalil**, Professor of Food Science and Technology, Faculty of Agriculture, Ain Shams University for supervising this work, attention and efforts made through the course of the implementation of this thesis.

Also, I would like to extend my thanks to all the staff members and colleagues in the Food Science and Technology Department, Faculty of Agriculture, Ain Shams University for his giving all the facilities that made this work possible, for their fruitful cooperation and friendships.

Finally, I can not forget my family for their continuous help and support through this work.

LIST OF CONTENTS