

**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

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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

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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

اسات تكنولوجيا 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

في العلوم الزراعية
(علوم وتكنولوجيا الأغذية)

قسم علوم الأغذية
كلية الزراعة
جامعة عين شمس

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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

العلوم الزراعية (علوم وتكنولوجيا الأغذية)

تمت مناقشة الرسالة والموافقة عليها

:

- سامى إبراهيم الصياد
أستاذ علوم وتكنولوجيا الأغذية ، كلية الزراعة ، جامعة أسيوط
- نادية رفعت عبد الرحمن
أستاذ علوم وتكنولوجيا الأغذية المتفرغ ، كلية الزراعة ، جامعة عين شمس
- حمدى مصطفى عبيد
أستاذ علوم وتكنولوجيا الأغذية ، كلية الزراعة ، جامعة عين شمس
- أحمد يوسف جبريل
أستاذ علوم وتكنولوجيا الأغذية المتفرغ ، كلية الزراعة ، جامعة عين شمس

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بإستخدام طرق غير تقليدية
في العلوم الزراعية (علوم وتكنولوجيا الأ ي) :

:

. . أحمد يوسف جبريل

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

. . حمدى مصطفى عبيد

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

د. هانى إدريس خليل

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

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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 ($4\pm 2^{\circ}\text{C}$ 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 ($22\pm 2^{\circ}\text{C}$ 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.

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