UNIVERSITI PUTRA MALAYSIA

CORRELATION OF ACRYLAMIDE WITH PRECURSORS AND COLOUR IN FROZEN PAR-FRIED FRENCH FRIES

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By

BABAK HATAMI BAROOGH

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Master of Science

April 2012

I DEDICATE THIS THESIS TO MY PARENTS AND ALL MY TEACHERS AND LECTURERS

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

CORRELATION OF ACRYLAMIDE WITH PRECURSORS AND COLOUR IN FROZEN PAR-FRIED FRENCH FRIES

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April 2012

Chairman : Prof Jinap Selamat, PhD

Faculty : Food Science and Technology

The aim of this study was to verify the occurrence of acrylamide formation after final frying and to study the correlation of acrylamide content with amino acids, reducing sugars and moisture content in frozen French fries samples, also to investigate acrylamide formation and reducing sugar content as main precursor in different production date and production plant of frozen fried French fries samples. Acrylamide analysis was based on gas chromatographic mass spectrometric technique (GC-MS) that included extraction and derivatization before analysis. Amino acids and reducing sugars determination has been done using high performance liquid chromatography (HPLC). It was discovered that final frying generates 76.04-348.55 µg/kg of acrylamide in French fries samples by wide range of reducing sugar content in the form of fructose and glucose (0.11-1.30 and 0.096-1.294 mg/g, respectively) and fifteen free amino acids (0.01-9.17 mg/g) that had been detected in frozen French fries sample before final

frying. Although, asparagine content (2.76-9.17 mg/g) was higher among other free amino acids, however; threonine and glutamine showed the higher correlation with acrylamide content. In addition, among reducing sugars, there was a significant correlation between glucose and acrylamide content and acrylamide and color development (Δa). It can be concluded correlation of acrylamide and precursors in frozen par fried French fries samples is not same as fresh fried potatoes. In second part, it has been investigated that there was not a significant difference between means of acrylamide content and reducing sugars of different brand ($P > 0.05$) and was no significant difference ($P > 0.05$) between reducing sugars and acrylamide content of two harvest years (2008-2009), although; acrylamide content in 2009 was higher than 2008. This part of study indicated that climate change from 2008 to 2009 has no significant single effect on acrylamide content in this product. Acrylamide content formed after frying frozen French fries sample of twelve month production within these two years are significantly different ($P < 0.05$). The highest content of acrylamide (348.55µg/kg) was found in samples produced in January that were significantly different among other months. The lowest amount of acrylamide (76.04µg/kg) was found in samples produced in September.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagi memenuhi keperluan untuk ijazah Master Sains

KORELASI AKRILAMIDA DENGAN PREKURSOR DAN WARNA DALAM KENTANG BEKU SEPARUH MASAK YANG DIGORENG

Oleh

BABAK HATAMI BAROOGH

April 2012

Pengerusi: Professor Jinap Selamat, PhD

Fakulti: Sains Makanan dan Teknologi

Tujuan kajian ini adalah untuk mengesahkan berlakunya pembentukan akrilamida selepas menggoreng dan mengkaji perkaitan antara kandungan akrilamida dengan asid amino, gula penurun dan kandungan lembapan di dalam sampel kentang goreng beku, juga untuk menyiasat pembentukan akrilamida dan kandungan gula penurun sebagai prekursor utama pada tarikh pengeluaran dan kilang pengeluaran kentang goreng beku yang berbeza. Analisis akrilamida berdasarkan teknik kromatografi gas spektrometrik (GC-MS) yang melibatkan pengekstrakan dan derivatization sebelum analisis. Asid amino dan gula penurun ditentukurkan mengikut kaedah kromatografi cecair berprestasi tinggi (HPLC). Ia telah ditemui bahawa menggoreng menjana 76.04-348.55 μg / kg akrilamida dalam sampel kentang goreng oleh pelbagai kandungan gula penurun dalam bentuk fruktosa dan glukosa (0.11-1.30 dan 0.096-1.294 mg / g, masing-masing)

dan 15 asid amino bebas (0.01-9.17 mg / g) yang telah dikesan dalam sampel kentang goreng beku sebelum goreng. Walaupun, kandungan asparagine (2.76-9.17 mg / g) adalah lebih tinggi di kalangan asid amino bebas yang lain, bagaimanapun, threonin dan glutamin menunjukkan korelasi yang lebih tinggi dengan kandungan akrilamida. Di samping itu, antara gula penurun, terdapat hubungan yang signifikan antara glukosa dan kandungan akrilamida dan akrilamida dengan pembangunan warna (Δa). Dapat disimpulkan korelasi akrilamida dan prekursor dalam kentang goreng beku tidak sama seperti kentang goreng segar. Dalam bahagian kedua, tiada perbezaan yang signifikan antara purata kandungan akrilamida dan gula penurun bagi jenama yang berbeza (P> 0.05) dan tiada perbezaan yang signifikan (P> 0.05) antara gula penurun dan kandungan akrilamida bagi dua tuaian tahun (2008-2009), walaupun; akrilamida kandungan pada tahun 2009 adalah lebih tinggi daripada 2008. Kajian juga menunjukkan bahawa perubahan iklim dari 2008 hingga 2009 tidak mempunyai kesan yang ketara ke atas kandungan akrilamida dalam produk ini. Kandungan akrilamida dibentuk selepas menggoreng kentang goreng beku daripada dua belas bulan pengeluaran dalam tempoh dua tahun ini berbeza secara signifikan (P <0.05). Kandungan tertinggi akrilamida (348.55μg/kg) telah dijumpai dalam sampel pada bulan Januari yang menunjukkan perbezaan yang ketara di kalangan bulan-bulan yang lain. Jumlah terendah akrilamida (76.04μg/kg) telah dijumpai dalam sampel yang dihasilkan pada September.

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I certify that an Examination Committee met on 26/04/2012 to conduct the final examination of Gisia Daniali on his Mst degree of Food Science thesis entitled "Determination of acrylamide in banana-based snack and the effect of precursors on the acrylamide formation" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the student be awarded the Master of Science degree. Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. Members of the Supervisory Committee were as follows.

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I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

BABAK HATAMI BAROOGH

Date: 26 April 2012

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