UNIVERSITI PUTRA MALAYSIA

INCREASING RESISTANT STARCH CONTENT IN FISH CRACKERS THROUGH VARIOUS COOKING-CHILLING CONDITIONS

MOHD ZUHAIR BIN MOHD NOR

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By

MOHD ZUHAIR BIN MOHD NOR

Thesis Submitted to the School of Graduates Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

August 2012

DEDICATION

To my beloved wife, Intan Syafinaz;

My family members and friends.

Thanks for your encouragement, patience and loving support.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the partial requirement for the degree of Master of Science

INCREASING RESISTANT STARCH CONTENT IN FISH CRACKERS THROUGH VARIOUS COOKING-CHILLING CONDITIONS

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August 2012

Chairman : Rosnita A. Talib, PhD

Faculty : Engineering

Fish cracker is one of the favourite snacks in Malaysia. However, studies on resistant starch (RS) in it have been paid little attention. Resistant starch is a starch that goes through the small intestine without being digested, providing a similar effect as dietary fibre. This RS can potentially be formed during the cooking and chilling processes in the production of the fish cracker. Both processes involve starch gelatinization and retrogradation that can lead to the formation of RS, creating a healthy and valuable product. Thus, this work investigates the effect of varying cooking-chilling conditions on resistant starch (RS) content and other important quality characteristics in fish cracker products. Process conditions such as the number of repetitive cooking-chilling (RCC) cycles (1 to 4 cycles), cooking temperature (100 °C, 115 °C and 121 °C) and chilling duration (1 to 4 days) as well as the type of starch used in the formulation (tapioca, wheat and sago) were studied with the aim to enhance the fish crackers with an

appreciable amount of resistant starch without compromising the quality characteristics. The quality characteristics of fish crackers in terms of hardness and moisture content of the chilled fish cracker gels, the RS of the dried fish crackers as well as the linear expansion (LE), hardness and colour of the fried fish crackers were evaluated.

The results showed that up to four cycles of RCC increased the RS content in all products. Sago starch fish crackers cooked at 121 °C had the highest RS content in the dried samples. The repeated cooking-chilling cycles increased the extent of starch gelatinization with each successive cooking cycle and promoted retrogradation upon cooling, thus, promoting the formation of RS. However, initially cooking the fish crackers at 100 °C and exposing to a longer chilling duration of up to four days did not demonstrate any changes in the RS. Different combinations of cooking-chilling repetition, cooking temperatures and chilling durations produced varying RS content in the fish crackers.

As for other quality characteristics, increasing the RCC cycles produced chilled fish cracker gels that were less hard and had higher moisture content. Longer chilling durations gave the opposite results. The quality characteristics of the fried fish crackers, namely hardness and colour, were mostly dependent on their expansion ability during frying. Fish crackers containing a higher RS have a lower LE with a negative correlation of R^2 = -0.777, thus, fried products with a lower LE were higher in hardness values and darker in colour.

The findings of the present study demonstrated that the variations of cooking-chilling conditions were able to increase the RS content in fish crackers. The lab-produced fish crackers in this study were superior in RS content with an acceptable range of LE and hardness values compared to the commercial non-fried and instant fish crackers. Thus, the lab-produced fish crackers in this study offer better health benefits in term of RS with comparable LE and hardness values for the consumer.

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

MENINGKATKAN KANDUNGAN KANJI RINTANG DI DALAM KEROPOK IKAN MELALUI PELBAGAI KEADAAN MEMASAK-MENYEJUK

Oleh

MOHD ZUHAIR BIN MOHD NOR

Ogos 2011

Pengerusi : Rosnita A. Talib, PhD

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Keropok ikan merupakan salah satu snek kegemaran di Malaysia. Sungguhpun begitu, kajian berkenaan kandungan kanji rintang (RS) di dalamnya jarang diberikan perhatian. Kanji rintang adalah kanji yang melalui usus kecil tanpa dicernakan, memberikan kesan yang serupa seperti gentian diet. Kanji rintang ini berpotensi untuk dihasilkan semasa proses memasak dan menyejuk di dalam pembuatan keropok ikan. Kedua-dua proses melibatkan gelatinasasi dan retrogradasi kanji yang membawa kepada pembentukan RS, seterusnya menghasilkan produk yang sihat dan bernilai. Oleh itu, penyelidikan ini mengkaji kesan kelainan keadaan memasak-menyejuk terhadap kandungan kanji rintang (RS) dan ciri kualiti penting yang lain di dalam produk keropok ikan. Keadaan proses seperti bilangan kitaran pusingan memasak-menyejuk (RCC) (1 hingga 4 kitaran), suhu memasak (100 °C, 115 °C dan 121 °C) dan tempoh penyejukan (1 hingga 4 hari) serta

jenis kanji yang digunakan di dalam formulasi (ubi kayu, gandum dan sagu) adalah diselidiki dengan tujuan bagi meningkatkan kandungan kanji rintang di dalam keropok ikan tanpa menjejaskan ciri kualitinya. Ciri kualiti bagi keropok ikan dinilai dalam bentuk nilai kekerasan dan kandungan kelembapan untuk gel keropok ikan, kandungan RS di dalam keropok ikan kering serta pengembangan lelurus (LE), kekerasan dan warna untuk keropok ikan goreng.

Keputusan menunjukkan bahawa RCC sehingga empat pusingan meningkatkan kandungan RS di dalam semua produk. Keropok ikan diperbuat dari kanji sagu yang dimasak pada suhu 121 °C mempunyai kandungan RS paling tinggi di dalam sampel kering. Pengulangan pusingan memasak-menyejuk meningkatkan tahap penggelatinan kanji pada setiap pusingan memasak dan membantu retrogradasi apabila menyejuk, seterusnya menggalakan pembentukan RS. Namun begitu, keropok ikan yang dimasak pada suhu awalan 100 °C dan didedahkan kepada tempoh penyejukan yang lama sehingga empat hari tidak menunjukkan sebarang perubahan terhadap RS. Kombinasi pengulangan memasak-menyejuk, suhu memasak dan tempoh penyejukan yang berbeza menghasilkan keropok ikan dengan kandungan RS yang berlainan.

Untuk ciri kualiti yang lain, peningkatan kitaran RCC menghasilkan gel keropok ikan sejuk yang kurang keras dan mempunyai kandungan kelembapan yang lebih tinggi. Manakala pendedahan kepada tempoh penyejukan yang lebih lama memberi kesan yang bertentangan. Ciri kualiti bagi keropok ikan goreng iaitu nilai kekerasan dan warna adalah bergantung kepada kadar pengembangan keropok semasa penggorengan. Keropok ikan yang mengandungi kandungan RS yang tinggi mempunyai LE yang

rendah dengan kolerasi negatif R^2 = -0.777, seterusnya produk goreng dengan LE yang rendah adalah tinggi nilai kekerasannya dan lebih gelap dari segi warnanya.

Penemuan di dalam kajian ini menunjukkan bahawa kelainan keadaan memasak-menyejuk boleh meningkatkan kandungan RS di dalam keropok ikan. Keropok ikan yang dihasilkan di makmal melalui kajian ini adalah lebih baik dari segi kandungan RS serta mempunyai julat LE dan nilai kekerasan yang boleh diterima apabila dibandingkan dengan keropok ikan komersial kering dan segera. Seterusnya, keropok ikan yang dihasilkan di makmal melalui kajian ini memberikan faedah kesihatan yang lebih baik dari segi RS berserta nilai LE dan kekerasan yang berpatutan kepada pengguna.

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I certify that a Thesis Examination Committee has met on 1 August 2012 to conduct the final examination of Mohd Zuhair bin Mohd Nor on his thesis entitle "Increasing resistant starch content in fish crackers through various of cooking-chilling conditions" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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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.** The members of the Supervisory Committee were as follows:

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DECLARATION

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 institution.

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MOHD ZUHAIR BIN MOHD NOR

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