UNIVERSITI PUTRA MALAYSIA

THERMAL, PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF RED TILAPIA *(OREOCHROMIS NILOTICUS)*

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By

MAHSHID EBRAHIMIAN

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

To my beloved family

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

THERMAL, PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF RED TILAPIA (*OREOCHROMIS NILOTICUS*)

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Chairman : Prof. Jamilah Bakar, PhD

Faculty : Food Science and Technology

Food preservation by thermal processing is one of the common techniques to provide the market with safe products. Information about thermal properties (*k*, c_p *! . L V* essential for efficient design of all food processing operation. During the chill storage of fish, many chemical and biochemical changes occur in the fish tissues, which influence quality and thermophysical properties of the stored fish. Therefore, the objectives of this study were to develop models for thermal properties of red tilapia experimentally as a function of temperature and moisture content, to find the relationship between thermal diffusivity ratio and acceptability of fish, and to investigate the effect of storage conditions (temperature, time) on texture parameters, sensory attributes, freshness and thermal properties of red tilapia. Samples were VWRUHGLQFKLOOHUVDW DQG analyses were carried out at 0, 1, 5, 9, 13 and 17 days of storage. Full factorial design was used to arrange the possible treatments and two-way analysis of variance (ANOVA) was employed to investigate the effect of storage conditions. Thermal properties data were fitted into mathematical models

and the results were compared with those reported by other researchers according to their root mean square error (RMSE). The quality changes of fish samples were determined by K-value, sensory assessment, instrumental texture analysis and changes of WKHUPDO GLIIXVLYLW\UDWLR, α_{fresh}, which included the effects of other thermal properties. The results showed that all sensory attributes (colour, odour, flavour, and general acceptability) decreased significantly ($p < 0.05$) with increase in temperature and days of storage. A significant increase ($p < 0.05$) in α_{fresh} was obtained throughout the days of storage. There were no significant differences ($p > 0.05$) in thermal diffusivity ratio due to changes in temperature range from WR &. The sensory evaluations were related to α_{fresh} variation. There was an inverse relationship between them, and R^2 IRU VDPSOHV NHSW DW DQG & HUH and 0.92, respectively. Therefore, the α_{fresh} ratio can be used as a numerical tool for food technologist to measure the consumer acceptance of chilled tilapia. Textural attributes of the fish flesh (hardness, cohesiveness, adhesiveness, springiness, gumminess and chewiness) were reduced with the increase in temperature and days of storage. There was a significant decrease ($p < 0.05$) in hardness of fish flesh during the storage period; however, no significant decreases were obtained for other texture attributes. The nucleotide degradation, as estimated by the k-value (freshness quality index) RI VDPSOHV VWRUHG DW & & DQG LQFUHDVHG VLJQLILFDQWO\ ($p < 0.05$) during the storage period. The highest increase was observed for k-value of VDPSOHV NHSW DW &. The overall results of this study indicated that the acceptability RI UHGWLODSLDD VWRUHG DW & GD\V DW & DQG GD\ s at 8 & E\ sensory and k-value methods. However, the suitability of thermal diffusivity ratio to assess freshness need to be more thoroughly researched.

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

SIFAT TERMAL, FISIKO-KIMIA DAN SENSORI IKAN TILAPIA MERAH (*OREOCHROMIS NILOTICUS*)

Oleh

MAHSHID EBRAHIMIAN

June 2012

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Pengawetan makanan melalui pemprosesan termal merupakan teknik normal bagi menyediakan pasaran dengan produk yang selamat. Maklumat tentang sifat termal (*k*, c_p ! . D G D O D K S H Q W L Q J E D J L U H N D E H Q W X N \ D Q J E H U pemprosesan makanan Ketika penyimpanan dingin ke atas ikan, kebanyakan perubahan kimia dan biokimia berlaku pada tisu ikan, yang mempengaruhi kualiti dan sifat termofizikal ikan yang tersimpan. Oleh sebab itu, objektif kajian ini adalah untuk menghasilkan model bagi sifat termal ikan tilapia merah yang secara eksperimental berfungsi sebagai suhu dan kandungan lembapan, untuk mencari hubungan antara ratio kemeresapan termal dan penerimaan ikan, dan untuk menyelidiki kesan kondisi penyimpanan (suhu, masa) ke atas parameter tekstur, atribut sensori, sifat kesegaran dan termal ikan tilapia merah. Sampel disimpan di dalam pendingin pada suhu 0, 4, dan 8 & dan analisis telah dilakukan pada 0, 1, 5, 9, 13 dan 17 hari penyimpanan. Reka bentuk faktorial penuh telah digunakan untuk menyusun rawatan yang sesuai dan Analisis Varians Dua Hala (ANOVA) telah

digunakan untuk menyelidiki kesan kondisi penyimpanan. Data sifat termal telah disesuaikan dengan model matematik dan keputusan telah dibandingkan dengan laporan oleh penyelidik lain berdasarkan ralat punca min kuasa dua (RMSE). Perubahan kualiti pada sampel ikan telah ditentukan oleh nilai-K, penaksiran sensori, analisis tekstur instrumental dan perubahan ratio kemeresapan termal .. $_{fresh}$), yang merangkumi kesan sifat termal yang lain.Hasil dapatan menunjukkan bahawa semua atribut sensori (warna, bau,perisa, dan penerimaan umum) menurun dengan peningkatan suhu dan bilangan hari penyimpanan (p ”). Peningkatan yang signifikan dalam .. $_{fresh}$ diperoleh di sepanjang bilangan hari penyimpanan (p ” 0.05). Tidak terdapat perbezaan yang signifikan dalam ratio kemeresapan termal disebabkan julat perubahan suhu dari 0 hingga 8 & (p ” Penilaian sensori berkaitan dengan variasi .. $_{fresh}$. Terdapat hubungan yang sebaliknya antara mereka, dan R^2 bagi sampel yang disimpan pada suhu 0 &, 4 & dan 8 & ialah masing-masing 0.84, 0.87 dan 0.92. Oleh sebab itu, ratio .. $_{fresh}$ boleh digunakan sebagai alat numerikal bagi ahli teknologi makanan untuk mengukur penerimaan pelanggan terhadap tilapia dingin. Atribut tekstural bagi isi ikan (kekerasan, kejeleketan, kelekatan, kekenyalan, kebergetahan dan keliatan) telah menurun dengan peningkatan suhu dan bilangan hari penyimpanan. Terdapat penurunan yang signifikan (p ” dari segi kekerasan isi ikan semasa tempoh penyimpanan; walau bagaimana pun, tidak terdapat penurunan yang signifikan bagi atribut tekstur yang lain. Degradasi nukleotida, yang dianggarkan oleh nilai-k (index kualiti kesegaran) bagi sampel yang tersimpan pada suhu 0 &, 4 & dan 8 & meningkat secara signifikan (p ” ketika tempoh penyimpanan. Peningkatan tertinggi telah dikesan bagi nilai-k untuk sampel yang disimpan pada 8 &. Keputusan keseluruhan kajian ini menunjukkan bahawa penerimaan tilapia merah merujuk kaedah deria dan

nilai-k DGDODK KDUL SDGD & KDUL SDGD & GDQ KDUL SDGD &. Walau bagaimanapun, kajian yang lebih teliti diperlukan untuk kesesuaian nisbah kemeresapan haba bagi penilaian kesegaran tilapia merah.

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DECLARATION

I declare that the thesis is my original work except for quotations and citation 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 other institutions.

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