UNIVERSITI PUTRA MALAYSIA

EFFECTS OF SELECTED POLYSACCHARIDES ON PHYSICAL PROPERTIES OF FISH GELATIN-BASED EDIBLE FILMS

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BY

ELHAM MOHAMMAD ZADEH

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

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DEDICATION

It is my honor to dedicate this Master thesis to my adorable parents

For their endless love and support,

Who though me the value of education.

It is also dedicated to my sister and my brother for their continued encouragements during all these years of study.

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

EFFECTS OF SELECTED POLYSACCHARIDE ON PHYSICAL PROPERTIES OF FISH GELATIN-BASED EDIBLE FILMS

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Chairman: Prof. Jamilah Bakar, PhD

Faculty: Faculty of Food Science and Technology

Gelatin-based edible packaging is thin, flexible and biodegradable biopolymers with broad applications. However, physical and thermal properties of fish gelatin limit its use in many applications. Therefore, the objective of this study was to improve the mechanical properties, permeability properties including water vapor (WVP) and oxygen permeability (PO_2), thermal properties and the color properties of the fish gelatin-based film by the addition of gellan and κ-carrageenan as variables with sorbitol in different concentrations. The study also aimed to identify the best combination of the additives that could produce an edible fish gelatin-based film having improved physical properties. Fish gelatin-based film was prepared by casting technique with the average thickness of 0.05±0.01mm. Control film was 5% fish gelatin with no gellan, κ-carrageenan and sorbitol. Different levels of gellan and κ-carrageenan with 25% and 35% sorbitol had significant effects on TS, %E, PF, WVP, PO2, T_m and the enthalpy ($p<0.05$). The addition of κ-carrageenan (0-2% w/w based on gelatin) or gellan (0-2% w/w based on gelatin) with sorbitol (25% and 35%

w/w based on gelatin) improved mechanical, permeability and thermal properties of fish gelatin-based film compared to control film or those films with just sorbitol. Formulated films contain 35% sorbitol and 2% gellan showed the highest %E and PD among the films contain gellan, also melting temperature and the enthalpy of these films increased to 140°C and 53J/s respectively. Water vapor and oxygen permeability were decreased after adding gellan and sorbitol, although they had no significant effect on TS and PF as compared to control film. Formulated films with 25% sorbitol and 2% κ-carrageenan had the highest TS and PF. The films containing 35% sorbitol and 2% κ-carrageenan showed the highest PD, E and thermal properties, which were around 95.88%, 130% and also T_m and ΔH_m around 142.5 °C and 131.4 J/g respectively. The addition of κ-carrageenan and sorbitol improved the WVP and PO_2 as compared with control film. κ-carrageenan had more positive effect on the physical properties of formulated fish gelatin film rather than gellan. Formulated films with 2% κ-carrageenan and 35% sorbitol had better mechanical, thermal and permeability properties of the film. The brightness of the formulated films was decreased and the yellowness and greenness were increased after adding either gellan or κ-carrageenan. The comparison of the best level of formulated gelatin film with PLA film showed that formulated gelatin film had better elasticity and permeability properties and lower strength than PLA film.

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

KESAN BEBERAPA POLISAKARIDA TERPILIH PADA SIFAT FISIKAL FILEM EDIBLE GELATIN IKAN

Oleh

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Pengerusi: Prof. Jamilah Bakar, PhD

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Bungkusan boleh makan berasaskan gelatin adalah tipis, fleksibel dan terbiodegradasi dengan aplikasi yang luas. Namun, sifat fizikal dan termal gelatin ikan menghadkan penggunaannya dalam banyak aplikasi. Oleh itu, kajian ini dijalankan adalah untuk meningkatkan sifat mekanik, sifatketelapan termasuk wap air (WVP) dan ketelapan oksigen (PO_2), sifat terma dan sifat warna dari filem berasaskangelatinikan dengan penambahan gellan dan K-karagenan sebagai pembolehubah dengan sorbitol dalam kepekatan yang berbeza.Penyelidikan ini juga bertujuan untuk mengenal pasti kombinasi bahanterbaik yang dapat menghasilkan sebuah filem boleh makan berasaskan gelatin ikan yang memiliki sifat fisikokimia yang dipertingkatkan. Filem berasaskan gelatin ikan dihasilkan melalui teknik penuangan dengan ketebalan sekitar 0.05 ± 0.01mm. Filem kawalan (5% gelatin ikan tanpa karaginan, gellan dan sorbitol) memiliki kekuatan regangan. Kandungan gellan dan karaginan yang berbeza dengan 25% dan 35 sorbitol% mempunyai kesan yang signifikan pada TS, E%, PF, WVP, PO2, Tm dan entalpi ($p < 0.05$). Penambahan K-

karagenan (w 0-2% b / b berdasarkan gelatin) atau gellan (0-2% b / b berdasarkan gelatin) dengan sorbitol (25% dan 35% b / b berdasarkan gelatin) meningkatkan sifat mekanikal, ketelapan dan sifat terma filem gelatin berasaskan ikan berbanding dengan filem kawalan atau filem yang hanya mengandungi sorbitol. Filem dengan rumusan mengandungi 35% sorbitol dan 2 gellan% menunjukkan E% dan PD tertinggi antara filem mengandungi gellan. suhu lebur dan entalpi filem-filem mengandungi gellan 2% dan sorbitol 35% meningkat menjadi 140 ° C dan 53J / s masing-masing. Ketelapan wap air dan oksigen yang semakin berkurangan selepas dengan penambahan gellan dan sorbitol, walaupun mereka tidak mempengaruhi secara signifikan terhadap TS dan PF berbanding dengan filem kawalan. Filem dirumus dengan sorbitol 25% dan 2 karagenan% memiliki TS dan PFyang tertinggi. Filem-filem yang mengandungi sorbitol 35% dan 2% karagenan masing-masing menunjukkan PD tertinggi, E dan sifat terma sekitar 95,88%, 130% dan juga Tm dan ΔHm sekitar 142,5 ° C dan 131,4 J / g. Penambahan karagenan dan sorbitol meningkatkan WVP dan PO2 berbanding dengan filem kawalan. K-karagenan lebih mempengaruhi ciri-ciri filem yang dirumus gelatin ikan berbanding gellan. Filem dirumus dengan karagenan 2% dan 35% sorbitol memiliki sifat yang mekanik, terma dan ketelapanyang lebih baik. Kecerahan filem yang dirumus mengalami penurunan manakala kekuningan dan kehijauan meningkat selepas penambahan gellan atau K-karagenan.

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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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ELHAM MOHAMMAD ZADEH
Date: Dec 2011

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