



**DEVELOPMENT AND CHARACTERIZATION OF POLYLACTIC
ACID/ POROUS CORN STARCH – INCLUSION COMPLEX
BLEND FILM CONTAINING THYMOL**

by

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Sekian, terima kasih.

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LIST OF ABBREVIATIONS

Abbreviations	Definition
°C	Degree celcius
%	Percent
β - CD	Beta - cyclodextrin
AC	Active compound
DSC	Differential scanning calorimetry
EE	Encapsulation efficiency
EO	Essential oil
FDA	Food and Drug Administration
FTIR	Fourier transform infrared spectrophotometer
g	Gram
GRAS	Generally Recognized as Safe
ICs	Inclusion complexes
PCS	Porous corn starch
PLA	Polylactic acid
PLA 4043D	Poly (lactic acid) 4043D
RH	Relative humidity
THY	Thymol
T _c	Crystallization temperature
T _m	Melting temperature
T _g	Glass transition temperature
TGA	Thermogravimetric analysis
WVP	Water vapor permeability
WVTR	Water vapor transmission rate

**PEMBANGUNAN DAN KARAKTERISASI FILEM BERCAMPURAN ASID
POLILAKTIK/KANJI JAGUNG BERLIANG MENDUNGKI
TIMOL - KOMPLEKS INKLUSI**

ABSTRAK

Asid polilaktik adalah bio – poliester yang digunakan secara meluas dalam bidang pembungkusan makanan atas sebab ia mudah dibiodegradasi, kitar semula dan tidak bertoksik. Asid polilaktik digunakan secara meluas dalam bidang pembungkusan makanan. Namun begitu, ia disertai dengan kelemahan seperti kerapuhan yang tinggi, kestabilan haba serta sifat penghalang wap air yang lemah. Akhir – akhir ini, pelbagai usaha untuk memperbaiki sifat - sifat asid polilaktik telah dibuat. Namun begitu, pengadunan asid polilaktik dengan kanji jagung berliang, yang merupakan sejenis kanji ubahsuaian yang dilengkapi dengan rongga liang besar bersesuaian untuk pembentukan kompleks inklusi, masih belum diterokai. Tujuan penyelidikan ini adalah untuk menghasilkan filem kompleks inklusi bercampuran asid polilaktik/kanji jagung berliang yang mengandungi timol sebagai sebatian aktif melalui cara ko - pemendakan dan acuan mampatan, untuk menentukan kesannya pada sifat-sifat penghalang wap air, mekanikal, dan haba asid filem polilaktik. Berdasarkan keputusan spektroskopi inframerah fourier transformasi, puncak penyerapan yang berkorelasi dengan kumpulan berfungsi C=O meregang (1749.44 cm^{-1}), C-H membengkok (1452.40 , 1381.03 , and 1359.82 cm^{-1}), C-O meregang (1267.23 , 1182.36 , 1128.36 , and 1082.07 cm^{-1}), CO-O meregang (1045.42 cm^{-1}) dijumpai di filem asid polilaktik – kompleks inklusi, yang menunjukkan keserasian yang tinggi antara kompleks inklusi dengan asid polilaktik. Penggabungan kompleks inklusi dengan filem asid polilaktik disahkan selanjutnya melalui penurunan suhu permulaan kemerosotan filem asid polilaktik – kompleks inklusi ke 292.0°C akibat kandungan timol yang menunjukkan suhu permulaan kemerosotan yang lebih rendah.

Sifat penghalang wap air asid polilaktik juga menunjukkan peningkatan (14.3×10^{-4} g/Pa.s.m.) melalui pengadunan dengan kompleks inklusi kanji jagung berliang/timol, ini dispekulasi kerana penghasilan isipadu bebas yang besar dalam filem asid polilaktik. Secara kesimpulannya, kanji jagung berliang dapat menghasilkan kompleks inklusi yang berserasian tinggi dengan asid polilaktik.

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ABSTRACT

Polylactic acid is a bio – based polyester, widely applied in the field of food packaging due to its biodegradability, recyclability and non – toxicity nature. However, it is accompanied by drawbacks such as high brittleness, poor thermal stability and barrier properties. In the past, various attempts of improving the functional properties of polylactic acid has been made. Blending of polylactic acid with porous corn starch, which is a type of modified starch equipped with large pore cavities suitable for the formation of inclusion complex, however, has yet been explored. The aim of this research was to fabricate a polylactic acid/porous corn starch – inclusion complex blend film with thymol as the active compound via co – precipitation for the formation of inclusion complex and compression molding for film formation, to determine its effect on the mechanical, thermal, and water vapor barrier properties of polylactic acid. Based on the Fourier - transform infrared spectroscopy result, absorption peaks observed in PLA – inclusion complex film samples, which corresponded to C=O stretching (1749.44 cm^{-1}), C-H bending (1452.40 , 1381.03 , and 1359.82 cm^{-1}), C-O stretching (1267.23 , 1182.36 , 1128.36 , and 1082.07 cm^{-1}), CO-O stretching (1045.42 cm^{-1}), were found to be identical with pure polylactic acid film, indicating a high miscibility between inclusion complex and polylactic acid film. Incorporation of inclusion complex into polylactic acid film was further confirmed through the depression of onset degradation temperature of polylactic acid – inclusion complex film to 292.0°C due to the presence of thymol in polylactic acid film with a lower degradation temperature. Incorporation of inclusion complex into polylactic acid film sample also resulted in a higher water vapor

permeability (14.3×10^{-4} g/m.s.Pa), hypothesized to be due to a higher free volume generated. In summary, porous corn starch notably yielded inclusion complex with good miscibility with PLA.