TESIS

PENGEMBANGAN FILM BIOPLASTIK NANOKOMPOSIT HA/PVP/CNC UNTUK APLIKASI KEMASAN MAKANAN

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Magister Sains pada Program Studi Magister Kimia

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PROGRAM STUDI MAGISTER KIMIA

FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM

UNIVERSITAS PENDIDIKAN INDONESIA

2024

Pengembangan Film Bioplastik Nanokomposit HA/PVP/CNC untuk Aplikasi Kemasan Makanan

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S.Si Universitas Pendidikan Indonesia, 2023

Sebuah Tesis yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Magister Sains (M.Si.) pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

LEMBAR PENGESAHAN

PENGEMBANGAN FILM BIOPLASTIK NANOKOMPOSIT HA/PVP/CNC UNTUK APLIKASI KEMASAN MAKANAN

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LEMBAR PERNYATAAN

Dengan ini saya menyatakan bahwa tesis dengan judul "Pengembangan Film Bioplastik Nanokomposit HA/PVP/CNC untuk Aplikasi Kemasan Makanan" ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila dikemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

Bangkok, 27 Agustus 2024

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KATA PENGANTAR

Segala puji dan syukur penulis panjatkan kepada Tuhan Yesus Kristus atas berkat dan anugerah-Nya yang melimpah, sehingga penulis dapat menyelesaikan tesis ini. Tesis dengan judul "Pengembangan Film Bioplastik Nanokomposit HA/PVP/CNC untuk Aplikasi Kemasan Makanan" ini diajukan sebagai salah satu syarat untuk meraih gelar Magister Sains pada Program Studi S2 Kimia, Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam, Universitas Pendidikan Indonesia.

Penulis menyadari bahwa tesis ini masih memiliki kekurangan dan keterbatasan. Oleh karena itu, penulis sangat mengharapkan kritik dan saran yang konstruktif dari berbagai pihak. Semoga tesis ini dapat memberikan manfaat, baik bagi penulis, pembaca, maupun peneliti selanjutnya.

Bangkok, 27 Agustus 2024

Gabriela Chelvina Santiuly Girsang

UCAPAN TERIMA KASIH

Puji dan syukur penulis panjatkan kepada Tuhan Yesus Kristus atas berkat dan kasih setia-Nya, yang memungkinkan penulis menyelesaikan tesis yang berjudul "Pengembangan Film Bioplastik Nanokomposit HA/PVP/CNC untuk Aplikasi Kemasan Makanan" sebagai salah satu syarat untuk memperoleh gelar magister.

Dalam proses penelitian dan penyusunan tesis ini, penulis telah menerima banyak bantuan, arahan, serta dukungan dari berbagai pihak. Oleh karena itu, penulis ingin menyampaikan rasa terima kasih yang tulus dan mendalam, khususnya kepada:

1. Orang tua (J. Girsang/K. E. br. Sijabat) beserta adik penulis (A. H. A. br. Girsang) yang terkasih, yang senantiasa memberi dukungan, semangat, dan doa kepada penulis;
2. Paman dan Bibi (A. Munthe/S. br. Girsang) beserta sepupu penulis (G. B. C. Munthe dan S. T. br. Munthe) yang senantiasa memberi dukungan, semangat, dan doa kepada penulis;
3. Bapak Dr. H. Budiman Anwar, M.Si., selaku Pembimbing I dan Pembimbing Akademik yang telah memberi dukungan, arahan, dan bimbingan kepada penulis selama proses penelitian dan penulisan tesis;
4. Ibu Prof. Fitri Khoerunnisa, Ph.D., selaku Pembimbing II dan Ketua Program Studi Kimia FPMIPA UPI yang telah mendukung, mengarahkan, dan membimbing penulis selama proses penelitian dan penulisan tesis;
5. Prof. Supa Hannongbua, Assoc. Prof. Dr. Patchreenart Saparpakorn, Assoc. Prof. Dr. Pongthep Prajongtap, dan Assoc. Prof. Dr. Patraporn Luksirikul dari Fakultas Sains, *Kasetsart University*, Thailand atas bimbingan, dukungan, dan semangat semasa penulis melakukan riset pada program *Internasional Short-Term Internship/Co-Research Exchange Program at Graduate Level* (iIREPs);

6. Segenap dosen dan staf Program Studi Kimia Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam;
7. Nataya Shafira, Gabe Napitu, Brigitta Stacia Maharani, Jessica Veronica, dan Wafa Raihanah Arwa selaku teman dan sahabat penulis yang telah memberi dukungan, semangat, dan tempat berkeluh kesah semasa studi;
8. Rekan seperjuangan S2 Kimia Universitas Pendidikan Indonesia yakni Jihan, Dea, Teh Yurin, Teh Putri, Teh Riri, Kang Andika, Teh Silvia, Teh Ni Putu, Kang Hari, dan Teh Vizny yang selalu memberi semangat dan saran kepada penulis semasa studi;
9. Rekan satu tim riset Biopolimer yang dibimbing oleh Bapak Dr. H. Budiman Anwar, M.Si., dan tim riset yang dibimbing oleh Ibu Prof. Fitri Khoerunnisa, Ph.D, khususnya Valensia, Mutiara, Nusaibah, Amanda, dan Kezia;
10. Rekan satu tim riset yang telah memberi dukungan dan berkolaborasi bersama selama projek di Program iIREPs yakni Pee Meen, May, Pee Bow, Pee Fern, Pee Tao, Fern dan Phonn;
11. Pendanaan Penelitian dan Pengabdian Masyarakat Skema Tesis Magister dari Kemendikbudristek Indonesia beserta *Scholarship* dari Program iIREPs Fakultas Sains, *Kasetsart University*, Thailand yang telah memberikan fasilitas dan membantu pendanaan untuk penelitian ini;
12. Semua pihak yang telah berpartisipasi atas terselesaikannya penelitian beserta tesis ini.

Penulis berharap tesis ini dapat memberikan manfaat dan memperluas wawasan, baik bagi penulis sendiri maupun bagi pembaca dan masyarakat luas. Penulis juga sangat mengharapkan adanya kritik dan saran dari para pembaca untuk kemajuan dan perkembangan penelitian selanjutnya.

Bangkok, 27 Agustus 2024

Penulis

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ABSTRAK

Hyaluronic Acid (HA) mulai dikembangkan sebagai film plastik kemasan karena sifatnya yang non toksik, biokompatibel, dan biodegradable. Pencampuran HA dengan polimer *polyvinylpyrrolidone* (PVP) dan pengkompositan dengan *selulosa nanokristal* (CNC) memungkinkan penekanan biaya produksi serta pembentukan material film baru dengan sifat fisikokimia gabungan dari komponen penyusunnya. Penelitian ini bertujuan untuk menyelidiki pengaruh penambahan dan variasi komposisi PVP dan CNC terhadap struktur dan sifat fisikokimia dari film HA/PVP dan HA/PVP/CNC. CNC disintesis dari selulosa bakterial (BC) menggunakan metode hidrolisis asam sementara film HA/PVP dan HA/PVP/CNC disintesis menggunakan teknik *solution casting* dengan pelarut air. CNC dikarakterisasi dengan FTIR, XRD, TEM, dan PSA. Karakterisasi film meliputi morfologi (SEM), gugus fungsi (FTIR), kristalinitas (XRD), serta sifat fisikokimia seperti kekuatan mekanik, penghalang uap air, degradasi, parameter termal, dan opasitas film. PVP berinteraksi dengan HA via ikatan hidrogen serta misibel dan bercampur baik pada rasio HA/PVP7. Peningkatan kandungan PVP dalam film HA/PVP menyebabkan peningkatan keseragaman morfologi; kristalinitas (44%); sifat mekanik; nilai WVTR (69,12 g/m^2.jam); stabilitas termal (260°C); dan opasitas film (0,73). Secara keseluruhan, film campuran HA/PVP memiliki sifat mekanik yang lebih rendah dibandingkan film HA murni akibat melemahnya gaya intermolekuler dan minimnya interkalasi antar rantai polimer. CNC memiliki kompatibilitas yang baik dengan matriks HA/PVP dan berinteraksi melalui ikatan hidrogen. Peningkatan kandungan CNC mengakibatkan kristalinitas (43%) serta nilai WVTR meningkat (78,34 g/m^2.jam). Pada konsentrasi rendah (HA/PVP/CNC1), CNC meningkatkan elongasi film hingga 70%, sementara pada kandungan tinggi, CNC memberikan efek penguatan yang ditandai oleh kenaikan *tensile strength* (HA/PVP/CNC3). Penambahan CNC dalam matriks HA/PVP menyebabkan stabilitas termal dan opasitas film meningkat (1,20).

Kata kunci: polymer blend, nanokomposit, film, HA, PVP, CNC.

ABSTRACT

Hyaluronic Acid (HA) has been developed as a packaging plastic film due to its non-toxic, biocompatible, and biodegradable properties. Mixing HA with polyvinylpyrrolidone (PVP) and incorporating cellulose nanocrystals (CNC) allows for cost reduction and the creation of new film materials with combined physicochemical properties of their components. This study aims to investigate the effects of varying PVP and CNC compositions on the structure and physicochemical properties of HA/PVP and HA/PVP/CNC films. CNC was synthesized from bacterial cellulose (BC) using an acid hydrolysis method, while HA/PVP and HA/PVP/CNC films were synthesized using a solution casting technique with water as the solvent. CNC was characterized by FTIR, XRD, TEM, and PSA. Film characterization included morphology (SEM), functional groups (FTIR), crystallinity (XRD), and physicochemical properties such as mechanical strength, water vapor transmission rate (WVTR), degradation, thermal parameters, and film opacity. PVP interacts with HA through hydrogen bonding and is miscible and well-mixed at the HA/PVP7 ratio. Increasing PVP content in the HA/PVP films increases morphology uniformity; crystallinity (44%); mechanical properties; WVTR value (69.12 g/m²·hour); thermal stability (260°C); and film opacity (0.73). Overall, the HA/PVP blend films have lower mechanical properties compared to pure HA films due to weakened intermolecular forces and minimal intercalation between polymer chains. CNC has good compatibility with the HA/PVP matrix and interacts via hydrogen bonding. Increasing CNC content results in increased crystallinity (43%) and WVTR value (78.34 g/m²·hour). At low concentrations (HA/PVP/CNC1), CNC enhances film elongation up to 70%, while at high concentrations, CNC provides reinforcement, indicated by increased tensile strength (HA/PVP/CNC3). The addition of CNC in the HA/PVP matrix results in improved thermal stability and increased film opacity (1.20).

***Keywords**: polymer blend, nanocomposite, film, HA, PVP, CNC.*

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