ABSTRACT

Nowadays, polymer blending is one of the most effective ways of providing a new and desirable polymers materials. Modification of chitosan by blending with another polymer can be explored further due to its functional groups. In this study, solution blending technique is used to blend chitosan and nylon-6 which also contains suitable functional group that can promote compatibility between these polymers. Film composed of nylon-6, chitosan and its chitosan/nylon-6 blends are employed to investigate the interaction between those two polymers. FT-IR results show the displacement of carbonyl band amide group of chitosan to the smaller wavelength. It implies that there is existence of strong hydrogen bonding between these two polymers which can promote towards the compatibility of chitosan and nylon-6 blend. DSC analysis of the blend also showed a reduction of melting point (T_m) and heat of enthalpy (ΔH_m) due to the formation of new hydrogen bonds between polymer molecules. While, SEM analysis showed that the smoothness surfaces of pure chitosan gradually disappear and the flat dense surface became undulating. Due to the immiscibility between chitosan and nylon-6, its blend also have scattered round plaque like structure. All the results shown that increasing in DD of chitosan will increase the compatibility between chitosan and nylon-6 blend.

ABSTRAK

Pencampuran polimer adalah salah satu cara yang paling efektif untuk menyediakan polimer yang baru dan dikehendaki. Modifikasi kitosan melalui pencampuran dengan polimer yang lain boleh dikaji dengan lebih lanjut kerana kehadiran kumpulan berfungsi yang bersesuaian. Dalam penyelidikan ini, teknik percampuran larutan telah digunakan untuk mencampurkan kitosan dan Nilon-6, yang juga mempunyai kumpulan berfungsi yang sesuai sekaligus dapat menggalakkan keserasian di antara kedua-dua polimer ini. Filem yang terdiri daripada Nilon-6, kitosan dan hasil campuran kitosan/Nilon-6 telah digunakan untuk mengkaji interaksi antara kedua-dua polimer. Keputusan FT-IR menunjukkan pemindahan ikatan karbonil amida. Ini menandakan adanya ikatan hidrogen yang kuat antara polimer. Analisis kalorimeter pengimbasan perbezaan (DSC) juga menunjukkan penurunan takat lebur (T_m) dan entalpi (ΔH_m) yang disebabkan oleh pembentukan ikatan hidrogen yang baru antara polimer. Manakala, analisis SEM pula menunjukkan bahawa permukaan kitosan yang rata makin menghilang dan menjadi semakin beralun apabila dicampurkan dengan Nilon-6. Keputusan ini juga menunjukkan bahawa kenaikan darjah pendeasetilan (DD) kitosan akan menggalakkan keserasian antara campuran nylon-6 dan kitosan.

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LIST OF ABBREVIATIONS

Bz/Chx	-	benzene/cyclohexane
CN	-	chitosan/nylon-6 blend
CS	-	Chitosan
DD	-	degree of deacetylation
DMAc	-	dimethylacetylamide
DSC	-	Differential Scanning Calorimetry
FT-IR	-	Fourier Transform Infrared
KCl	-	Potassium Chloride
KOH	-	Potassium Hydroxide
kPa	-	kilopascal
LiCl	-	Lithium Chloride
NaOH	-	Sodium Hydroxide
NMR	-	Nuclear Magnetic Resonance
PVA	-	polyvinyl alcohol
SEM	-	Scanning Electron Micrograph
w/v	-	weight per volume
v/v	-	volume per volume
ΔH_m	-	Enthalpy of melting

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Polymer modification by blending of two or more different polymers to obtain desired properties is becoming a common practice now. The advantages of having blended polymer are they exhibit superior and rare properties, unexpected from homopolymers. The investigation on blends or composites of synthetic polymer with naturally occurring polymer can promise high potential especially in the field of making biodegradable, renewable biomass structure which is low cost but at the same time can provide superior properties.

Chitosan is a natural amino polymer which is very abundant in the world. This polymer receives special attention because it possesses good film-forming, is highly hydrophilic and has excellent chemical-resistant properties. It is a copolymer of glucosamine and *N*-acetylglucosamine units linked by 1-4 glucosidic bonds and, are obtained from deacetylation of chitin [1]. The reaction of chitosan is more versatile than chitin due to the presence of amine ($-NH_2$) and hydroxyl groups (-OH). Chitosan also is biodegradable, biocompatible, non-toxic and its functional group can be modified to generate chitin derivatives. But, this derivative is lack of solubility in common organic solvents. During deacetylation process, chitosan with different degree of deacetylation (DD) can be produced. The process involves the removal of acetyl groups from the molecular chain of chitin, leaving behind a complete amino group and chitosan properties depends mainly on this high degree chemical reactive amino.

Whereas, nylon-6 is one of synthetic polymer which is made from repeating units linked by peptide bonds known as polyamide. It is capable of specific interactions when blended with other polymers, due to its amide group. Nylon-6 also possesses high elongation, durability, excellent abrasion resistant and high resistance to many chemicals. But, it is nonbiodegradable and can create environmental problem.

In our study, blends of chitosan and nylon-6 are prepared with the goal of both of this polymer can give a good material. It is expected that chitosan/nylon-6 blend are compatible with each other due to the presence of suitable functional group which will be elaborated in the next chapter.

1.2 Objectives

The objective of this research is to produce chitosan and nylon-6 blend *via* solution blending method and also to investigate the effect of degree of deacetylation of chitosan towards the miscibility and compatibility of chitosan/nylon-6 blend.

1.3 Scope of Study

In this study, the compatibility of chitosan and nylon-6 blend was being studied by using chitosan with different degree of deacetylation. The blend's compatibility was further characterized using FT-IR, SEM, and DSC.

1.4 Significance of Study

This research is conducted to explore the ability of chitosan and nylon-6 to be blended together to produce new material. Through this research, the characteristic of new material produced from chitosan/nylon-6 blend can be investigated and can be further suggested of its potential application.