Chemistry Research Journal, 2018, 3(3):84-87

Available online www.chemrj.org

Research Article

ISSN: 2455-8990
CODEN(USA): CRJHA5

Effect of Plasticizer in Crosslinking of Polyvinyl alcohol (PVA)/ Gelatin Blend

M.S. El-Hassan[1], M.A. ABBO[2], E.A. Hassan[3], Ahmed M. Ismaiel[1]*

[1]Department of Chemistry, Faculty of Science, Jazan University, Jazan, Saudi Arabia
[2]Department of Chemistry, College of Education and science Taif University, Saudi Arabia
[3]Department of Chemistry, College of Science, Sudan University of Science and Technology, Sudan

Abstract In this thesis, polymer blends of poly vinyl alcohol (PVA) and gelatin (PVA/Gelatin) were prepared in different ratios by casting method in the presence of Glycerin as cross-linking agent. The poly vinyl alcohol (PVA)/ gelatin Blend films were studied using different techniques such as swelling test, SEM and FT-IR spectrum. Results showed that blend film ratio had water retention capability. SEM indicated that blend film is homogeneous with a regular in the surface..

Keywords PVA/Gelatin, Swelling, cross-linking

Introduction

A polymer can finally define as a molecule that consists of at least a serial of three units of a monomer, which are bonded throw covalent bond to at least one other monomer unit or another molecule [1]. Poly vinyl alcohol (PVA) is a commercial polymer and its properties depend on its molecular weight, total degree of hydrolysis, sequence distribution of monomer units, and tactility. PVA is a semi crystalline polymer and its crystalline index depends on the synthetic process and physical ageing. Hydrogen bonds keep together polymer chains, even in the amorphous phase. PVA has been the subject of intensive research because it has many applications in industry and it is of relatively low cost [2]. Poly (vinyl alcohol) PVA is a well-known membrane material with good film-forming properties, is a highly hydrophilic polymer, and has easy availability. Investigations have been done on its use in the field of separation processes. However, such a polymer suffers from poor water resistance and low mechanical strength in aqueous solutions. Therefore, it has to be turned into completely insoluble stable material with good mechanical properties. A number of investigations have been reported in the literature to modify PVA by cross-linking with different reagents such as aldehyde, dicarboxylic acid, heat, H_3BO_3 and radiation [3].

Gelatin is a well-characterized protein fragment obtained by partial degradation of water insoluble collagen fibers and has been widely used in the biomedical field, because of its merits, including its biological origin, biodegradability, hydrogel properties, and commercial availability relatively low cost. Gelatin is an intriguing candidate for drug delivery and is widely being used as tissue engineering scaffold. Cross-linked gelatin sponges have also been investigated for their application as a component of artificial skin or tissue transplants to promote epithelialization and granulation tissue formation in Wound [4]. Polymer blends (PB) is made by mixing of at least two polymers or copolymers. Polymer blends are physical mixtures of two or more polymers with/without any chemical bonding between them [5].

In miscible polymeric blends, there are often specific interactions between functional groups or polymer segments that lead to decrease of the Gibbs energy of mixing. Miscible polymer blends present only on one phase, while immiscible blends present separated domains, and the final properties of polymer blends are directly related to the degree of their miscibility, in immiscible polymer blends, their physical properties are poor compared with those of parent polymers because of phase separations arising from weak interaction at the boundaries of component polymers. The miscibility and the physical properties of polymer blends can be improved by applying intermolecular interaction such as hydrogen bonding and dipole-dipole interaction between blend components. Intermolecular hydrogen bonding interaction by hydroxyl, halogen, carbonyl, and amide groups leads to the improvement of miscibility based on favorable enthalpic interaction between polymer chains. Addition of compatibilizer into immiscible polymer blends also improves the miscibility and the physical properties, for polymer-polymer miscibility investigations, the most useful techniques are electronic microscopy, spectroscopy [2].

Materials and Methods

The swelling degree of the sample was characterized at room temperature 25 °C for which rounded samples with 1cm diameter were placed in de-ionized water. The swelling degree was calculated by using the following equation:

$$\text{Degree of swelling (\%)} = [(W_t - W_0)/ W_0] \text{ X}100 \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

W_t (is the wet weight after degrading for a predetermined time). W_0 (is the original weight of the sample).

Results and Discussion

From Figure (1), we observed that the polymer blend of (PVA/Gelatin) film of the studied ratios (25/75), (50/50) and (75/25) showed higher swelling degree percentages (%) after different times of immersion in de-ionized water. The higher swelling degree percentage (%) 550% was presented after 6h for the studied polymer blend ratio (75/25) while, the unirradiated ratio (50/50) gives 300% at 4h. The highest swelling degree percentage (%) 244% was appeared after 2hrs for the ratio (25/75). Then the swelling degree percentages (%) decrease slightly by increasing time of immersion of studied ratio in de-ionized water as follow (75/25) 425% after 8hrs, (50/50) 230% after 6hrs and (25/75) 180% after 4hrs of immersion in water.

The values of the swelling degree percentages showed that the studied blend film ratio had water retention capability. The reason of higher swelling degree percentages (%) PVA/Gelatin blend of (75/25) ratio film sample might be due to free amino groups in Gelatin and hydroxyl group which plays an important role in water uptake because of their hydrophilic nature[6]. Also, the Polyvinyl alcohol (PVA) is hydrophilic polymer with unique properties leading to more uptake percentage. It absorbs water, swells easily and it has been used in controlled resale application [7].

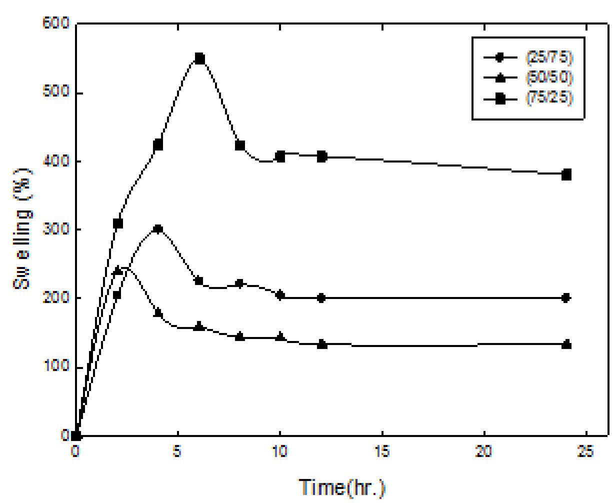
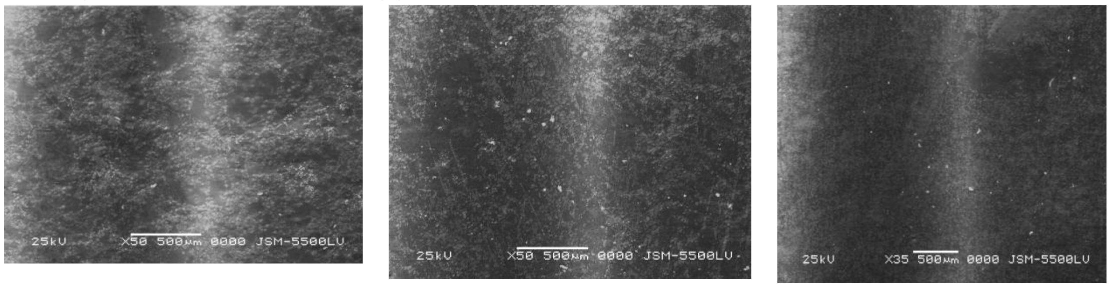


Figure 1: Swelling degree for PVA/ Gelatin polymer blends

Scanning Electron Microscopy (SEM):

Figures (2) shows the (SEM) study of the polymer blend (PVA/Gelatin) different ratios. For the ratio (25/75) of (PVA/Gelatin), blend film is homogeneous with a regular in the surface. This may be due to the high ratio of gelatin than PVA in polymer matrix of blend. Ratio (50/50), the upper surface and cross-section of the studied polymer blend showed homogeneity between the two miscible polymers of PVA and Gelatin phases. The surfaces of the blend films were also rough phase may be due to the two-equal percentage of polymer matrix, last ratio (75/25) shows relatively smooth and homogeneous surface with very sparsely distributed small particles without any phase separation. The homogeneity of the polymer blend film ratio (75/25) may be due to the heights ratio of PVA than Gelatin in polymer matrix in presence of glycerol.



A B C

Figure 2: PVA/gelatin Polymer blend ratio of A-(25/75),B-(50/50) and C-(75/25)

FT-IR Spectra

Figure (4) shows the FTIR spectrum for synthetic polymer blends of (PVA/Gelatin) different ratios (75/25), (50/50) and (25/75). Results refer to A weak band appeared at 2321.87 cm^{-1} is the characteristic bands of symmetric C-H stretching. C, C triplebond band is appeared at 2132.88 cm^{-1}. The stretching vibration bands of carboxylate anion COO^- showed at 1708.62 cm^{-1} [8]. A weak band is observed at 2136.74 cm^{-1} and has been assigned to the combination frequency of (CH+CC). We can conclude that the produced film had an ester linkage and secondary alcoholic group. Further, the FTIR results suggest a complete esterification of the of the carboxylic acid of gelatin. The absorption band at 860.88 cm^{-1} arises from C=C stretching vibration. OH wagging was found at 677.99 cm^{-1} [9-11].

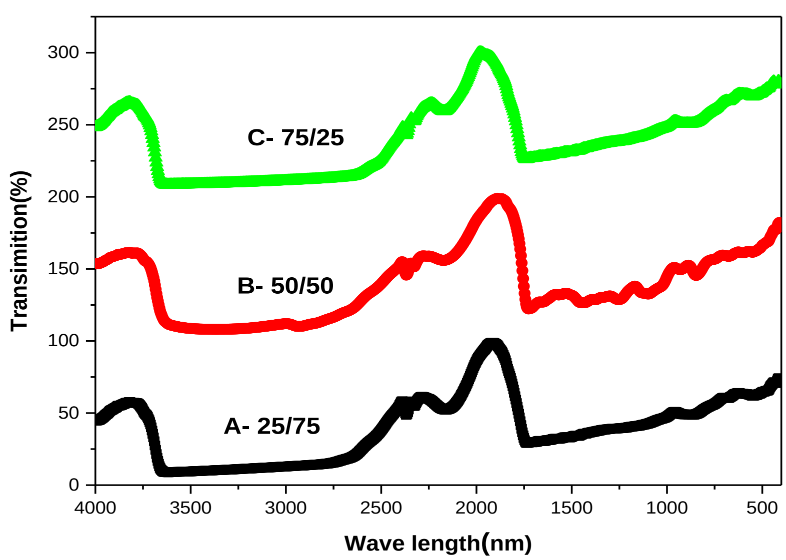


Figure 3: FT-IR spectra of PVA/gelatin Polymer blend ratio of A-(25/75), B-(50/50) and C-(75/25)

Conclusion

The present work was designed to assess the effect of glycerol plasticizer in crosslinking of polyvinyl alcohol (PVA)/ gelatin Blend. Swelling test show higher swelling degree percentages (%)PVA/Gelatin blend ratio film sample due to free amino groups in Gelatin and hydroxyl group which plays an important role in water uptake because of their hydrophilic nature. The FTIR results suggest a complete esterification of the carboxylic acid of gelatin. The homogeneity of the polymer blend film may be due to the heights ratio of PVA than Gelatin in polymer matrix in presence of glycerol.

References

1. European chemicals Agency (2012). Guidance for monomers and polymers. 2:9.
2. Z. I. Ali, W.H. Essa (2014). Characterization of Electron Beam Irradiated Poly Vinyl Alcohol / Poly Ethylene Glycol Blends. J. Sci. Res, 6(1):29.
3. H. A. ABD EL-REHIM, EL-SAYED A. HEGAZY, A. M. ALI (1999). Preparation of Poly (vinyl alcohol) Grafted with AcrylicAcid/Styrene Binary Monomers for Selective Permeation of Heavy Metals. Journal of applied polymer science, 74:807.
4. Md Arifur Rahman, Mubarak A. Khan, Shafi M. Tareq (2010). Preparation and Characterization of Polyethylene Oxide (PEO)/Gelatin Blend for Biomedical Application: Effect of Gamma Radiation. Journal of applied polymer science, 117:2075.
5. D.J. Walsh, S. Rostami (1985). Polymer blend, Adv. Polym. Sci. 70:119.
6. Kunal Pal, Ajit K. Banthia, Dipak K. Majumdar (2007). "Preparation and characterization of Polyvinyl alcohol –Gelatin Hydrogel Membranes for Biomedical Applications", Pharm. Sci. Tech., 8(1) 21.
7. Peppas N.A. and Korsmeyer R. W. (1986) "Dynamically swelling hydrogels in controlled release applications", In: Hydrogels in Medicine and Pharmacy, Peppas N.A., Ed., CRC Press, Flo., 3:110-129.
8. Rui Shi, Jingliang Bi, Zizheng Zhang, Aichen Zhu, Dafu Chen, Xinhua Zhou, Liqun Zhang, Wei Tian (2008) " The effect of citric acid on the structural properties and cytotoxicity of the polyvinyl alcohol/starch films when molding at high temperature", Carbohydrate polymers, 74**:**763-77.
9. Muyonga, J.H., C.G.B. Cole and K.G. Duodu (2004)" Extraction and physicochemical characterization of Nile Perch (*Lates niloticus*) skin and bone gelatin". Food Hydrocolloids, 18**:**581–592.
10. Tadokoro, H.B. (1959). Chem. Soc., Jpn. 32.
11. Tadokoro, H.S., S. Mita (1955) I. Bull., Chem. Soc., Jpn. 28.