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Swelling and FTIR studies on poly vinyl alcohol / carboxymethyl cellelouse blend films

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ABSTRACT: Polymers and polymeric composites have steadily reflected their importance in our daily life. Blending poly(vinyl alcohol) (PVA) with a potentially useful natural biopolymers such as carboxymethyl Cellulose (CMC) seems to be an interesting way of preparing a polymeric blends. The aim of the work is to blend PVA/CMC of compositions (100/0, 80/20, 60/40, 50/50, 40/60, 20/80, and 0/100 wt/wt%) were prepared to be used as bioequivalent materials. The blend have been Characterised by Fourier transform infra-red spectroscopy and swelling ratio. The obtained results showed variations in the FTIR spectra indicating the miscibility of the blend systems. More over the results showes improved swelling properties than the poly vinyl alcohol homopolymer.

KEYWORDS: Poly(Vinyl Alcohol) (PVA); Carboxymethyl Cellulose (CMC); Biodegradable polymer; Swelling; Blends; Bioequivalent materials; Solution casting; Fourier transform infra-red spectroscopy; polysaccharide.

1 INTRODUCTION

A wide range of synthetic aliphatic Polyesters and naturally occurring products are being used as biodegradable polymers for selected applications.

In recent years, copolymers and their blends have attracted the attention of material researchers to obtain intermediate properties with respect to homo-polymers for some specific functions. These interesting properties are attributed to the molecular motions in their amorphous phases. The interphase regions in blends and co-polymers are very important depending on the chemical nature of the doping substances and the type and extent in which they interact with host matrix [1].

Poly(vinyl alcohol) could be considered as a good host material due to good thermo-stability, chemical resistance and film forming ability. PVA is an important material in view of its large scale applications. It is used in surgical devices, sutures, hybrid islet transplantation, implantation, blend membrane, adhesivs and in synthetic cartilage in reconstructive joint surgery [2-6].

Carboxymethyl cellulose (CMC), amajor commercial derivative of cellulose, is a highly water soluble anionic polysaccharide (Fig.1), which is widely used in pharmaceutical, cosmetic, and food applications. In biomedical field, it is used to prevent the postoperative adherences and epidural scarring. It also possesses the advantages of being biodegradable and economic [7].

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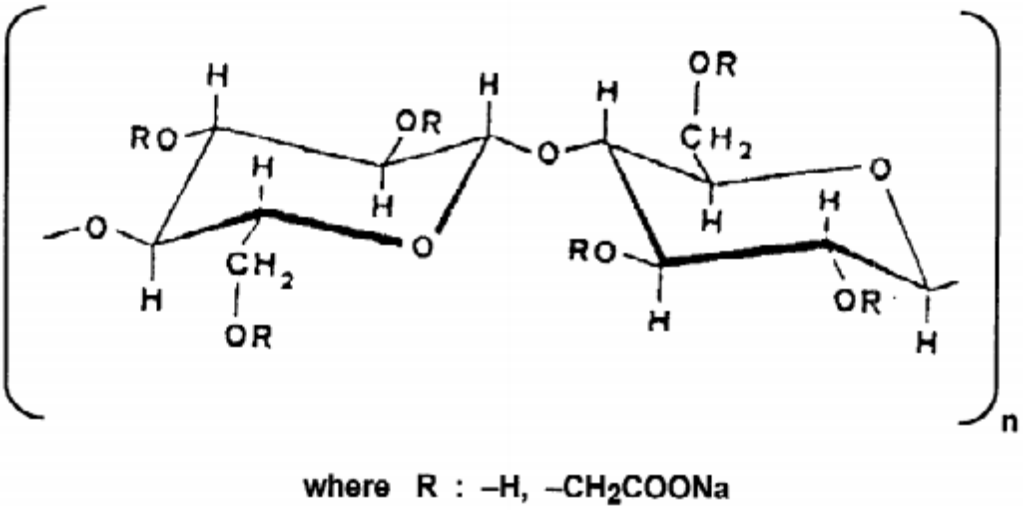

Fig.1. Structure of carboxymethyl cellulose (CMC)

At this work, we study the enhancement of PVA swelling properties by blending with highly absorbent biomaterial (carboxymethyl cellulose) by solution casting method.

2 EXPERIMENTAL SETUP

2.1 MATERIALS AND SAMPLES PREPARATION

The PVA granules with molecular weight of 14000 were supplied from Alpha Group, Cairo, Egypt. Carboxy methyl cellulose sodium salt CAS No. : 9004-32-4 was supplied from Oxford Laboratory, Mumbai, India.

The solution method was used to obtain film samples. This method depends on the dissolution, separately, the weighted amounts of PVA granules and CMC powder in double-distilled water. Complete dissolution was obtained using a magnetic stirrer in a 60˚C water bath to prevent thermal decomposition of polymer. To prepare thin films of the homopolymers (PVA and CMC) and the blend of their samples (PVA/CMC) with different weight percentages 100/0, 80/20, 60/40, 50/50, 40/60, 20/80, and 0/100 wt/wt%, the solutions were mixed together at room tempreture with a magnetic stirrer. Thin films of appropriate thickness (about 0.01 cm) were cast onto glass petri dishes (7 cm diameter). The prepared films were kept at room temperature (about 25˚C) for 7 days until the solvent completely evaporated and then kept in desiccators containing fused calcium chloride to avoid moisture.

2.2 FTIR SPECTROSCOPY

Transmission infrared spectra of the films were recorded at room temperature.The film was mounted directly in the sample holder.

2.3 SWELLING CHARACTARIZATION

PVP/CMC blend hydrogels with certain weight were immersed into deionized water and taken out at certain time to weight. Swelling degree was calculated as following :

$$\text{Swelling degree} = (G_t - G_d)/G_d \qquad (1)$$

Here G_t is the weight of the swollen sample at time t and G_d is the weight of the dry sample.

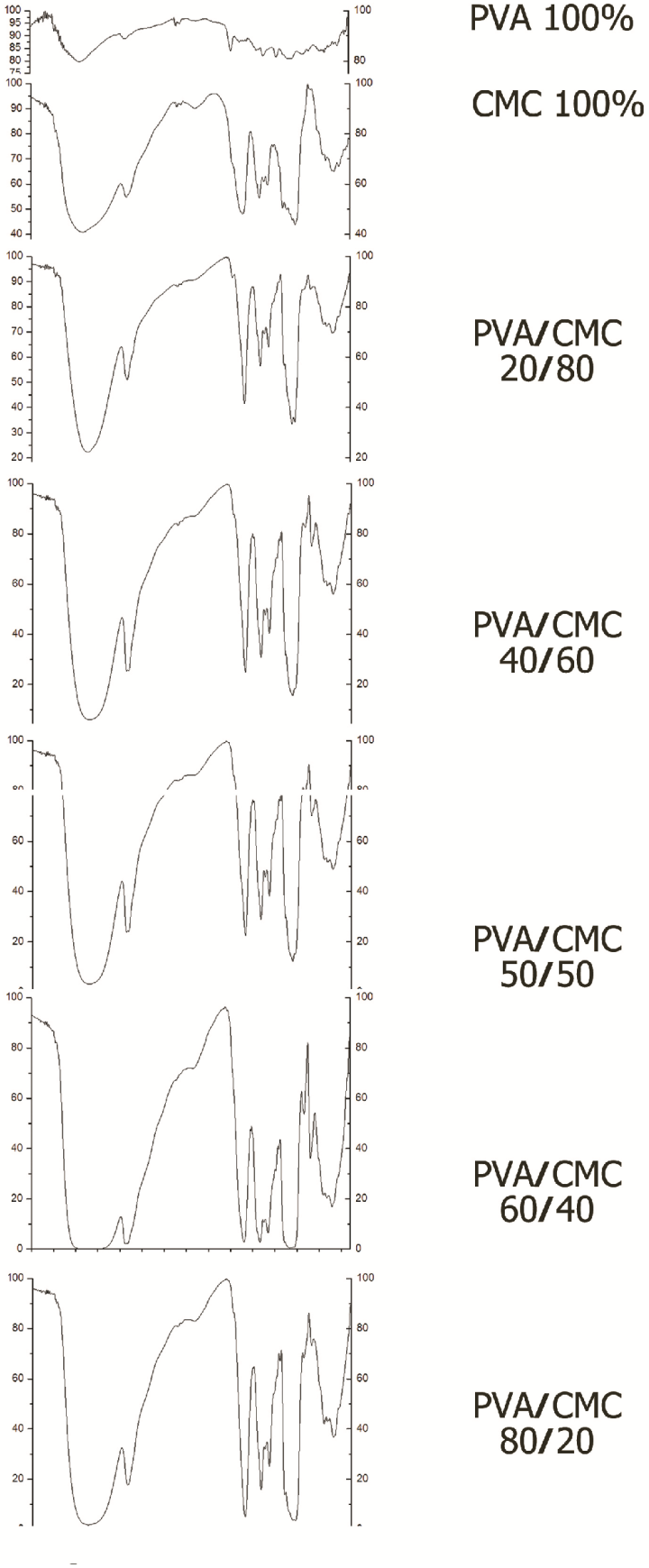

Fig. 2 FTIR spectra of PVA/CMC composites

3 RESULT AND DISCUSSION

3.1 FTIR ANALYSIS

FTIR is performed to identify and characterize the PVA/CMC Blend films. Figure 2 presents the FTIR spectra of the PVA/ CMC composites at ratios: 100/0, 20/80, 40/60, 50/50, 60/40 and 80/20 respectively.

3.2 SWELLING ANALYSIS

Fig. 3 represents the swelling analysis of the PVA/CMC composites. It was been observed that there are a variation in swelling ratios where the PVA films had the lowest swelling percentage, The CMC films had the highest swelling percentage and the swelling ratio increases by the increase of CMC content.

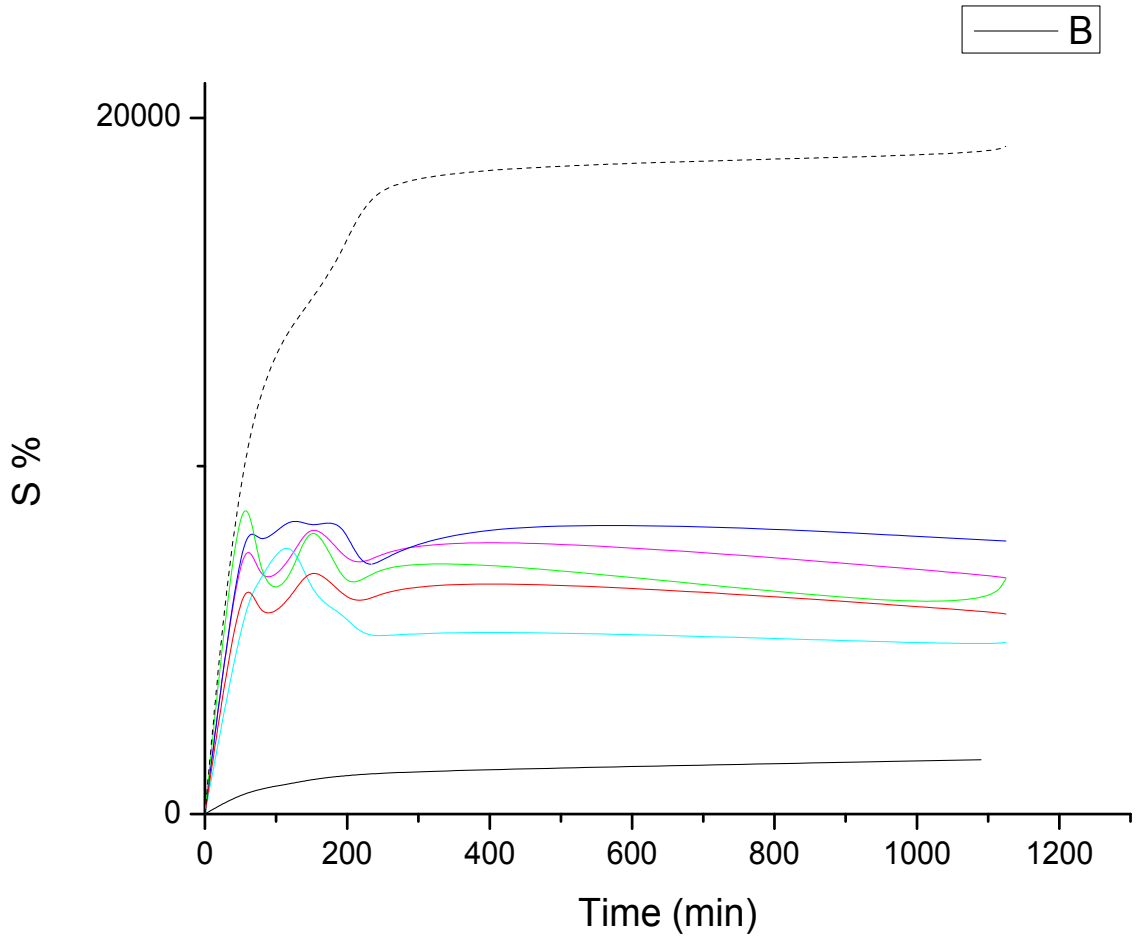

Fig. 3 Swelling percentage of PVA/CMC composites

4 CONCLUSION

Polyvinyl alcohol / carboxymethyl cellulose blend films have been prepared by solution casting technique. FTIR spectra proved the miscibility of the blend system. The swelling percentage of the blends dependes on the content of carboxymethyl cellulose. This is because carboxymethyl cellulose have both hydroxyl and carboxyl groups which make it more hydrophilic.

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