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Novel Biopolymer-Based Composite Wound Healing Wafers Containing *Astragalus sarcocolla* Gum

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SUMMARY

The aim of this research was the formulation development, optimisation and characterisation of wafers produced from various combinations of carrageenan and tragacanth gum as potential carriers for wound healing extracts. Gels composed of one of the following three polymers: carrageenan (CAR), tragacanth gum (TG) and hydroxypropyl methylcellulose (HPMC) were prepared and freeze dried to obtain single polymer blank wafers. The blank wafers were examined for required lyophilisation behaviour and physical elegance of the resulting product. Based on these results, HPMC was eliminated and a combination of CAR:TG at seven different polymer ratios was chosen for further research. These CAR:TG wafers were characterised using scanning electron microscope (SEM), X-ray diffraction (XRD), texture analysis (hardness and mucoadhesion), Fourier transform infrared spectroscopy (FTIR), swelling tests and fluid handling properties. The formulations with the optimal properties were selected for loading with the extract and the drug-loaded wafers were subsequently further characterised as above.

INTRODUCTION

An important part of pharmaceutical science research is the development of drug delivery systems. The features of the optimal drug delivery system vary depending on the type of the active ingredient, but the type of formulation plays a crucial role in ensuring the desired drug bioavailability and dosage at the intended site of action. CAR has been utilised for the development of drug delivery systems due to the ability to form a range of gels and films in the presence of calcium and potassium ions (Kuznetsova et al., 2020). TG has been used in drug delivery systems with the recent applications being incorporated in polyethylene glycol diacrylate and polyvinyl alcohol hydrogel dressings for wound healing. The composite formulations showed good antibacterial properties and good cytocompatibility (Hemmatgir et al., 2022). The novel aspect of this study is addition of *Astragalus sarcocolla* gum to composite of CAR:TG wafers which is expected to enhance the functional performance of dressing for chronic wound healing.

MATERIALS AND METHODS

Composite wafers were prepared by freeze drying gels combining 2% CAR:TG at seven different polymer ratios. These composite blank (BLK) CAR:TG wafers were characterised using SEM, XRD, texture analysis, FTIR, swelling tests and fluid handling properties. The formulation with the optimal properties were selected for extract loading and the physico-chemical tests repeated on the extract-loaded (EL) wafers.

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RESULTS AND DISCUSSION

BLK wafers (Fig. 1) obtained from 2% CAR:TG 3:2 and 2:1 gels showed the highest hardness values of 4.83 and 4.38 N respectively and the BLK 2% CAR:TG 0:1 wafer showed the lowest hardness of 1.94 N. High CAR concentrations resulted in higher hardness values due to reduced porosity and increased density (SEM). Further, the EL wafers showed higher hardness (Fig. 2) than BLK wafers at all ratios, attributed to the decreased porosity and thicker walls.

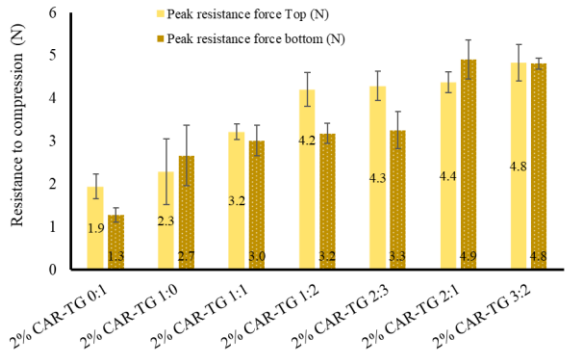


***Fig. 1**. Hardness profile of BLK wafers*

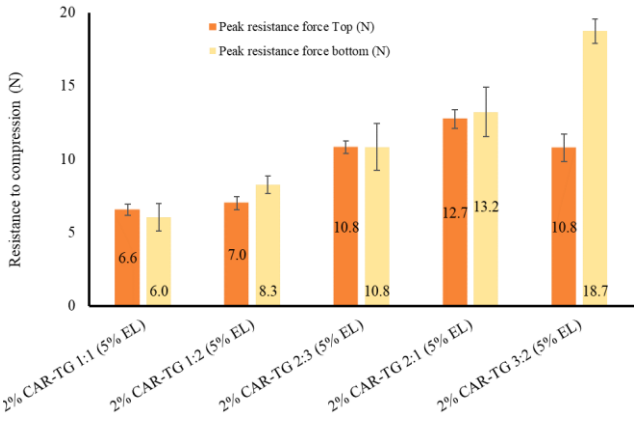


***Fig. 2**. Hardness profile of 5% EL wafers*

The BLK 2% CAR:TG 0:1 wafers swelled to its peak within 15 and 60 min after which they disintegrated. while the other formulations showed a steady increase up to 180 min (Fig. 3), with CAR:TG 1:0 wafer maintaining its structure throughout the test. The SEM micrographs showed the different ratios of CAR and TG has an impact on the pore sizes and pore distribution of BLK wafers (Fig. 4)

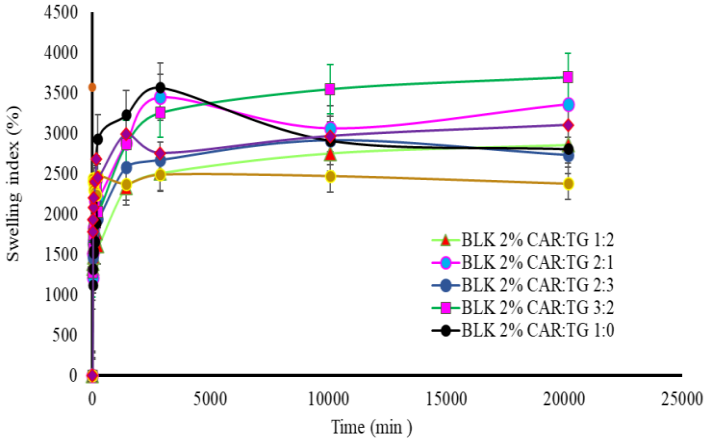
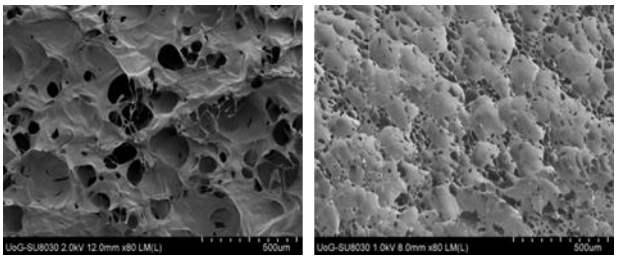


*Fig. 3. **Swelling profiles of BLK wafers***



BLK 2% CAR:TG 1:1 5%EL 2%CAR:TG 1:1

***Fig. 4.** SEM images of BLK and 5% EL wafers.*

Further, 5% EL wafers showed denser microstructure with small, oval sized pores and leafy sheets embedded with micro pores.

CONCLUSIONS

The results obtained from this study indicated that wafer composites formulated with 2% CAR :TG has the potential to be used as a carrier for wound healing actives.

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