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Hydration and Erosion Properties of Cellulose Ethers

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Purpose

Hydrophilic derivatives of cellulose ethers (methylcellulose, MC and hypromellose, HPMC) are employed in controlled drug delivery polymeric devices because of their potential to control drug release profiles. Mechanistically, hydration and erosion (dissolution) of polymeric chains are the fundamental parameters that determine the rate of drug release. The aim of this work was to study the hydration and erosion properties of MC and HPMC, applying the Vergnaud model and a phenol-sulphuric acid assay respectively. The impact of different physicochemical properties (particle size, substitution levels and molecular size) was also investigated.

Methods

A gravimetric method was employed for studying swelling of MC and HPMC matrices using pH 7.2 phosphate buffer (20 ml) as a hydration medium and hydration kinetics were analysed using Vergnaud model. The erosion of matrices was studied using USP I apparatus (pH 7.2 phosphate buffer, 900 ml) at 37°C and 100 rpm. The amount of dissolved polymer was quantified by application of a phenol-sulphuric acid (PSA) assay.

Results

The increased polymer molecular weight and substitution level of hydroxypropoxy groups led to higher swelling rate ranges between 41.01 to 89.74 (% h⁻¹) but a lower degree of erosion, which declined from 0.020 to 0.005 (% min⁻¹). This was also true of reduced particle sizes, regardless of MC and HPMC grades. The mechanism of hydration for all the matrices was observed to be diffusion controlled as values of swelling exponent (n) were < 0.5 in all cases.

Conclusion

From the current study it can be inferred all these matrices underwent diffusion controlled hydration. The particle size, substitution levels and increasing molecular weight demonstrated a clear influence on swelling and erosion rates. The PSA assay was successfully applied to study polymer erosion kinetics from cellulose ethers with varied physicochemical properties.