**Rheological Spectra of New Cellulosic Ionogels with Cholinium Lysinate**

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**Highlights**

* Formulated cellulosic ionogels formulated were physical weak well-structured gels.
* Elastic behavior was dominant rheological behavior of the ionogels.
* The ionogel with 2% of cellulose exhibited the highest rheological properties.

**1. Introduction**

Cholinium amino acid ionic liquids (ChAAILs) are a type of ionic liquid (IL) classified as a third generation IL or bionic liquid (BIL) [1]. ChAAILs are composed of a cholinium cation and an amino acid anion (e.g. glycine, serine, lysine, etc.). The interest in these ILs is due to they are substantially harmlessness, biodegradable, and non-toxic [2]. In recent years, the applications of ChAAILs have gone beyond the field of biomass pretreatment. Thus, ChAAILs has been proposed to use in CO2 capture, as lubricants, or in drug delivery formulations [2]. In this work, the use of ChAAILs for the development of gels, called ionogels, is proposed for their use in medical/pharmaceutical industry. Ionogels are composed of an IL and a continuous phase (CF). The interactions between IL and the CF can be physical or chemical, i.e. reversible and irreversible, respectively [3]. Cellulose can be used as CF for the development of ionogels due to its renewability, biodegradability, non-toxic and biocompatibility [4]. This work studies the influence of the amount of cellulose on the rheological spectra of reversible ionogels formulated with the ChAAIL cholinium lysinate (ChLys).

**2. Methods**

The ionogels were formulated by dissolution of microcrystalline cellulose in ChLys, both previously dried for 12 h in a vacuum oven at 40 °C. The dissolution process was conducted under magnetic stirring at 100 °C under N2 atmosphere. The percentages of cellulose added for each ionogel were 0.5, 1, 1.5 and 2 wt. %. The dissolution time was determined by acquiring different aliquots every 30 min and visualizing them under a Carl Zeiss Axio Scope A1 microscope equipped with a Zeiss AxioCam ICc1. When the cellulose was dissolved completely, solutions are poured into a steel mold covered with PET film at room temperature up to gelation.

The rheological characterization was carried out in an Ares rheometer (TA Instruments). Dynamic frequency sweep tests from 0.01 to 50 Hz were conducted at 25 °C, with a strain of 0.01% (within the lineal viscoelastic region).

**3. Results and discussion**

The rheological spectra of the formulated cellulosic ionogels belonged to *plateau* region. The storage modulus (G') was higher than the loss modulus (G''), therefore the dominant behaviour was elastic in the studied range for all ionogels (Figure 1). The ratio G'/G'', or tan δ, for 1 Hz was ranged between 4.7 and 7.8, indicating that ionogels were physical weak well-structured gels.



**Figure 1.** Rheological spectra of the cellulosic ionogels formulated.

The rheological behaviour of the ionogels was changed by the cellulose concentration (Figure 1). The elastic moduli increased as the load cellulose was increased; for 1 Hz, G' for 2% was nearly twenty-fold higher than that 0.5% of cellulose. However, this increase was less pronounced in the case of the loss moduli. Similar results and behaviours have been found for other polysaccharide-based ionogels, such as agarose or guar gum [5-6]. The ionogel strengths (G0), defined as the measure of the elastic energy stored in the unit volume of network, were 2133, 16179, 22051, and 51586 Pa for 0.5, 1, 1.5 and 2%, respectively. For these reasons, the cellulose had an influence on the rheological properties of the ionogels.

**4. Conclusions**

The cellulosic ionogels were formulated successfully and can be classified as physical weak well-structured gels according to the obtained rheological spectra. The dissolved cellulose had a significant influence on the rheological properties, being the ionogel with 2% of cellulose the ionogel with the most solid-like behaviour.

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