DEVELOPMENT AND RHEOLOGICAL EVALUATION OF CHITOSAN: PEQUI OIL GELS

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ABSTRACT

Chitosan gels have been used for the development of therapeutic implants and vehicles. In the preset study, we focused in the modification of rheological properties of chitosan gels by addition of pequi oil (*Caryocar brasiliense* Camb.). This typical fruit of the Brazilian Cerrado is rich in various carotenoids, several of them with pro-vitamin A activity. Due to their composition, pequi oil has been reported as an important antioxidant agent with anti-inflammatory activity. Also, pequi oil has been recently related as a potential material using against cancer, reducing carcinogenic process and controlling tumor growth[1]. Chitosan (DA 85%) was supplied by Aldrich and two molecular weights were used: low (MW 150 000) and high (MW 600 000). Solutions of both molecular weights at 0.5%, 1.0% and 2.0% (w/w) were prepared by dissolution in 1% acetic acid (w/w). Pequi oil was gently supplied by Universidade Federal de Goiás (UFG-Brasil) and a 0.2% (w/w) solution was slowly added at chitosan solutions using vigorous stirring. After complete dissolution, solutions were immediately used in rheological measurements. This technique is useful for understanding the gel characteristics and consequently their possible applications. Rheological experiments were performed using stainless steel cone/plate geometry (2º cone angle, 20 mm cone diameter) with the gap set at 69 µm. In oscillatory (1 Hz and 25°C with a strain range from 0.05 to 500 Pa) tests all chitosan gels have G´´ > G´ in the range studied that confirm the viscous characteristic of chitosan gel. For chitosan high MW, pequi oil addition increases the elastic and viscous behavior of gels, suggesting an increase in gel strength. For gel prepared with 2% chitosan was observed an increase in G´ modulus around 300%. The same behavior was observed for low MW chitosan at 1% and 2% concentration, suggesting that pequi oil changes the gel structure. Frequency measurements (0.1 to 100 rad s^{-1} at 25°C and strain of 1%) indicates that pequi oil influences the modulus only for high MW chitosan suggesting that the network formed by interaction between chitosan and pequi oil increases as a function of chitosan molecular weight. Also, chitosan concentration influences the rheological behavior, as at low chitosan concentration, modulus values were higher for high MW. With an increase of concentration, G´ and G´´ were higher for low chitosan MW confirming that different networks are formed as function of chitosan molecular weight. The temperature sweep test (25-75°C, 1 Hz and 1% strain) showed that the gelification process occurred in the gels, e.g. that an elastic gel network has been formed. For both molecular weight, pequi oil addition decrease the temperature of gelation, especially for chitosan high MW, suggesting that the interaction between chitosan and pequi oil was weaker when higher chains was used for gel formation, probably by a difficult to interaction of pequi oil, which needs lower temperature to promote the gel formation. Flow measurements (shear stress from 0.01 to 100 Pa at 25°C) showed that in all cases, viscosity decreased with increasing shear rate, indicating a shear-thinning (pseudoplastic) behaviour. For low MW chitosan pequi oil presence increased the vicosity around 50% for all concentrations. For high molecular weight, this behavior was observed only for 2% concentration wherein viscosity increase to 5 for 300 Pa s^{-1} by pequi oil presence.

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References

[1]Miranda-Vilela, A. S.; Peixoto, R.; Longo, J.; Cintra, D.; Portilho, F.; Miranda, K.; Sartoratto, P.; Báo, S.; Azevedo, R.; Lacava, Z. *J. Bio. Nanothec.* **2013**, *9*, 1261.