Gelatin-Graphene Oxide Aerogels Loaded with Flavan-3-Ols as a Hemostatic Device.

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Gelatin (Gel) is a natural biopolymer with high biodegradability and biocompatibility that together with graphene oxide (GO) allow to produce aerogels whose properties depend on the synthesis method. The objective of this study was to develop an aerogel Gel-GO, by means a covalent and noncovalent interaction, characterizing their chemical and mechanical properties. Also, the aerogels were loaded with seed extracts (mainly flavan-3-ols) from Pais grapes (SE) and their properties were evaluated and compared. Aerogels were synthesized mixing a gelatin solution previously prepared by heating a desired amount of gelatin in Milli-Q water at 60°C for an hour with a GO suspension synthesized by modified Hummer's method. The mixture was in stirring at 37 °C and 70 °C with a reaction time of 2 minutes and 24 hours to allow the noncovalent and covalent interactions, respectively. Later, the samples were subjected to cross-linking and lyophilization to obtain the aerogels. The SE was added in different amounts to the solution, previous to the cross-linkage process, at constant stirring for 1 hour. The samples were analyzed by FTIR, XPS, and SEM. Also, it was carried out a thermogravimetric analysis. The PBS absorption, elastic modulus, and the Zeta potential were also measured.

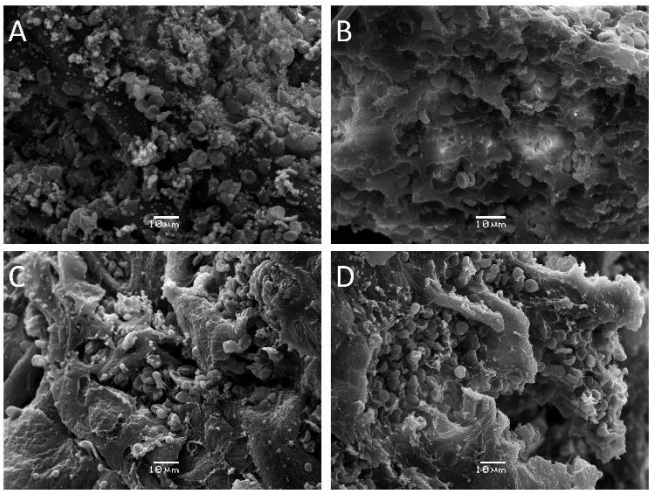

Figure 1: Morphology of non-covalent aerogels with absorbed blood.
[Conditions: A) pH 3 - 0% SE, B) pH 3 - 5% SE, C) pH 11 - 0% SE, D) pH 11 - 5% SE].

Covalent and noncovalent aerogels were successfully obtained. Covalent interaction improved their mechanical properties at low GO:Gel ratio and alkali conditions of the GO suspension. On the other hand, noncovalent interaction presented suitable mechanical properties at high GO:Gel ratio and acid conditions of the GO suspension. These aerogels show more stability in aqueous media and better PBS absorption than covalent aerogels. For the flavan-3-ols load, their incorporation decreases the mechanical properties of the aerogel and show no relevant changes in the Zeta potential. However, these extracts improve surface affinity to the hemoglobin as shown in Figure 1. In conclusion, to both synthesis methods, the GO:G ratio and the pH had effects in the aerogel properties, were non-covalent aerogels shows better properties for hemostatic applications. Also, the incorporation of the SE changes these properties and improves the aerogel clotting behavior.