DOTAGEL: A hydrogen and amide bonded gelatin based tunable antibacterial high strength adhesive synthesized in an unoxidized environment

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Comparison of different gelatin sources

In this work gelatin from three sources have been used. These are bovine gelatin (BG), porcine gelatin (PG) and fish gelatin (FG). Gelatin-Tannic Acid (GA:TA) based adhesives were formed in two different acidic mediums: Hydrochloric Acid (HCl) and Acetic Acid (AA) using all three of these gelatin sources shown in Figure S1. The formed adhesives are shown below:

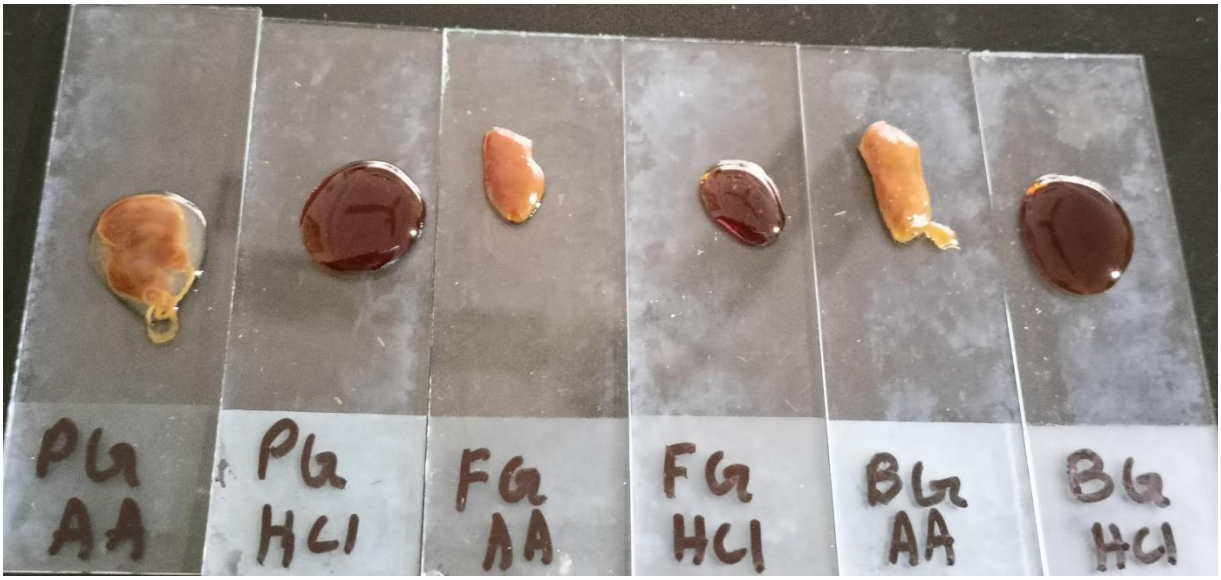

Figure S1: GA:TA based bioadhesives from three different gelatin sources in two different acidic mediums

The adhesive strength of all these six novel bioadhesives were tested following the ASTM standard F2255-05 using universal testing machine (UTM). The results of adhesive tests are shown in Figure 3A and 3B in the final manuscript. Based on their usability and adhesive strength (further discussed in the final manuscript in Section 3.1), BG was selected as the gelatin source for all further studies and for forming DOTAGEL after adding dopamine (DA) to the GA:TA based adhesive.

Characterizations

Field emission scanning electron microscopy (FESEM):

The morphology of the adhesive was observed by using FESEM. (Sigma 300VP, ZEISS) at an acceleration voltage of 15 kV with energy dispersive x-ray analysis (EDX). The adhesives were air dried for 120 hours before performing the characterization.

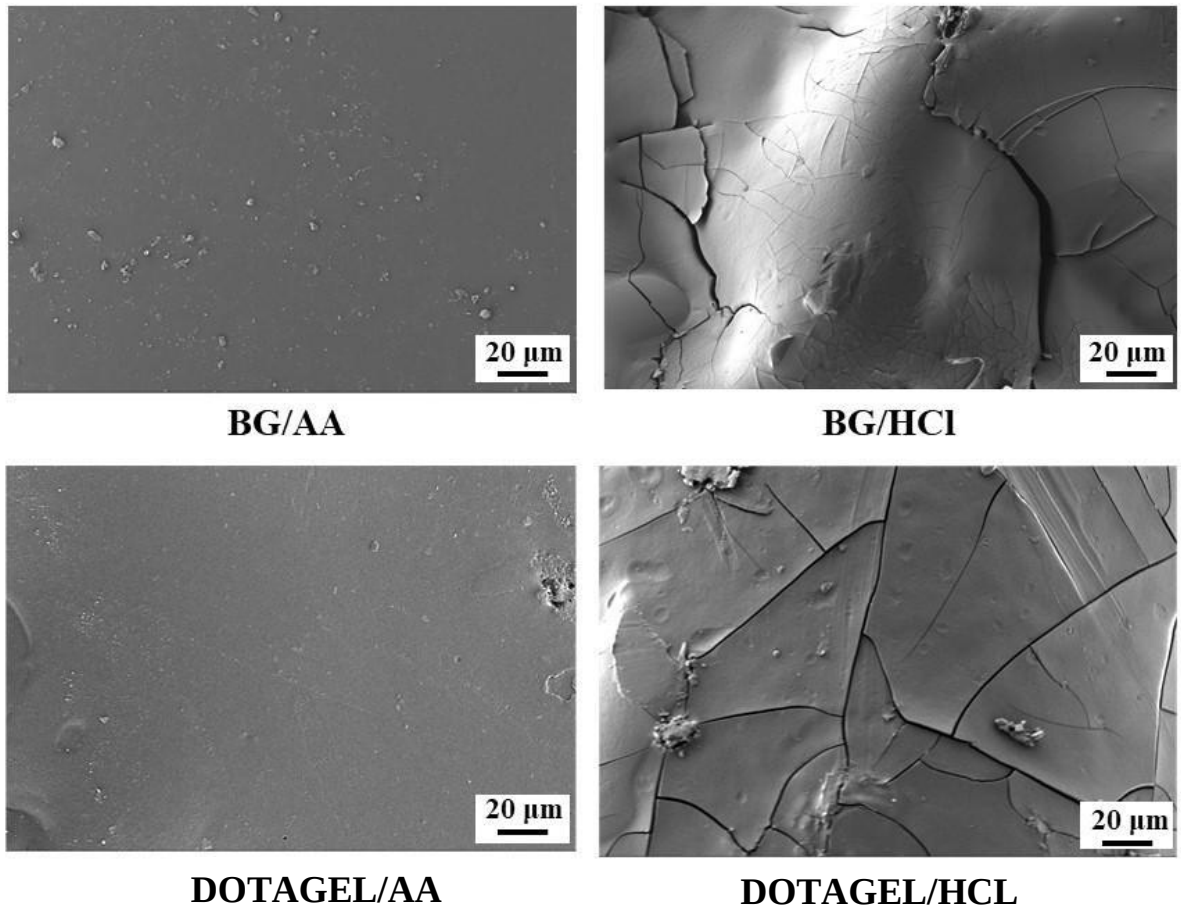

Figure S2: FESEM images of BG/AA, BG/HCl, DOTAGEL/AA and DOTAGEL/HCl at 500x magnification.

From figure S2 it can be seen that the liquid-like adhesive formed for HCl medium had multiple cracks while the adhesive from AA medium was relatively stable when dried.

X-ray diffraction

X-ray diffraction was performed by XRD Diffractometer (RIGAKU Ultima IV, X-Ray Diffractometer, Japan) in the range of 5° to 80°. Cu-Kα radiation with the wavelength of 0.15418 nm was used for obtaining X-ray diffraction. Data were collected in the 2θ range from 5° to 80°. From the XRD graph in Figure S3, it can be observed that all the bioadhesives are amorphous in nature. Moreover, DOTAGEL/AA and DOTAGEL/HCL also do not show the crystalline nature since the amorphous GA and TA are used in 100 times higher concentration than the crystalline DA in the sample.

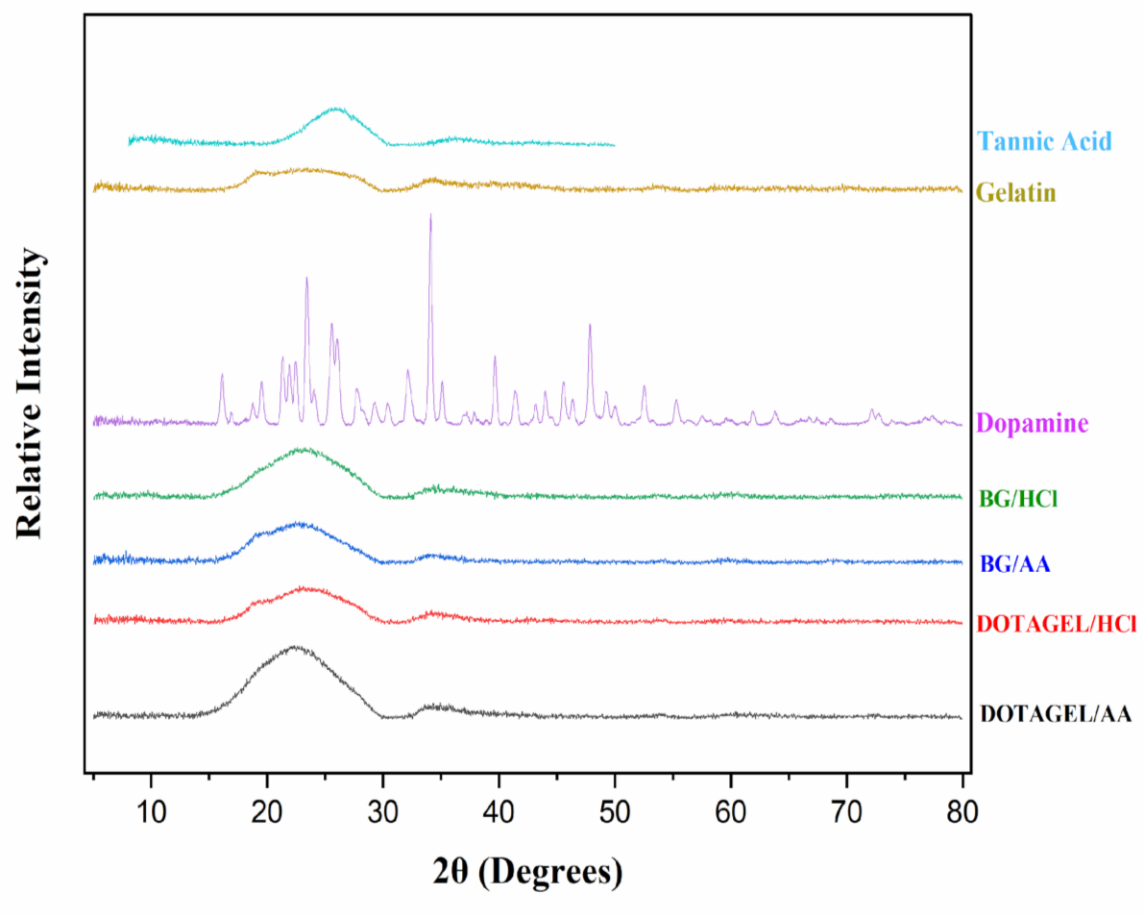

Figure S3: XRD patterns of BG/AA, BG/HCl, DOTAGEL/AA, DOTAGEL/AA, tannic acid, dopamine and gelatin.

Simultaneous thermal analysis (STA)

Simultaneous thermal analysis (STA) (NETZSCH STA 449 F1 Jupiter) was performed on the proposed adhesives to obtain both differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) data which is shown in Figure S4 . The measurement was conducted from 20 to 400 ℃ at a rate of 10 ℃/minute.

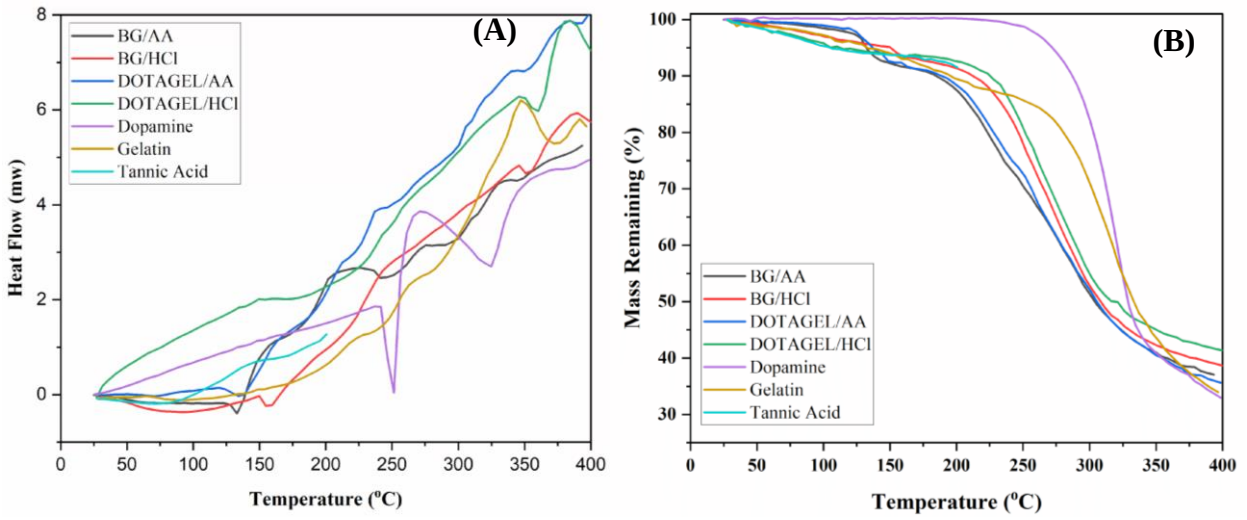

Figure S4: (A) DSC and (B) TGA curves of all the bioadhesives. All the samples exhibited one-step thermal deterioration and displayed similar thermal behavior.