Microorganism Inspired Hydrogels: Fermentation Capacity, Gelation Process and Pore-forming Mechanism under Temperature Stimulus

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Experimental section

1.1 Rheological measurements

The rheological measurements of HYS25, HSY35 and HSY50 were determined by oscillatory shear measurements performed on an ARG2 rheometer (TA instruments, USA) with a titanium cone-plate geometry (20 mm diameter). The gap was changed according to the thickness of samples. The experiments were carried out in the range from 0.1 to 100 rad/s at 30°C. The oscillation frequency (ω) dependences of G' of pure PAM (PAM30 to PAM50) hydrogel and HSYT hydrogel (HSY25 to HSY50) were measured and analyzed (Fig. S1).

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Supplementary data

Fig. S1 is the storage modulus of pure PAM hydrogels and HSYT hydrogels. As shown in Fig. S1, with increasing angular velocity from 0 to 100 rad/s, the storage modules of samples increase first and then keep almost constant. It is seen from Fig. S1 (a) that the G' values of pure PAM hydrogels are 2200, 2994, 4470, 6399 and 8839 Pa at the angular velocity of 10 rad/s. It indicates that, with increasing temperature from 30^{o}C to 50^{o}C, the value of G' shows increasing tendency because of rapid polymerization rate under higher reaction temperature. However, as shown in Fig. S1(b), at the angular velocity of 10 rad/s, the values of G' of HSYT25/30/35/40/45/50 hydrogels are 4385, 9364, 7402, 7070, 3248 and 2173 Pa, respectively. In other words, G' values of HSYT hydrogels increased firstly, and then decreased with the increase of temperature form 25^{o}C to 50^{o}C. On the one hand, at 30^{o}C and 35^{o}C, HSY30 and HSY35 hydrogels present the highest G' values, which can be ascribed to the synergistic effect of gelling and fermentation process. In comparison with Fig. S1(a), the elastic deformation ability of HSY30, HSY35 and HSY40 hydrogels shown in Fig. S1(b) are much higher than those of PAM hydrogel prepared at 30^{o}C to 40^{o}C, while the elastic deformation ability of HSY45 and HSY50 are lower than that of PAM hydrogels prepared at 45^{o}C and 50^{o}C. The above results indicate that, at a certain reaction temperature, the elastic deformation ability of porous HSYT hydrogels measured by rheological measurement were higher than those of pure PAM hydrogel. Actually, at temperature above 45^{o}C, the yeast cells become damaged and are prone to be inactivation. The gas CO_2 was generated within short time, and then the efficiency of fermentation decreases, leading to poor compress strength. In any way, it confirmed that the shape and the elastic deformation ability of hydrogels depend on the gelation process and gas foaming process of yeast fermentation.

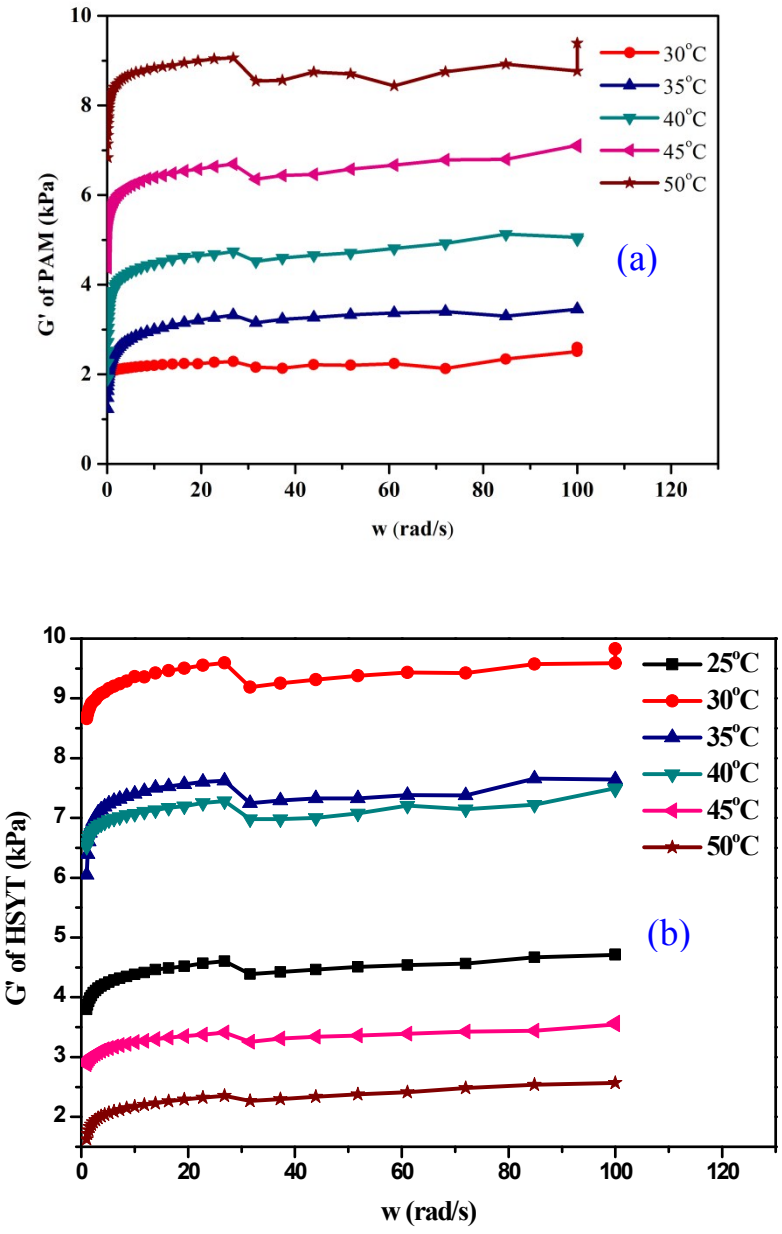

Fig. S1. The storage modulus of pure PAM hydrogels at 30 to 50°C (a) and HSYT hydrogels (b) prepared at 25 to 50°C