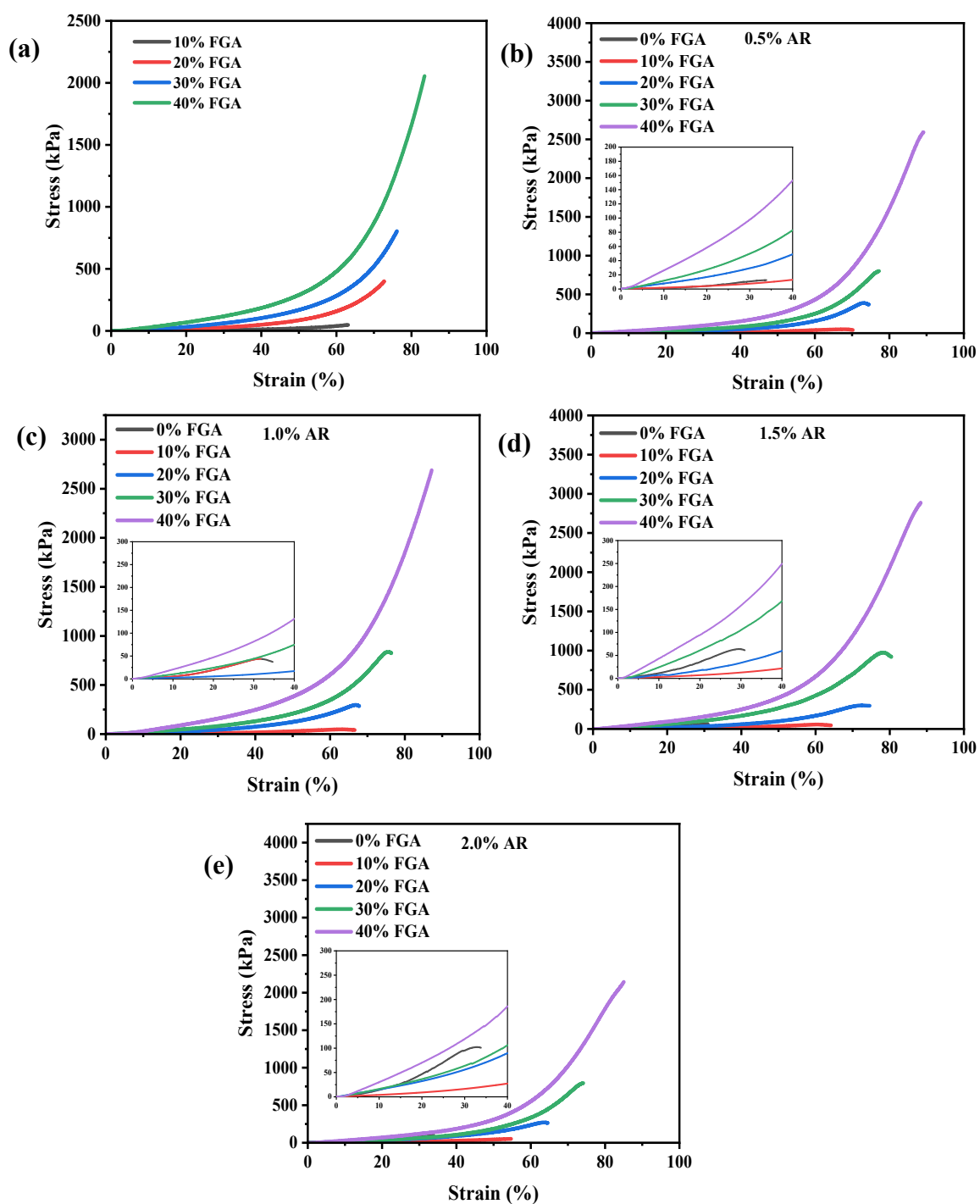
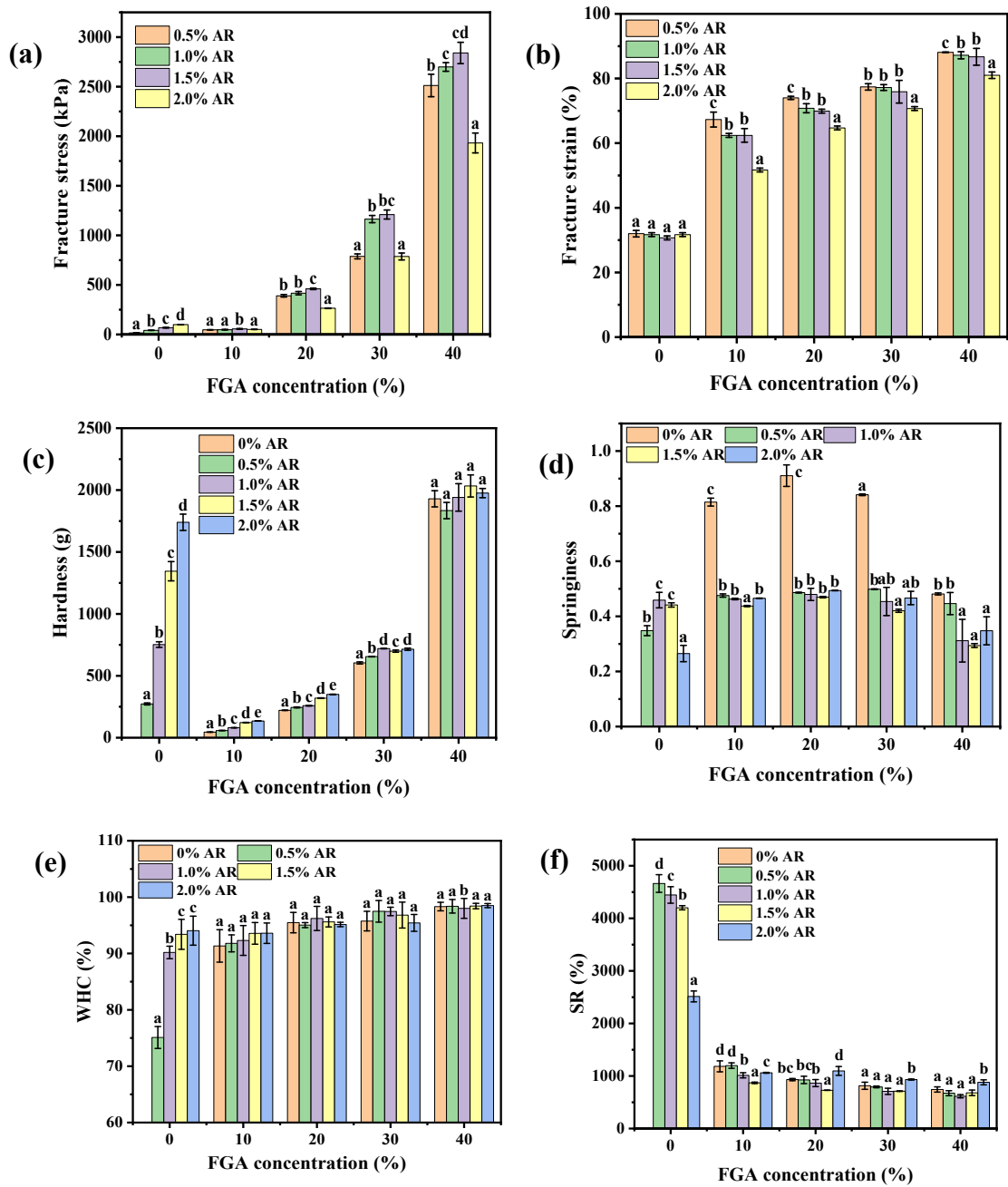


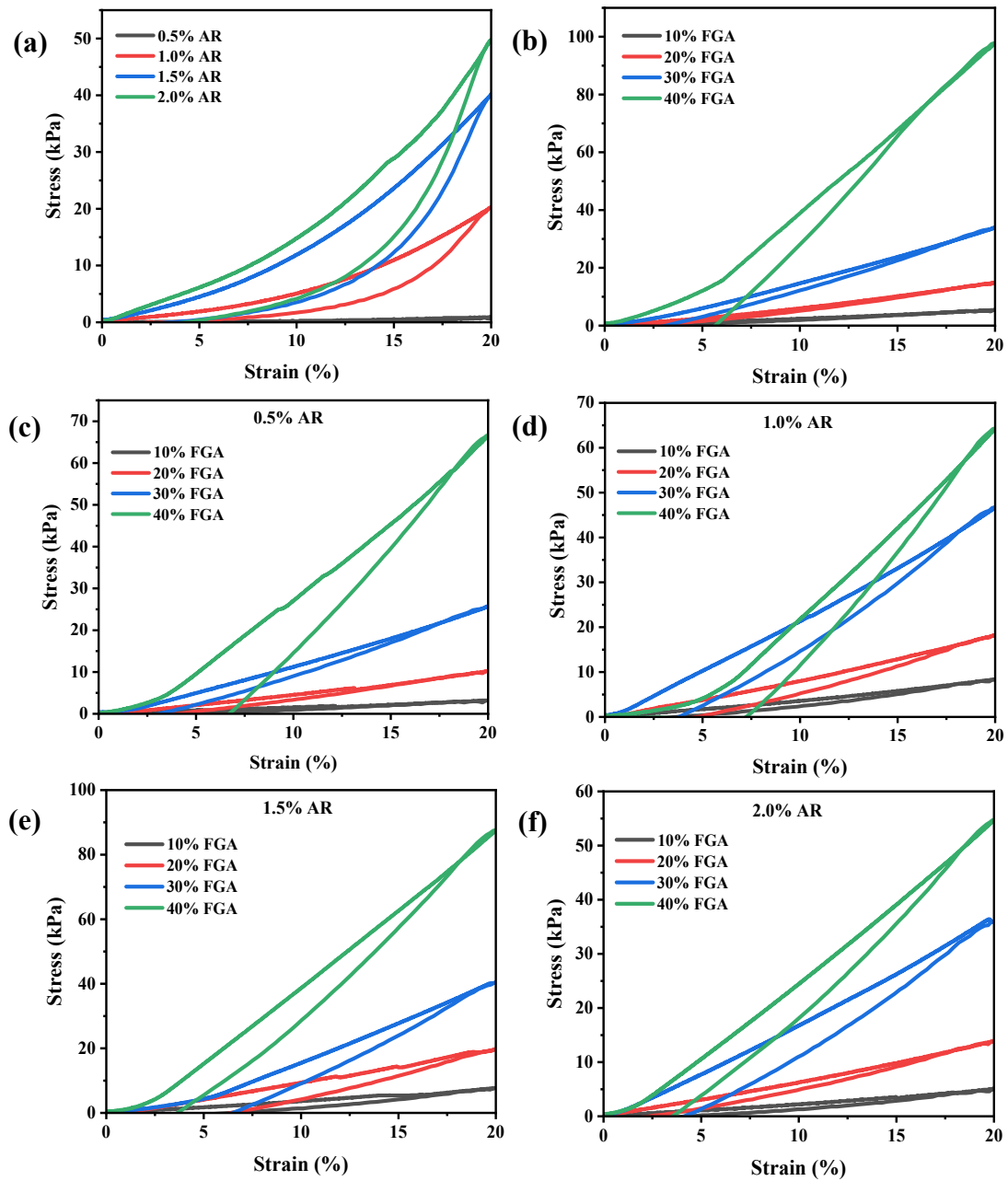
Supplementary information



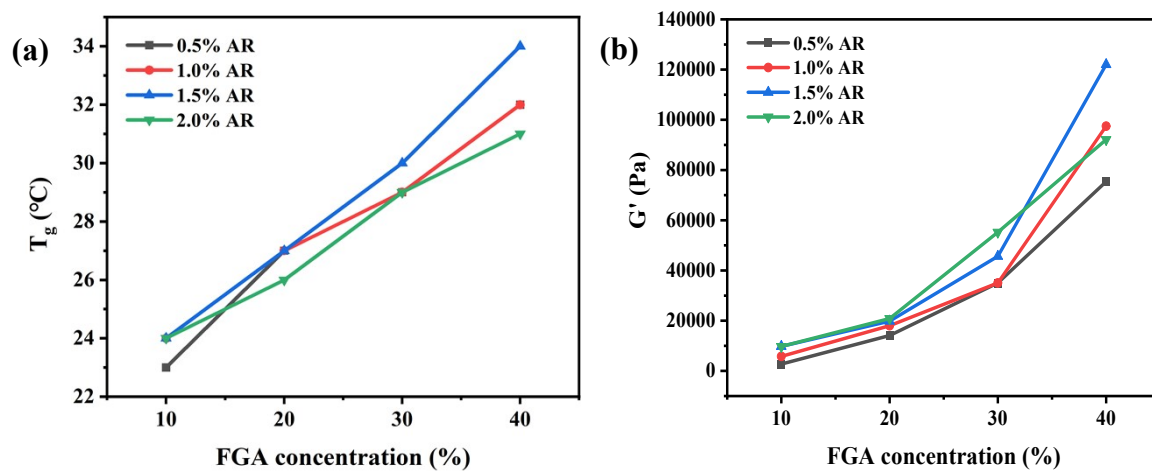
Supplementary Figure 1. Compressive stress-strain trend chart of (a) (10-40 wt%) FGA SNs, (b) 0.5 wt% AR/ (0-40 wt%) FGA gels, (c) 1.0 wt% AR/ (0-40 wt%) FGA gels, (d) 1.5 wt% AR/ (0-40 wt%) FGA gels, (e) 2.0 wt% AR/ (0-40 wt%) FGA gels.



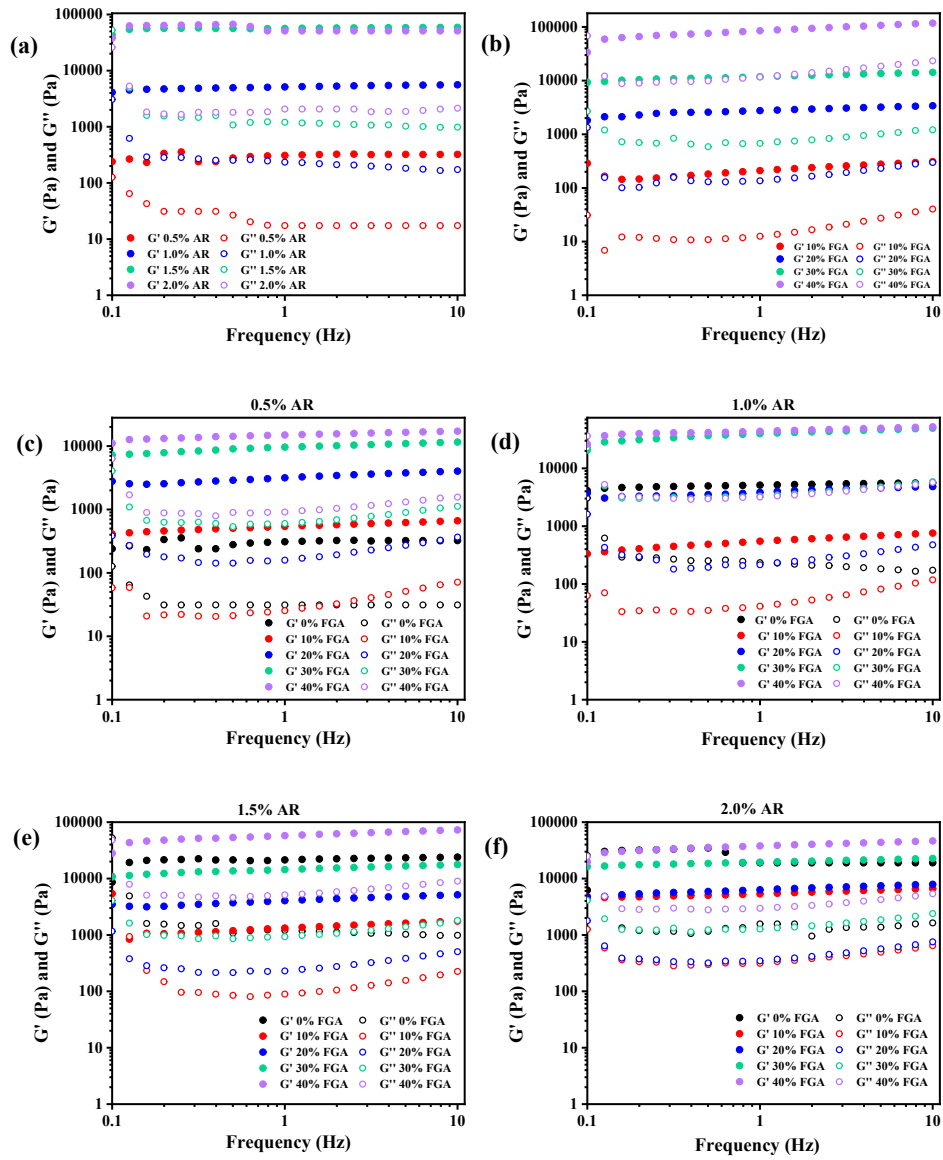
Supplementary Figure 2. (a) Compressive fracture stress, (b) fracture strain, (c) hardness, (d) springiness, (e) WHC, (f) SR of hydrogel samples containing (0-40 wt%) FGA and (0-2 wt%) AR.



Supplementary Figure 3. Compressive loading-unloading chart of (a) (0.5-2 wt%) AR SNs, (b) (10-40 wt%) FGA SNs, (c) 0.5 wt% AR/ (10-40 wt%) FGA DN, (d) 1.0 wt% AR/ (10-40 wt%) FGA DN, (e) 1.5 wt% AR/ (10-40 wt%) FGA DN, (f) 2.0 wt% AR/ (10-40 wt%) FGA DN.



Supplementary Figure 4. (a) T_g and (b) G' at 15 °C of (0.5-2 wt%) AR/ (10-40 wt% FGA) DNAs.



Supplementary Figure 5. G' and G'' of frequency sweep measurement of (a) (0.5-2 wt%) AR SNs, (b) (10-40 wt%) FGA SNs, (c) 0.5 wt% AR/(10-40 wt%) FGA DNs, (d) 1.0 wt% AR/(10-40 wt%) FGA DNs, (e) 1.5 wt% AR/(10-40 wt%) FGA DNs, (f) 2.0 wt% AR/ (10-40 wt%) FGA DNs.

Supplementary Table 1 Total variance explained

Principal component number	Eigenvalue	Percentage of Variance (%)	Cumulative (%)
1	3.23873	53.97882	53.97882
2	1.76716	29.45272	83.43154
3	0.48562	8.0937	91.52523
4	0.40685	6.78085	98.30609
5	0.07266	1.211	99.51708
6	0.02898	0.48292	100