Supplementary Information (SI) for Materials Horizons.
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Supplement Materials

Table S1. The primer sequences

Gene	Forward primers	Reverse primers
RAT-TNF-α	CCACGCTCTTCTGTCTACTG	GCTACGGGCTTGTCACTC
RAT-IL-1β	CAGCTTTCGACAGTGAGGAGA	TTGTCGAGATGCTGCTGTGA
RAT-Gapdh	CAAGTTCAACGGCACAGTCAA	GATCTCGCTCCTGGAAGATGG
MICE- TNF-α	CTGAACTTCGGGGTGATCGG	GGCTTGTCACTCGAATTTTGAGA
MICE-IL-1β	TGGAGAGTGTGGATCCCAAG	GGTGCTGATGTACCAGTTGG
MICE-Gapdh	TTCCAGGAGCGAGACCCCACTA	GGGCGGAGATGATGACCCTTTT
P. gingivalis 16S rRNA	AGGCAGCTTGCCATACTGCG CGCTAGTAATCGTGGATCAGAATG	ACTGTTAGCAACTACCGATGT TGTGACGGGCGGTGTGTA

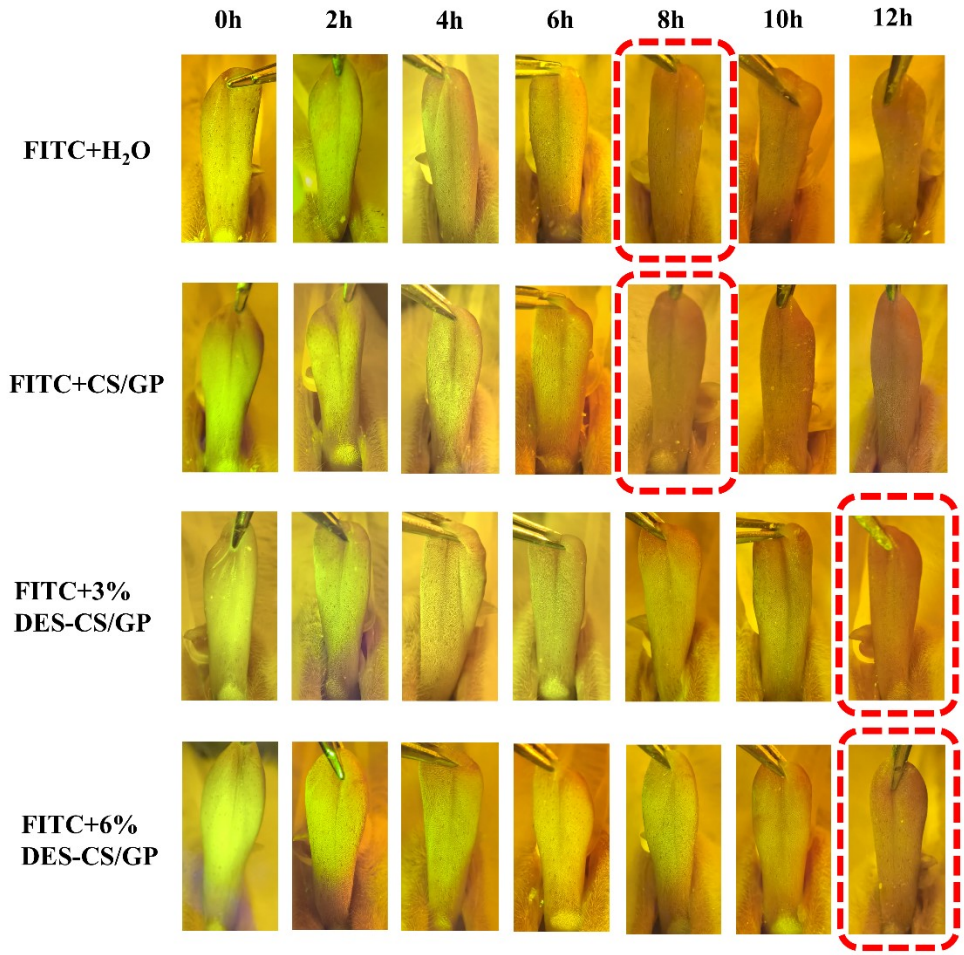


Figure S1. Images of the dorsal tongue surfaces in rats showing the *in vivo* degradation behavior of the hydrogels. The images show the progression of fluorescent dye (FITC) over time following treatment with different hydrogel formulations. The red frames indicate the time points when the fluorescent label disappeared in each group, highlighting the degradation of the hydrogels.

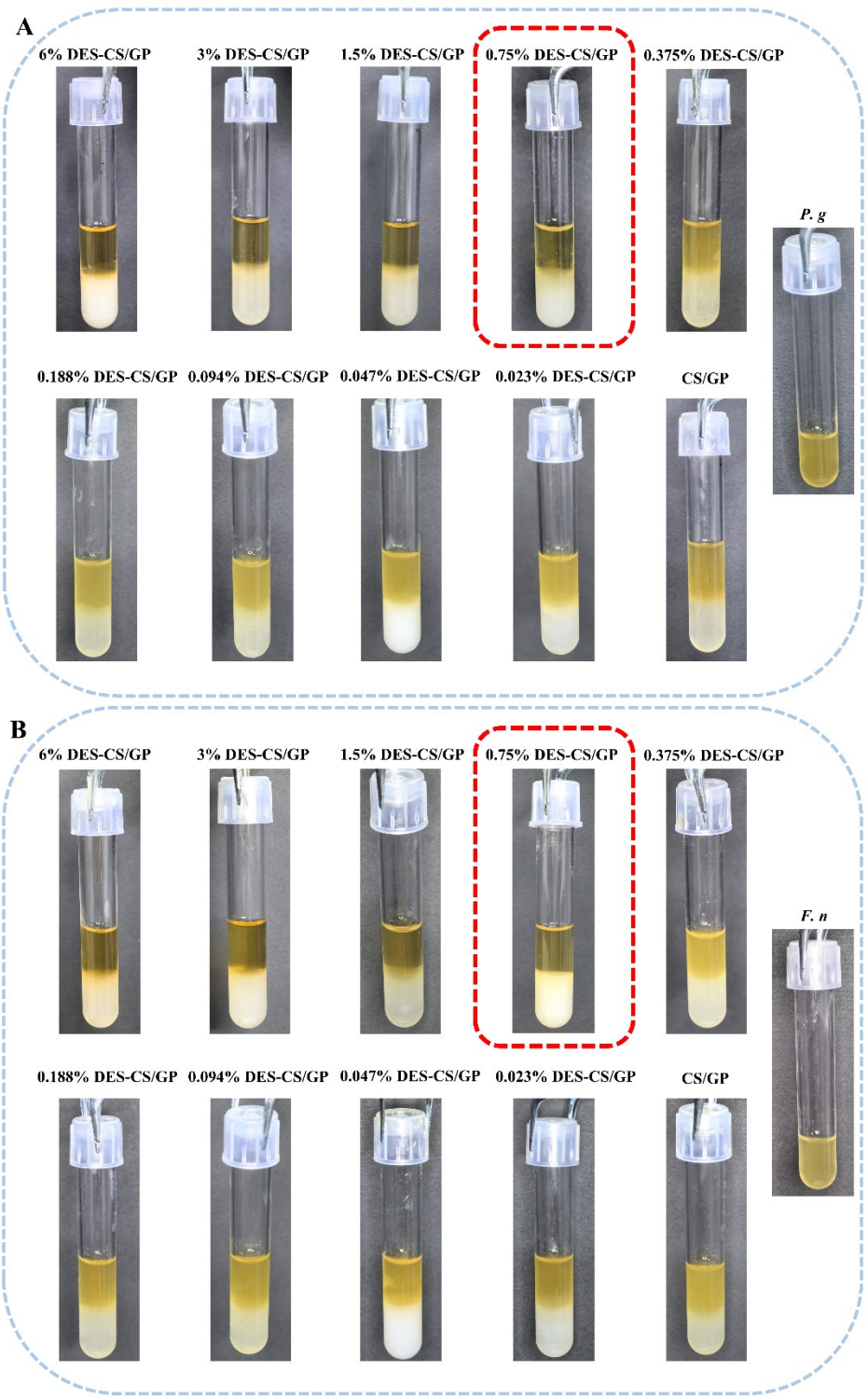


Figure S2. Minimum inhibitory concentration (MIC) of DES-CS/GP against *P. g* (A) and *F. n.* (B). Tubes represent different concentrations of DES-CS/GP hydrogels ranging from 6% to 0.023%. The red frames indicate the MIC, defined as the lowest concentration (0.75% DES-CS/GP) at which visible bacterial growth was completely inhibited.

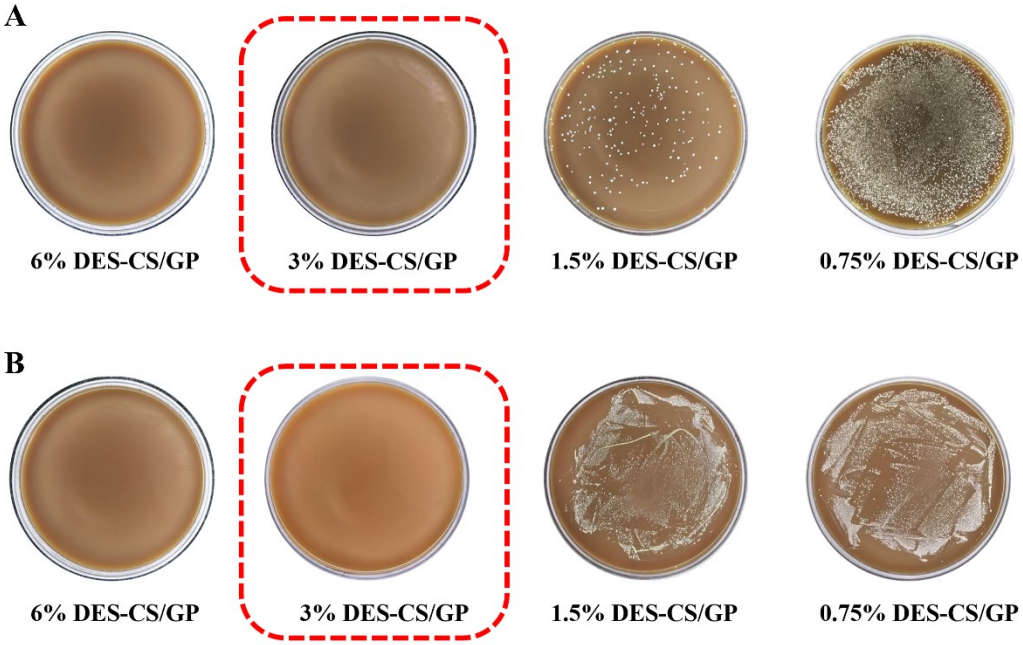


Figure S3. Minimum bactericidal concentration (MBC) of DES-CS/GP against *P. g* (A) and *F. n.* (B). The plates show bacterial growth after treatment with varying concentrations of DES-CS/GP hydrogels. The red frames highlight the MBC, defined as the lowest concentration (3% DES-CS/GP) at which no visible bacterial colonies are observed, indicating complete bactericidal activity.

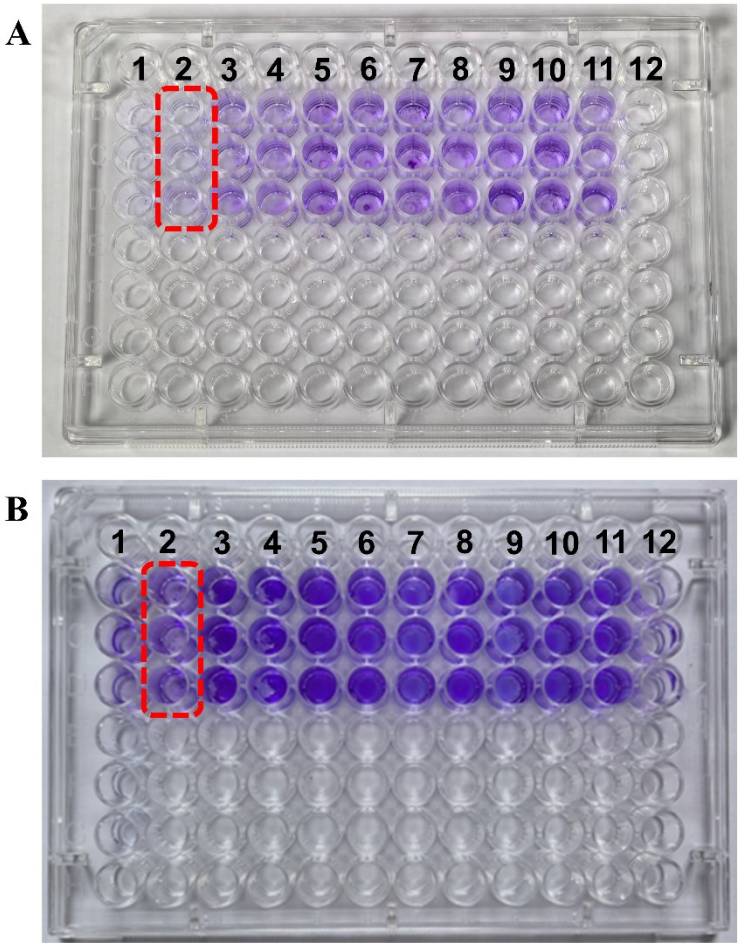


Figure S4. Minimum biofilm inhibitory concentration ($MBIC_{80}$) of DES-CS/GP hydrogel extracts against *P. g* (A) and *F. n.* (B) biofilms. Wells 1 to 10 contain bacterial cultures treated with DES-CS/GP hydrogel extracts prepared using a two-fold serial dilution method, starting from 6% (well 1) and decreasing sequentially. Well 11 is the bacterial control (no extract), and well 12 is the blank control (only medium). The red frames highlight the $MBIC_{80}$ (3% DES-CS/GP extract), defined as the lowest concentration at which 80% of biofilm formation is inhibited, as indicated by reduced crystal violet staining compared to the control group.

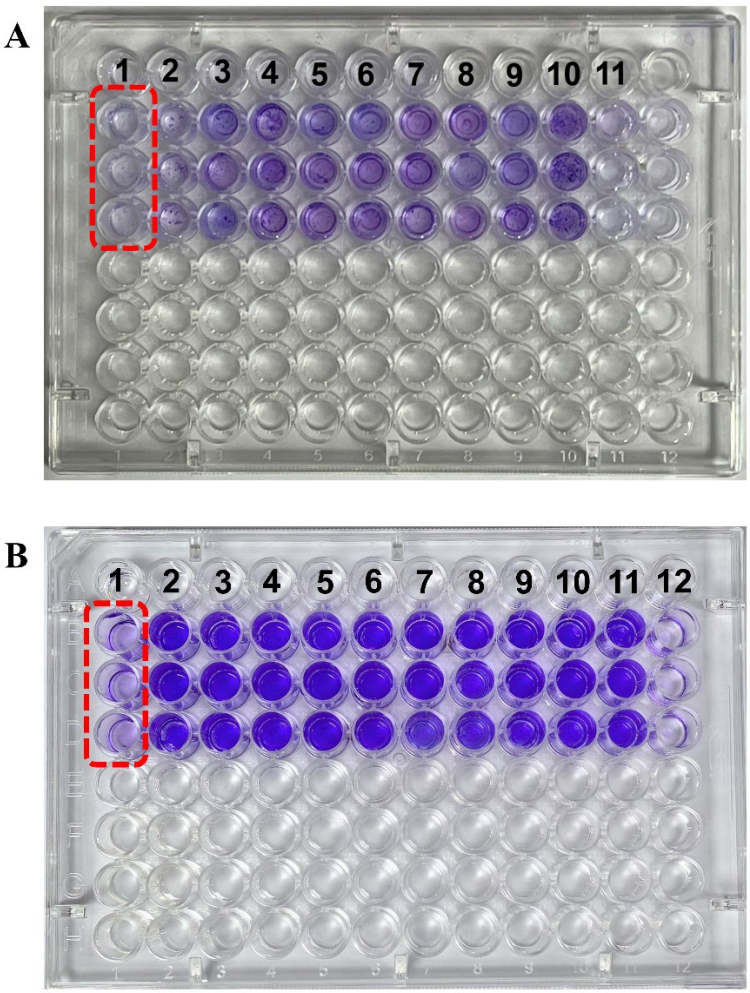


Figure S5. Minimum biofilm reduction concentration ($MBRC_{50}$) of DES-CS/GP hydrogel extracts against *P. g* (A) and *F. n.* (B) biofilms. (A) Wells 1 to 9 contain bacterial cultures treated with DES-CS/GP hydrogel extracts prepared using a two-fold serial dilution method, starting from 6% (well 1) and decreasing sequentially. Well 10 is the bacterial control (only bacterial suspension without extract), and well 11 is the blank control (only medium). (B) Wells 1 to 10 contain bacterial cultures treated with DES-CS/GP hydrogel extracts prepared using a two-fold serial dilution method, starting from 6% (well 1) and decreasing sequentially. Well 11 is the bacterial control (only bacterial suspension without extract), and well 12 is the blank control (only medium). The red frames indicate the $MBRC_{50}$, defined as the lowest concentration (6% DES-CS/GP extract) at which at least 50% of the biofilm is removed, as evidenced by reduced crystal violet staining compared to the bacterial control group.

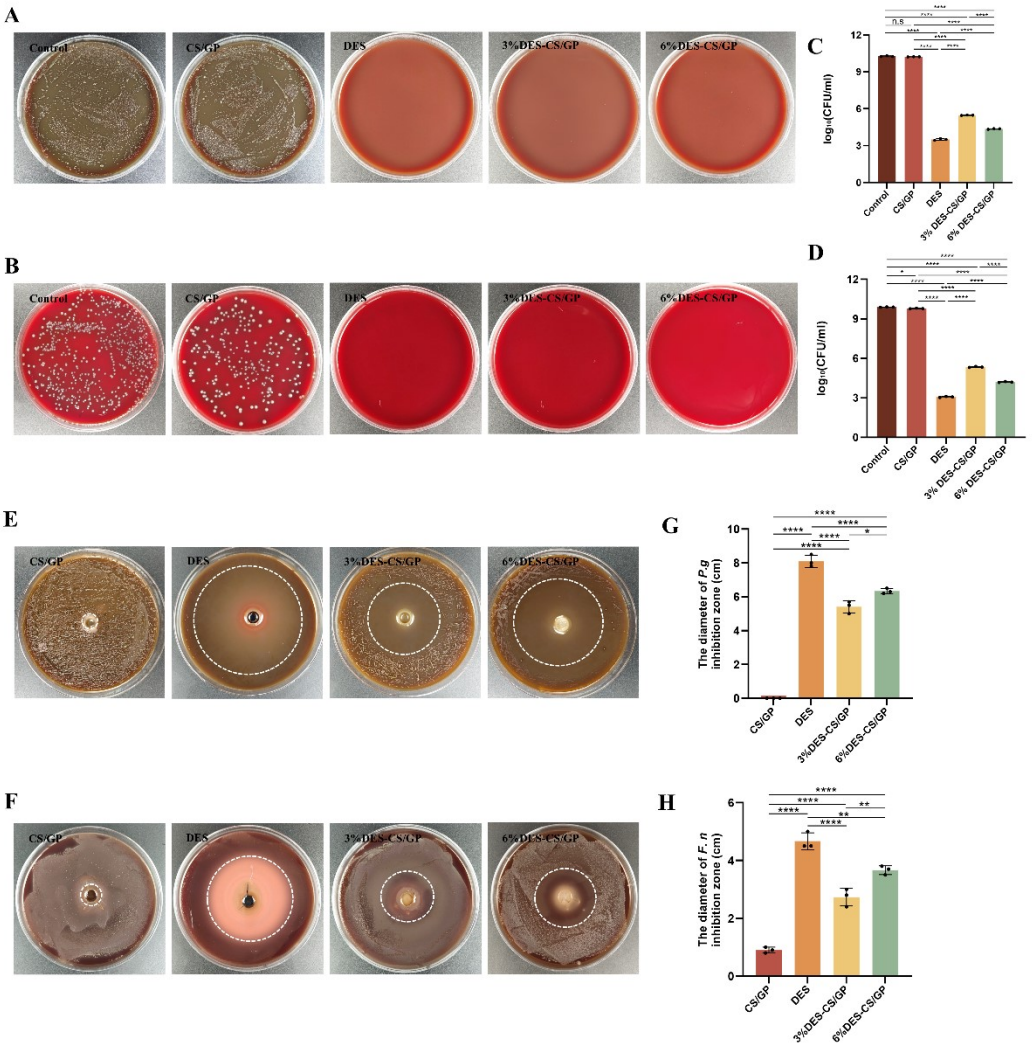


Figure S6. (A, B) Representative images of *P. g* (A) and *F. n* (B) colonies on blood agar plates after co-culturing *P. g* and *F. n* with CS/GP, DES, 3% DES-CS/GP, and 6% DES-CS/GP for 48 hours, the bacterial suspensions were diluted 10^5-fold. (C, D) Quantification of *P. g* (C) and *F. n* (D) colony-forming units (CFU) on blood agar plates. (E, F) Representative images of the agar diffusion test against *P. g* (E) and *F. n* (F) after different treatments. The white dotted circles depict the zone of inhibition. (G, H) Quantification of the diameter of inhibition zones for *P. g* (G) and *F. n* (H). Data are presented as the mean ± SD, n = 3. *$p < 0.05$, **$p < 0.01$, ****$p < 0.0001$. ns, not significant.

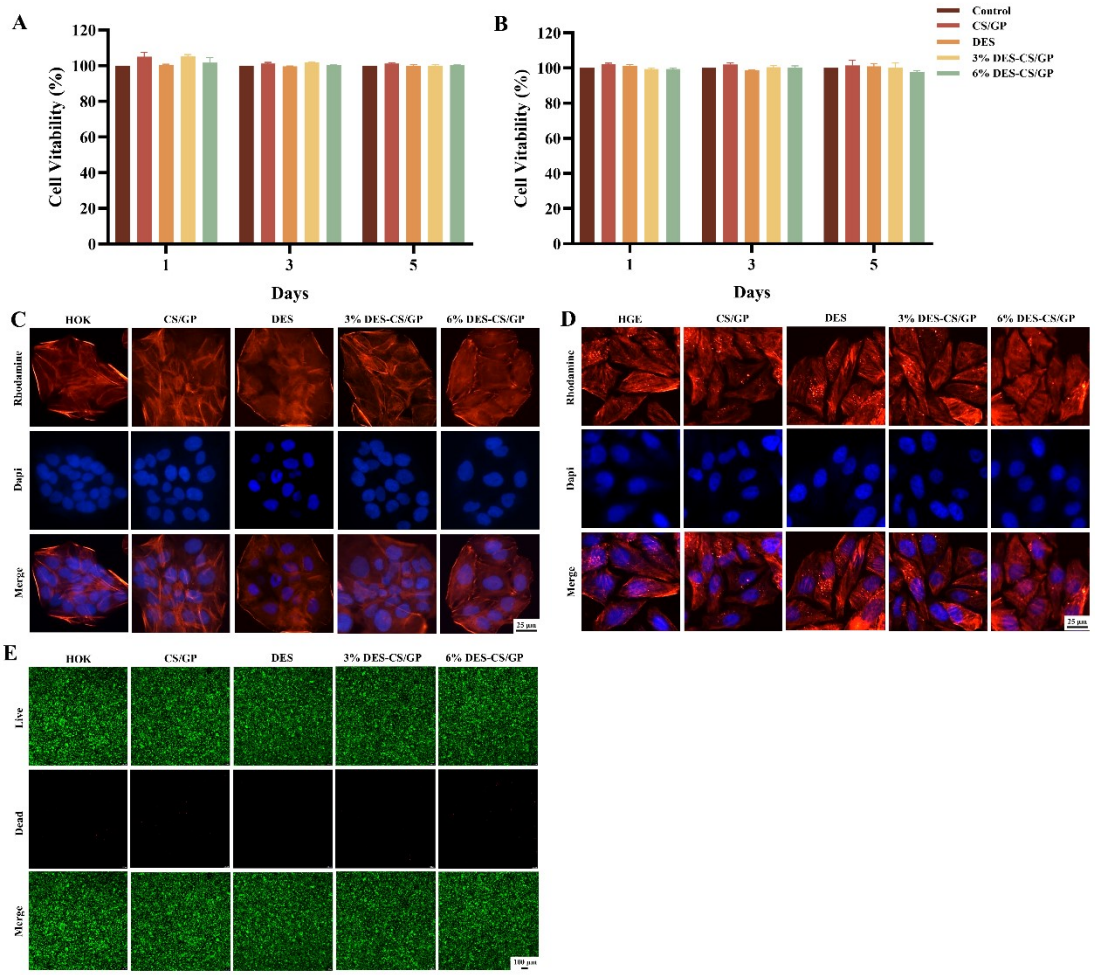


Figure S7. Cytocompatibility of DES-CS/GP *in vitro*. (A, B) Cell viability of human gingival epithelial cells (HGE, A) and human oral keratinocytes (HOK, B) cultured with different formulations for 1, 3, and 5 days. Data are presented as the mean ± SD, n = 3. (C, D) Representative images of Rhodamine-phalloidin and DAPI staining showing the cytoskeletal morphology (actin filaments, red) and nuclear morphology (blue) of (C) HOK and (D) HGE after different treatment. (E) Live/Dead staining of HOK treated with CS/GP, DES, 3% DES-CS/GP, and 6% DES-CS/GP. Live cells are stained green, and dead cells are stained red.

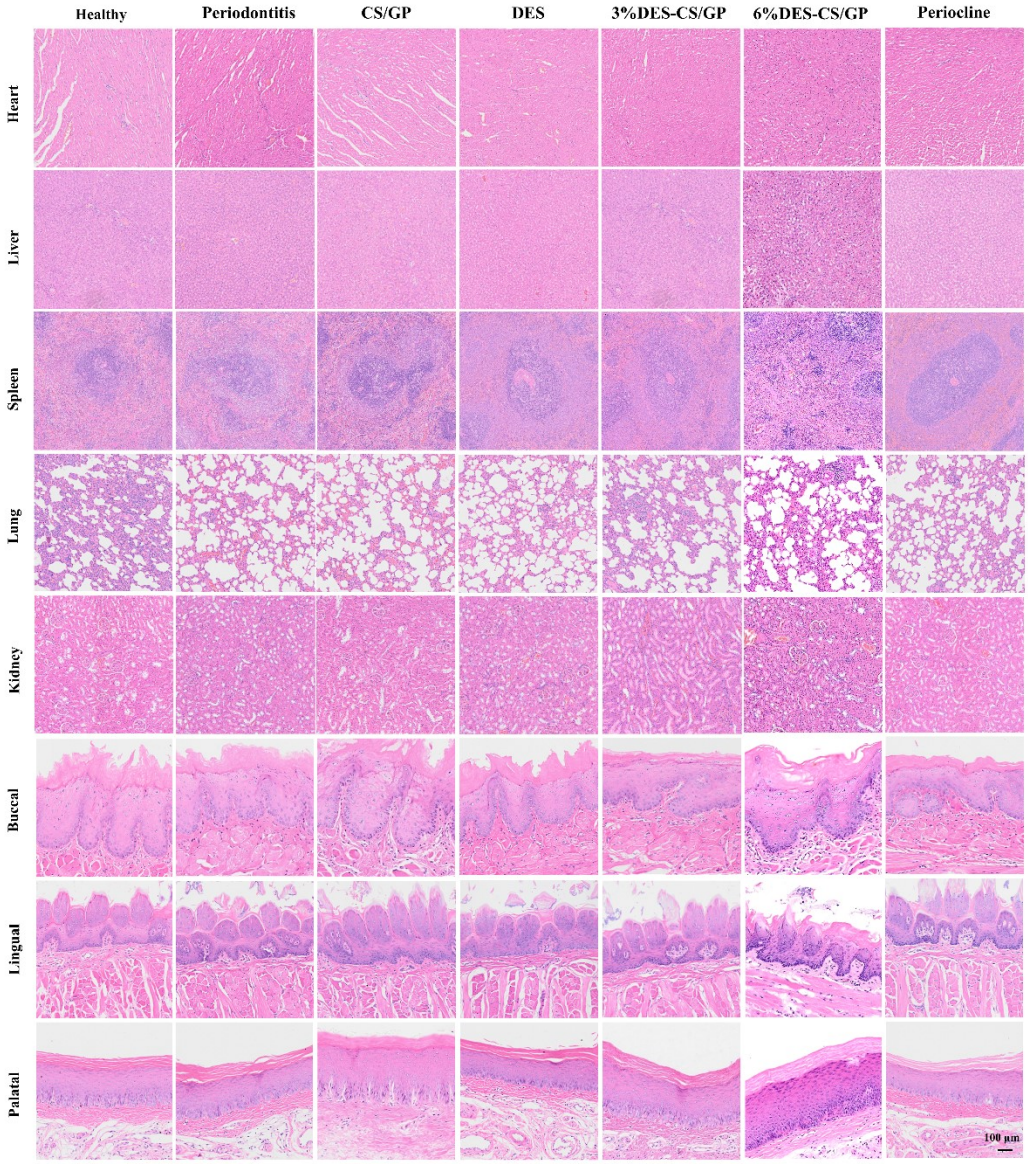
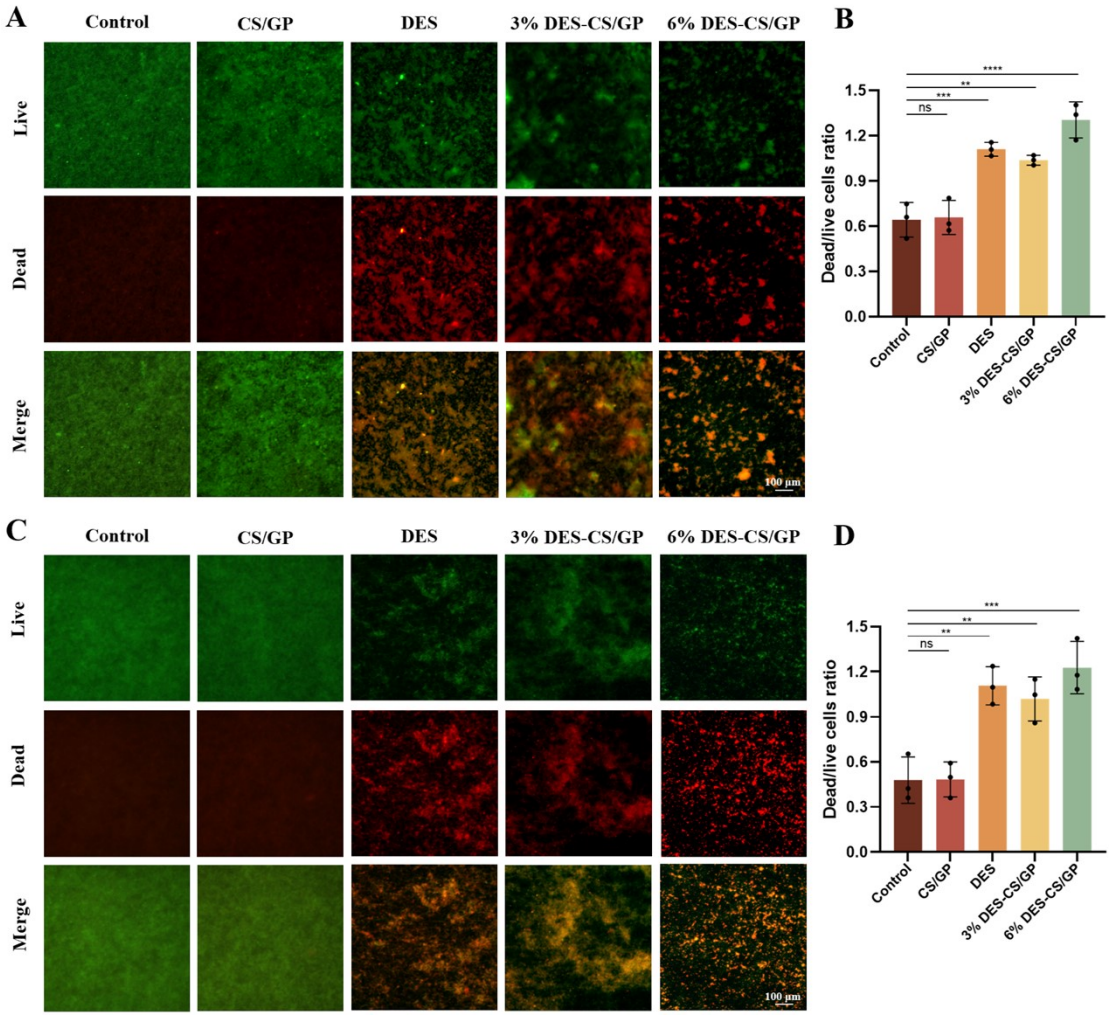


Figure S8. H&E staining images of major organs (heart, liver, spleen, lung, and kidney) and oral tissues (buccal, lingual, and palatal mucosa) after different treatments.


A
Control
CS/GP
DES
3% DES-CS/GP
6% DES-CS/GP
Live
Dead
Merge
100 μm
B
Dead/live cells ratio
ns
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Control
CS/GP
DES
3% DES-CS/GP
6% DES-CS/GP
C
Control
CS/GP
DES
3% DES-CS/GP
6% DES-CS/GP
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Control
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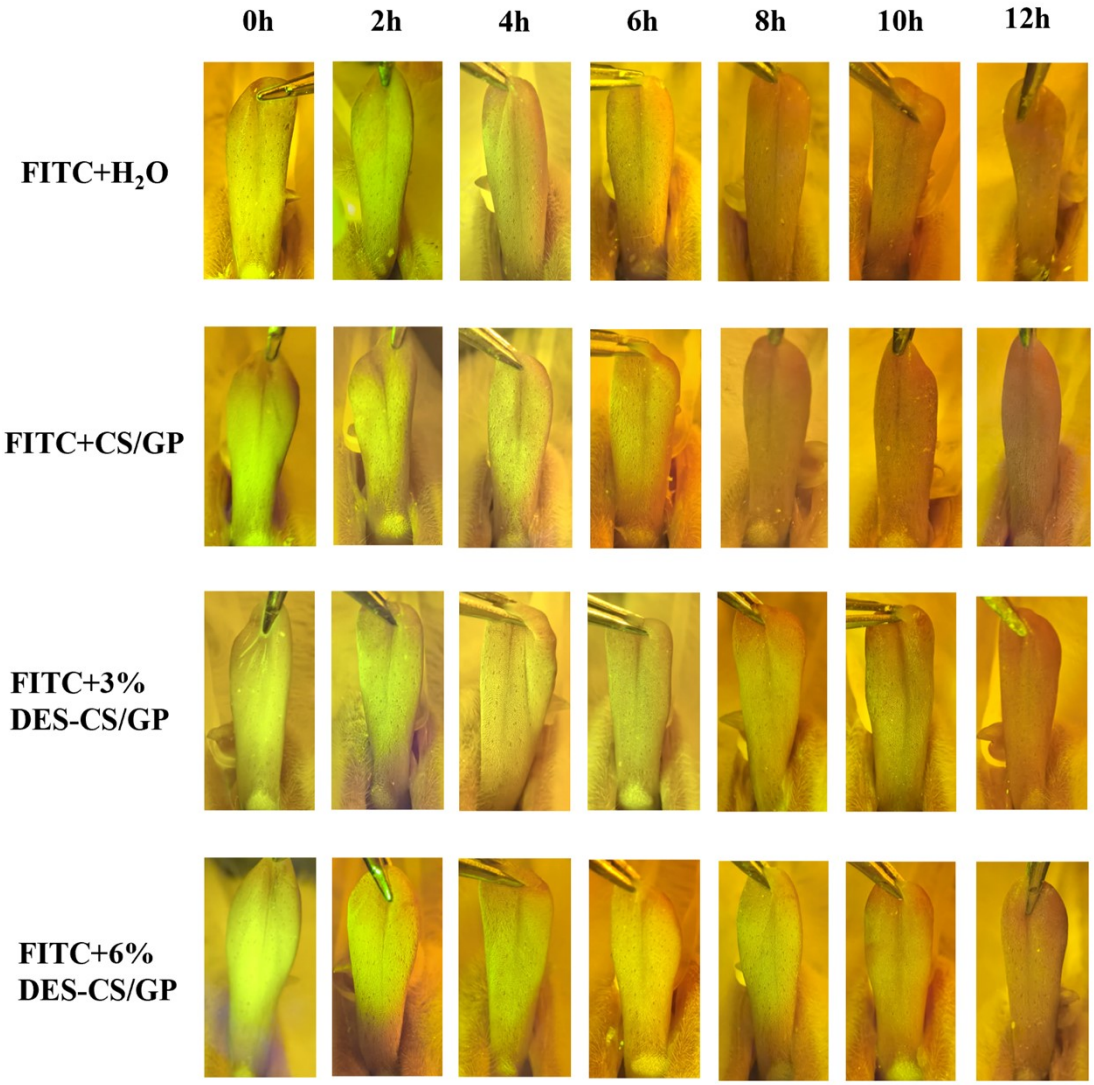
0h
2h
4h
6h
8h
10h
12h
FITC+H2O
FITC+CS/GP
FITC+3%
DES-CS/GP
FITC+6%
DES-CS/GP