Supplementary data

Novel pH Responsive Pectin-Based Hybrid Smart Hydrogels for In-Vitro Drug Release and In-Vivo Wound Healing Applications

Hirra Manzoor, Nasima Arshad*, Muhammad A.U.R. Qureshi, Sher Qadar,

Department of Chemistry Allama Iqbal Open University, Islamabad, Pakistan

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Corresponding author,
Nasima Arshad (PhD), Associate Professor (Physical Chemistry)
Email: nasimaa2006@yahoo.com; nasima.arshad@aiou.edu.pk
https://orcid.org/0000-0002-4257-9909

Graphene Oxide (GO) Characterization

FTIR spectrum of GO is shown in Fig. S1 (a). A prominent and wide -OH stretching peak was seen at roughly 3154 cm^{-1}, indicating that the produced GO contained hydroxyl groups. The strong C=O stretching peak was also detected at 1740 cm^{-1}, while the existence of C=C and C-O-C (epoxy) groups is indicated by the peaks at 1576 cm^{-1} and 1051 cm^{-1}, respectively. The peak at 1316 cm^{-1} exhibits C-O stretching bond [1].

The graphene oxide thermogram, shown in Fig. S1 (b), reflected three-step decomposition. Up to 100 ^{o}C, the elimination of bound water is thought to be responsible for the early deterioration in GO. In phase two, 22.27% of GO was broken down. For the second phase, oxygen-containing functionalities (-COOH, -OH, -C=O) are responsible for rapid breakdown between the temperature range of 100 to 250 ^{o}C. In the third step, a gradual decrease in weight was seen at temperatures between 250 to 700 ^{o}C. The thermally stable graphitic part was confirmed to exist by this third stage of disintegration, which was decomposed completely upto the temperature of 700 ^{o}C [2].

Fig. S1 (c) displays the XRD results of Graphene oxide (GO). GO showed a strong and intense XRD peak at a 2θ value of 12.09^{o}, which corresponded to the (001) with an interplanar spacing of 0.74 nm. The presence of reactive functional groups with oxygen was confirmed by the increase in interplanar spacing of graphene oxide (0.74 nm) as compared to that of pure graphite (0.335 nm). 26^{o} peak shows interlayer stacking of graphene sheets and 43^{o} confirms in plane structure of graphene sheets. This confirms the oxidation of graphite to graphene oxide [3].

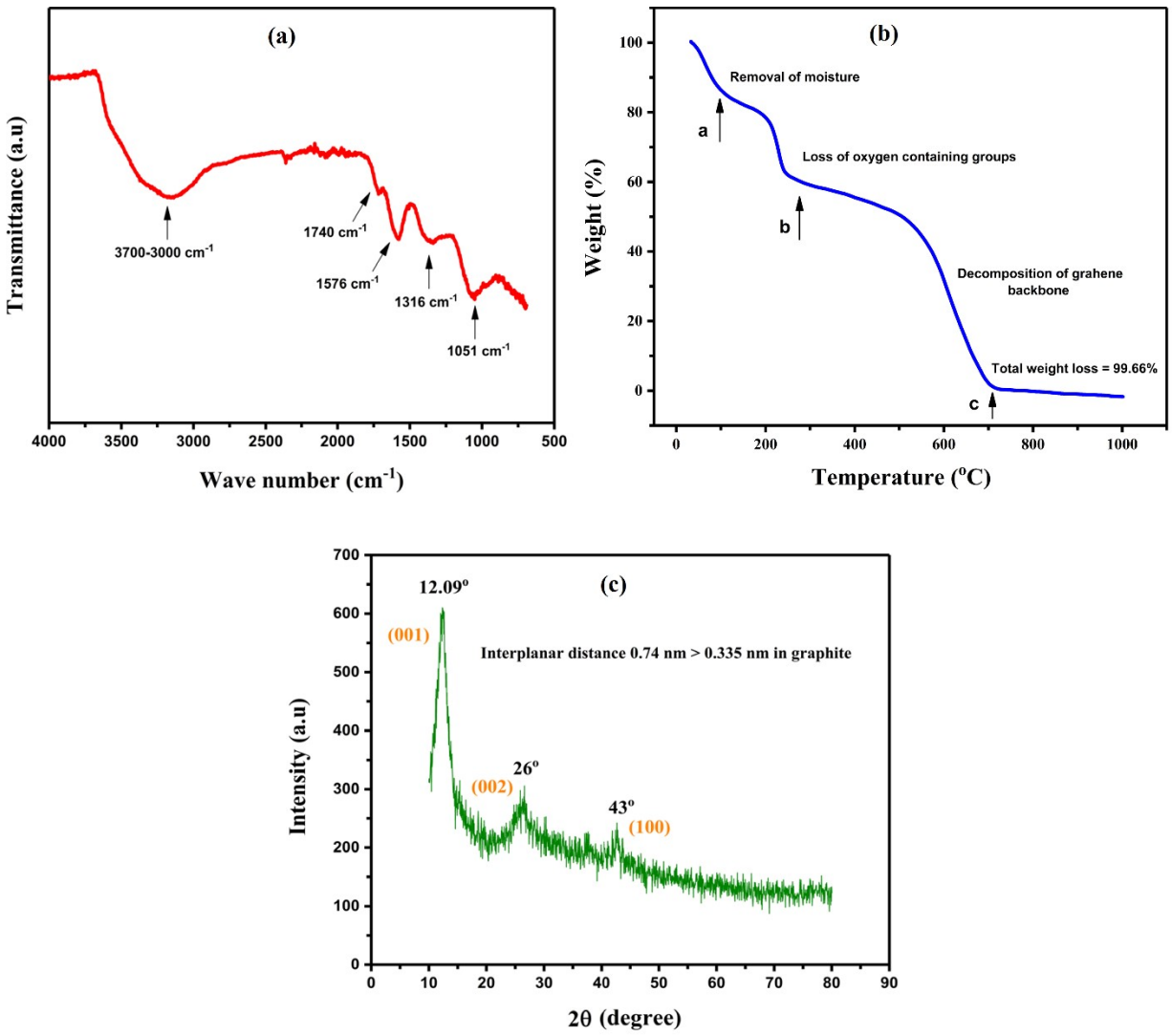

Fig. S1. (a) FTIR spectrum (b) TGA thermogram and (c) XRD spectra of graphene oxide.

References

[1] P. Viprya, D. Kumar & S. Kowshik, Study of different properties of graphene oxide (GO) and reduced graphene oxide (rGO), Eng. Proc. 59(1) (2023) 84. https://doi.org/10.3390/engproc2023059084

[2] D. Losic, F. Farivar & P. L. Yap, Refining and Validating Thermogravimetric Analysis (TGA) for Robust Characterization and Quality Assurance of Graphene-Related Two-

Dimensional Materials (GR2Ms), C- J. Carbon Res. 10(2) (2024) 30. http://dx.doi.org/10.3390/c10020030

[3] S. M. Alduwaib & M. M. Abd, Investigating the Structural, Optical and Antibacterial Properties of Go, Go: Ag, GO: ZnO Thin Layers and Go: ZnO/GO: Ag Bilayers Synthesized by Spray Pyrolysis Method. Iran. J. Mater. Sci. Eng. 17(4) (2020) 170. http://dx.doi.org/10.22068/ijmse.17.4.170

Table S1

Residual weight of GO reinforced Pectin/PVA/APTES/GO hydrogels in PBS solution with respect to time.

Time (days)	Weight (mg)				
	PPG (control)	PPG-2.5	PPG-5	PPG-7.5	PPG-10
0	30	30	30	30	30
1	19.02	22.21	23.5	25.17	26.33
3	9.98	13.46	16.5	15.38	17.86
7	8.17	10.99	12.11	13.29	15
10	6.22	9.05	9.86	11.47	12.73
14	4.08	6.36	8.14	9.19	10.05
21	2.06	3.28	4.54	5.02	6.6

Table S2

Residual weight of GO reinforced Pectin/PVA/APTES/GO hydrogels in Proteinase-K solution with respect to time.

Time (days)	Weight (mg)				
	PPG (control)	PPG-2.5	PPG-5	PPG-7.5	PPG-10
0	30	30	30	30	30
1	9.7	12.59	12	14.40	16.88
3	5.11	6.73	8.5	11.34	12.16
7	2.20	3.42	4.59	5.10	6.27

Table S3

Drug release data of GO reinforced Pectin/PVA/APTES/GO hydrogel in PBS solution at pH 7.4.

Time (mins)	Concentration (mg)	Drug release (%)	Square root of T	M_t/M_o	Log T	Log drug release
10	12.234	24.469	3.162	0.244	1.000	1.388
20	15.967	31.934	4.472	0.319	1.301	1.504
30	18.552	37.104	5.477	0.371	1.477	1.569
40	21.031	42.063	6.324	0.420	1.602	1.623
50	22.812	45.624	7.071	0.456	1.698	1.659
60	24.988	49.977	7.745	0.499	1.778	1.698
70	26.452	52.905	8.366	0.529	1.845	1.723
80	28.945	57.890	8.944	0.578	1.903	1.762
90	30.409	60.818	9.486	0.608	1.954	1.784
100	32.110	64.221	10.00	0.642	2.000	1.807
110	33.522	67.044	10.488	0.670	2.041	1.826
120	35.988	71.976	10.954	0.719	2.079	1.857
130	37.043	74.087	11.401	0.740	2.113	1.869
140	39.496	78.993	11.832	0.789	2.146	1.897
150	40.947	81.895	12.247	0.818	2.176	1.913
160	41.725	83.451	12.649	0.834	2.204	1.921
170	43.057	86.115	13.038	0.861	2.230	1.935
180	43.453	86.906	13.416	0.869	2.255	1.939
190	43.572	87.144	13.784	0.871	2.278	1.940
200	45.049	90.098	14.142	0.900	2.301	1.954
210	45.721	91.443	14.491	0.914	2.322	1.961
220	45.721	91.443	14.832	0.914	2.342	1.961
230	45.721	91.443	15.165	0.914	2.361	1.961

Fig. S2. Picture of cell viability analysis of the Reference.

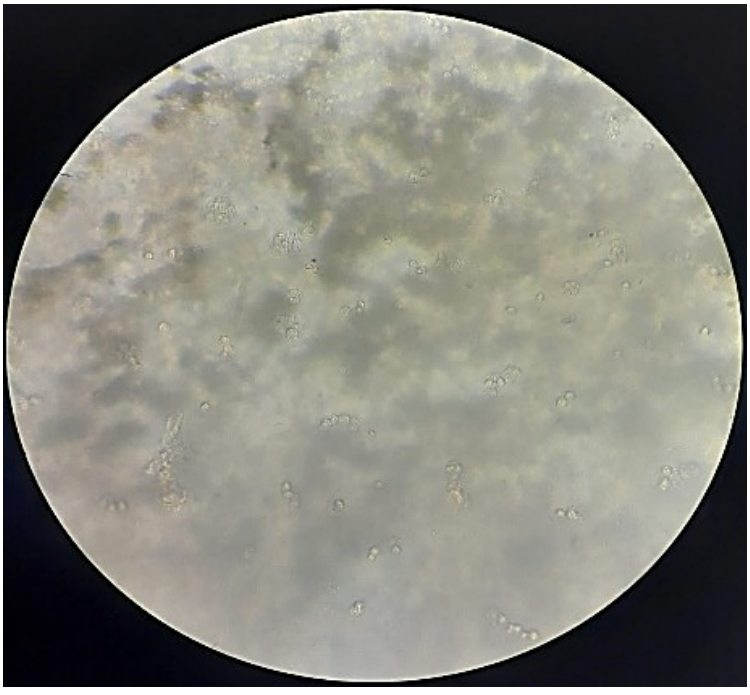

Fig. S3. Picture of cell viability analysis of PPG (control).

Fig. S4. Picture of cell viability analysis of PPG-2.5.

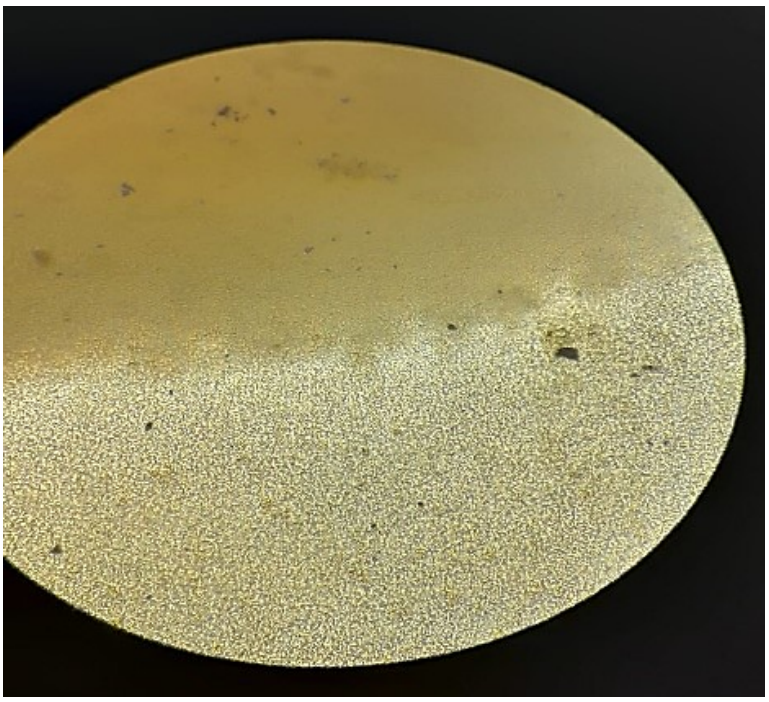

Fig. S5. Picture of cell viability analysis of PPG-5.

Fig. S6. Picture of cell viability analysis of PPG-7.5.

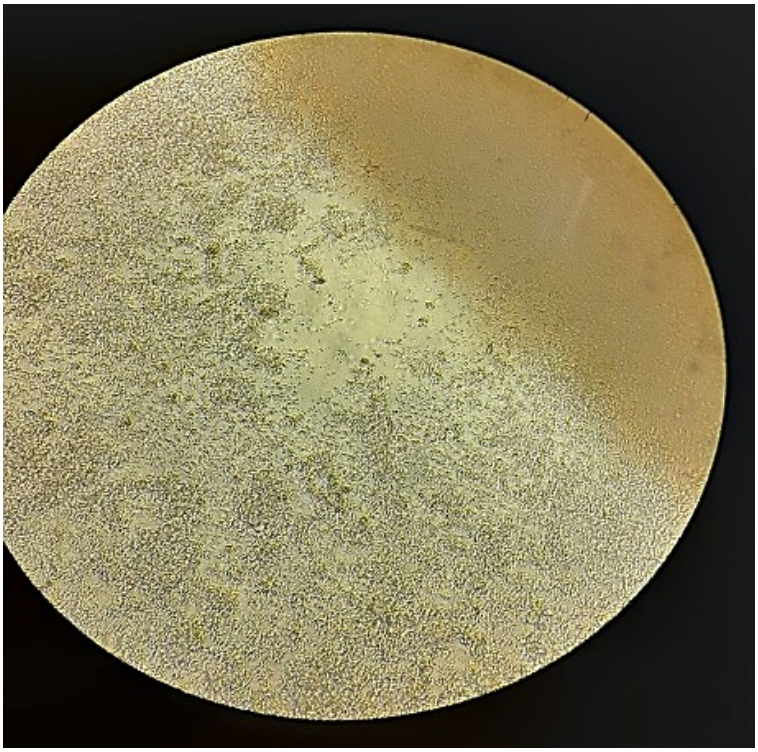

Fig. S7. Picture of cell viability analysis of PPG-10.