Table S1: Assignment of bands obtained from the FTIR spectrum of the three extracted lignin sample.

Wavenumber (cm^{-1})	Peak assignment	Lignin		
		SCB	HT1	HT2
3362-3404	Hydroxyl group (O-H) stretching from aliphatic and phenolic groups	+	+	+
2918-2960	C-H vibrations in methyl and methylene groups. C-H stretch in alkyl groups.	+	+	+
2841-2850	C-H vibrations in methyl and methylene groups	+	+	+
1634-1656	Conjugated C=O stretching in carbonyl groups	+	+	+
1592	C=O stretching, aromatic skeletal vibrations	-	+	+
1504 -1506	C=C-C aromatic ring stretching vibration	+	+	+
1459-1461	Asymmetric C-H deformation of methyl and methylene groups in ether bond. Characteristics of HGS lignin	+	+	+
1420	C=O stretching, aromatic skeletal vibrations	-	-	+
1326-1327	C-O grouping in S unit. Condensed G and S units. O-H deformation and CH_2 angular deformation	+	+	+
1259-1266	C-O vibration in G unit	+	+	+
1221-1222	C-C, C-O and C=O stretching	-	+	+
1118-1120	C=O stretching of G units. Expansion and contraction of aromatic ring	+	+	+
1021-1034	C-H in plane deformation in G units. C-O deformation in primary alcohols. Symmetrical stretching in C-O-C.	+	+	+
800-831	C-H deformation out of plane on all positions of H unit, at positions 2, 5, 6 of G units and positions 2, 6 of S units.	+	+	+

Table S2: Thermal analysis of SCB, HT1 and HT2 lignin.

Peak	Temperature/°C		
	HT1	HT2	SCB
Water evaporation	58.1	54.1	52.3
β-O-4 linkages cleavage	255.8	280.0	275.5
Major decomposition	336.8	341.5	275.5

Table S3: Swelling rate constant (k_s) of hydrogels in PBS at different pH.

Hydrogel	pH		
	5	7.4	8
BC 100%	0.0157	0.0013	**0.0352**
BC:BLig 90:10	0.0172	**0.2010**	0.0142
BC:BLig 80:20	0.0232	**0.0328**	0.0116
BC:BLig 70:30	0.0146	**0.1407**	0.0392
BC:BLig 60:40	0.0159	0.0195	**0.1173**

BC: Bagasse cellulose, BLig: Bagasse lignin

Table S4: Release kinetics and release mechanism of lignin at different pH.

pH	Cel-Lig Hydrogel	Release Kinetics					Drug Release mechanism
		Zero order	First order	Higuchi	Korsmeyer-Peppas		
		R^2	R^2	R^2	R^2	n	
5	BC:Blig 90:10	0.2807	0.2834	0.4491	**0.637**	0.05754	Quasi-Fickian diffusion
	BC:Blig 80:20	0.2734	0.3025	0.4419	**0.7967**	0.0522	
	BC:Blig 70:30	0.2822	0.3098	0.4512	**0.6857**	0.05769	
	BC:Blig 60:40	0.2184	0.2572	0.3673	**0.6919**	0.03593	
7.4	BC:Blig 90:10	0.6829	0.4934	0.8767	**0.9297**	0.9071	Non-Fickian diffusion
	BC:Blig 80:20	0.7079	0.4971	0.8953	**0.94**	0.728	
	BC:Blig 70:30	0.7092	0.5181	0.895	**0.9395**	0.9373	
	BC:Blig 60:40	0.7359	0.5427	0.9043	**0.9508**	1.031	Super case II transport
8	BC:Blig 90:10	0.4658	0.5914	0.6389	**0.7972**	0.1017	Quasi-Fickian diffusion
	BC:Blig 80:20	0.5045	0.6581	0.683	**0.9282**	0.1048	
	BC:Blig 70:30	0.4982	0.6581	0.6782	**0.9592**	0.1026	
	BC:Blig 60:40	0.4152	0.5639	0.5993	**0.9266**	0.0857	

BC: Bagasse cellulose, BLig: Bagasse lignin

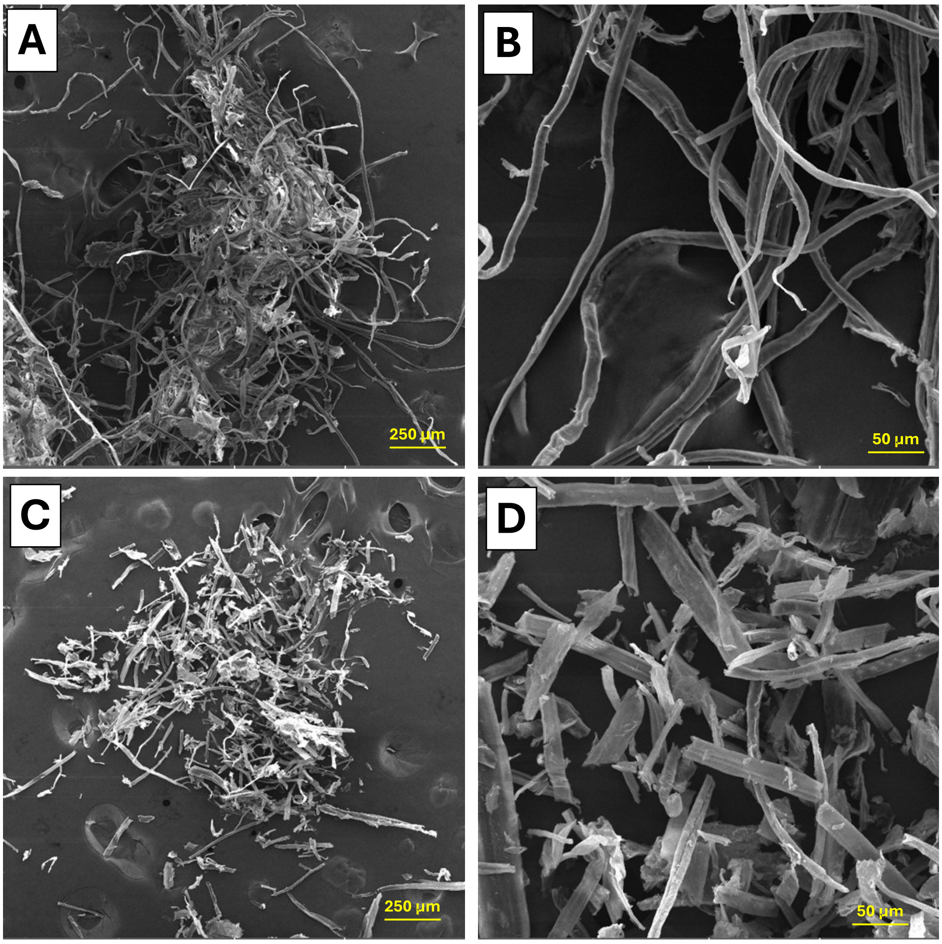

Figure S1: SEM images of SCB cellulose (A-B) and SCB cellulose following an acid hydrolysis (C-D).

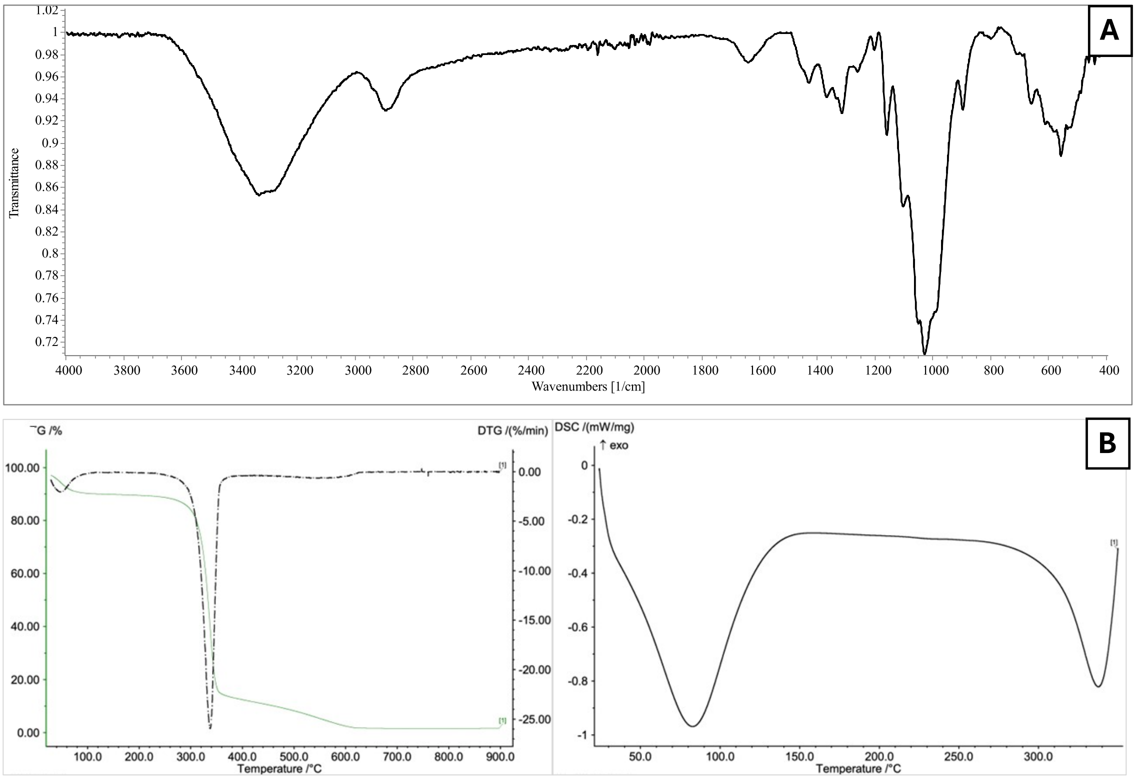

Figure S2: (A) FTIR spectrum of SCB cellulose and (B) Outcome of the SCB cellulose thermal analysis, where the left graph illustrates the TGA and DTG curves and the right graph represents the DSC curve.

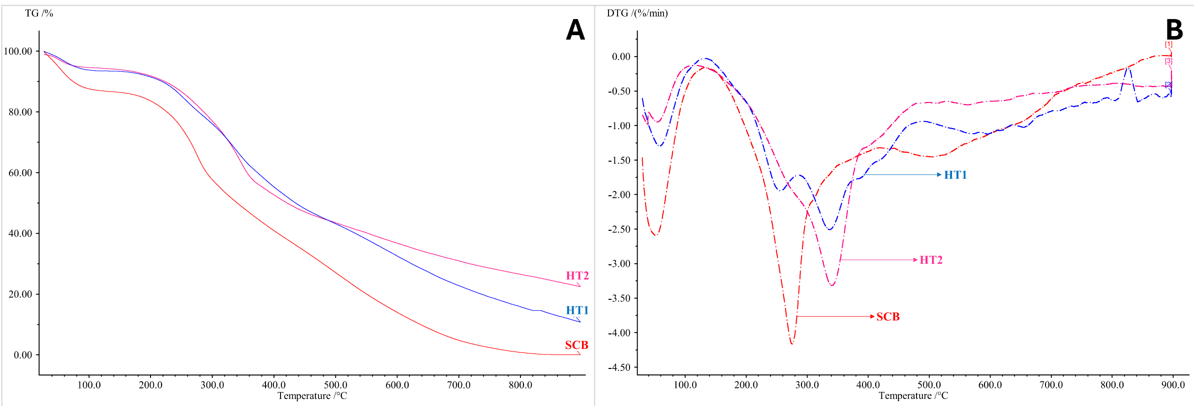

Figure S3: TGA (A) and DTG (B) curves of extracted lignin samples.

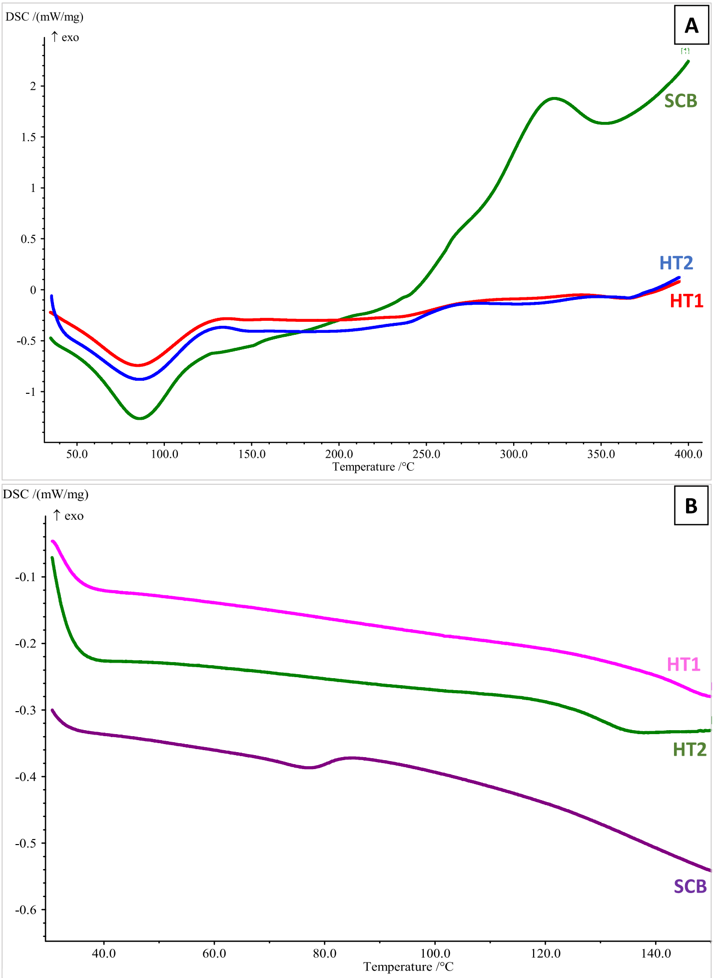

Figure S4: DSC curves of SCB, HT1 and HT2 lignin samples, where (A) without cooling and (B) without cooling.

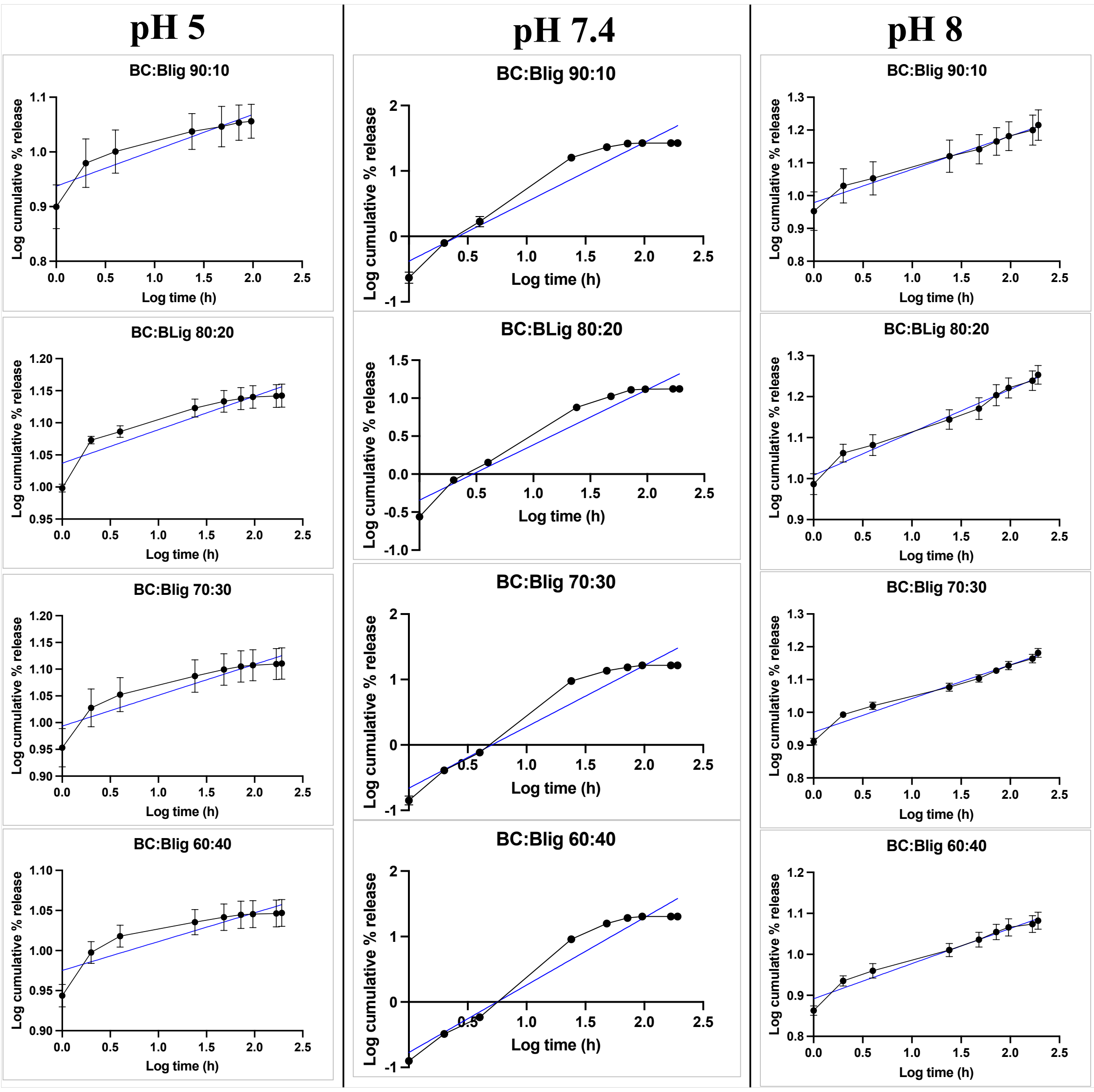

Figure S5: Graphical representation of the best-suited swelling kinetics at different pH, where BC: bagasse cellulose, Blig: bagasse lignin.