

Composite Biopolymer-based Wafer Dressings Loaded with Microbial Biosurfactants for Potential Application in Chronic Wounds

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SUPPLEMENTARY TABLES

Table S1. Comparison of the mean pore sizes (\pm SD) (μm) of single, composite and optimized BSs loaded wafers ($n = 3$).

(% w/w)	1:0	0:1	(μm)	
1.0	173.77 (\pm 75.99)	126.10 (\pm 45.04)	-	-
1.5	146.56 (\pm 53.65)	85.63 (\pm 25.64)	-	-
2.0	79.06 (\pm 23.22)	65.78 (\pm 13.90)	-	-
2.5	90.66 (\pm 28.08)	-	-	-
3.0	97.88 (\pm 22.35)	-	-	-
	1:1	1:2	1:3	3:1
1.5	87.07 (\pm 30.26)	169.00 (\pm 38.66)	78.80 (\pm 15.92)	-
2.0	180.25 (\pm 53.44)	87.10 (\pm 19.37)	89.07 (\pm 22.22)	153.80 (\pm 34.30)
	0.1% RL	0.2% RL	0.1% SL	5% SL
1.5	136.60 (\pm 50.95)	122.26 (\pm 46.30)	98.21 (\pm 42.52)	141.13 (\pm 47.15)

Table S2. Wavenumbers of various polymer and BSs starting materials and representative single CARR and SA wafers based on possible intermolecular/intramolecular interactions analyzed by ATR-FTIR analysis.

Peak number	CARR STD	SA	RL	SL	1.5% (1:0)	1.5% (0:1)
1	3373	3244	3257	3368	3368	3252
2	-	1595	2924-2855	2928-2855	1373	1598
3	1221	1407	1726	-	1224	1408
4	-	-	1655	1641	1156	1083
5	925	1025	1575	1553	925	1028
6	844	-	-	1415	844	-
7	-	-	1397	1369	-	-
8	-	-	1317	1247	-	-
9	-	-	1123	1170	-	-
10	-	-	-	1077	-	-
11	-	-	1046	1034	-	-
12	-	-	981	-	-	-
13	-	-	916	-	-	-
14	-	-	881	-	-	-
15	-	-	831	-	-	-
16	-	-	808	-	-	-
17	-	-	704	-	-	-
18	-	-	663	-	-	-

Table S3. Comparison of wavenumbers present in selected optimised CARR:SA:BLKs and representative CARR:SA:BSs loaded wafers based on ATR-FTIR analysis

Peak number	1.5% (1:3)	1.5% (1:3) 0.2% RL	1.5% (1:3) 0.1% SL
1	3337	3283	3284
2	1599	1598	1599
3	1410	1411	1411
4	1255	1255	1255
5	1029	1028	1029
6	931	931	932
7	-	846	-

Table S4. Comparison of the porosities of single, composite and BSs loaded wafers

(%, w/w)	CARR :SA 0:1	Pore analysis (%)			
1.5	-				
2.0	100.00 (± 7.20)				
	1:1	1:2	1:3	3:1	
1.5	49.92 (± 11.10)	50.83 (± 1.40)	90.48 (± 17.20)	-	
2.0	43.26 (± 10.21)	67.79 (± 15.10)	49.25 (± 5.04)	53.98 (± 7.25)	
	0.1% RL	0.2% RL	0.1% SL	5% SL	
1.5	100.00 (± 6.62)	100.00 (± 3.97)	97.34 (± 3.37)	98.94 (± 2.04)	

Table S5. Comparison of the water absorption (A_w) and equilibrium water content (EWC), of single, composite and BSs loaded wafers

1.5	0:1	1:1	1:2	1:3	3:1
A_w	-	2521 (\pm 468)	3074 (\pm 241)	2826 (\pm 135)	-
EWC	-	96.12 (\pm 0.63)	96.84 (\pm 0.23)	96.58 (\pm 0.16)	-
2	0:1	1:1	1:2	1:3	3:1
A_w	2369 (\pm 75)	1974 (\pm 180)	2574 (\pm 590)	1943 (\pm 412)	2854 (\pm 407)
EWC	95.95 (\pm 0.12)	95.15 (\pm 0.43)	96.14 (\pm 0.84)	94.95 (\pm 1.15)	96.57 (\pm 0.44)
1.5	0.1% RL	0.2% RL	0.1% SL	5% SL	
A_w	2699 (\pm 157)	3560 (\pm 122)	3458 (\pm 458)	3569 (\pm 262)	-
EWC	97.46 (\pm 0.24)	97.53 (\pm 0.05)	97.61 (\pm 0.57)	97.00 (\pm 0.57)	-

Table S6. Comparison of the evaporative water loss (EWL) of 1.5% CARR:SA (1:3) BSs loaded wafers

1.5%(1:3) CARR:SA	1	2	3	4	5	6	24 h (%)
0.1% RL	90.54 (\pm 1.41)	81.05 (\pm 2.48)	72.11 (\pm 3.69)	64.56 (\pm 4.38)	57.83 (\pm 4.99)	51.86 (\pm 5.43)	14.36 (\pm 1.20)
0.1% SL	91.70 (\pm 0.13)	83.44 (\pm 0.32)	75.32 (\pm 0.50)	68.53 (\pm 0.76)	62.49 (\pm 1.24)	57.24 (\pm 1.29)	14.40 (\pm 0.84)
0.2% RL	89.99 (\pm 2.13)	79.87 (\pm 4.08)	70.17 (\pm 5.77)	62.15 (\pm 6.91)	55.10 (\pm 7.89)	48.87 (\pm 8.78)	14.48 (\pm 1.21)
5% SL	90.63 (\pm 0.90)	81.50 (\pm 1.59)	72.90 (\pm 2.13)	65.66 (\pm 2.47)	59.44 (\pm 2.74)	53.62 (\pm 3.07)	15.22 (\pm 0.03)

Table S7. Comparison of the water vapour transmission rate (WVTR) of BLK 1.5 and 2% CARR:SA (0:1, 1:1, 1:2, 1:3, 3:1) wafers

1.5%	1	2	3	4	24 h (g/m ² day ⁻¹)
0:1	-	-	-	-	-
1:1	87.53 (± 4.28)	199.76 (± 4.27)	317.66 (± 6.61)	595.70 (± 50.41)	3082 (± 285)
1:2	89.03 (± 1.31)	201.27 (± 3.46)	318.79 (± 4.61)	644.94 (± 24.17)	2777 (± 105)
1:3	105.07 (± 6.21)	250.13 (± 57.90)	376.89 (± 69.67)	735.29 (± 76.06)	3054 (± 184)
3:1	-	-	-	-	-
2%					
0:1	124.12 (± 19.57)	225.42 (± 24.83)	346.33 (± 30.39)	660.59 (± 49.66)	2920 (± 132)
1:1	84.32 (± 3.71)	189.58 (± 7.09)	300.68 (± 9.63)	585.14 (± 13.90)	2661 (± 114)
1:2	89.41 (± 2.59)	198.63 (± 2.04)	311.24 (± 2.04)	577.78 (± 4.63)	2657 (± 69)
1:3	130.72 (± 63.72)	318.04 (± 103.78)	491.77 (± 167.47)	886.95 (± 219.86)	3285 (± 690)
3:1	130.72 (± 41.68)	260.88 (± 44.32)	386.70 (± 45.70)	731.14 (± 112.37)	3330 (± 439)

Table S8. Comparison of the water vapour transmission rate (WVTR) of BSs loaded 1.5% CARR:SA (1:3) wafers

1.5% CARR:SA (1:3)	1	2	3	4	5	6	24 h (g/m ² day ⁻¹)
0.1% RL	126 (±5)	278 (±5)	615 (±20)	832 (±45)	990 (±56)	1148 (±66)	3080 (±143)
0.2% RL	127 (±3)	277 (±9)	590 (±27)	806 (±37)	958 (±51)	1106 (±61)	2982 (±145)
0.1% SL	129 (±5)	275 (±9)	498 (±36)	672 (±53)	818 (±56)	965 (±67)	2828 (±157)
5% SL	133 (±2)	273 (±5)	433 (±38)	586 (±38)	725 (±37)	864 (±38)	2702 (±49)

Table S9. Residual moisture of optimized formulations analyzed by TGA

Moisture content (%)	0:1	1:1	1:2	1:3	3:1
1.5%	-	14.18 (± 0.64)	14.46 (± 0.10)	14.86 (± 0.53)	-
2.0%	14.36 (± 0.06)	13.75 (± 0.33)	14.23 (± 0.10)	15.16 (± 0.18)	13.77 (± 1.33)

Table S10. Comparison of the mucoadhesive stickiness of single, composite BLK and drug loaded wafers

Stickiness (N)					
Single polymer wafers	1:0	0:1			
1 (% w/w)	0.34 (± 0.12)	0.31 (± 0.02)	-	-	-
1.5 (% w/w)	0.14 (± 0.02)	0.28 (± 0.06)	-	-	-
2 (% w/w)	0.16 (± 0.01)	0.29 (± 0.02)	-	-	-
2.5 (% w/w)	0.18 (± 0.03)	-	-	-	-
3 (% w/w)	0.20 (± 0.00)	-	-	-	-
Composite wafers	1:1	1:2	1:3	2:1	3:1
1 (% w/w)	0.29 (± 0.11)	0.36 (± 0.14)	0.24 (± 0.02)	0.26 (± 0.09)	0.18 (± 0.04)
1.5 (% w/w)	0.81 (± 0.06)	0.47 (± 0.14)	0.60 (± 0.19)	-	-
2 (% w/w)	0.42 (± 0.09)	0.35 (± 0.11)	0.61 (± 0.22)	-	0.47 (± 0.17)
DL loaded wafers	0.1% RL	0.2% RL	0.1% SL	5% SL	-
1:3 (1.5%)	0.55 (± 0.02)	0.56 (± 0.10)	0.58 (± 0.13)	0.48 (± 0.05)	-

Table S11. Comparison of the work of adhesion (WOA) of single, composite and drug loaded wafers

Work of adhesion (WOA) (N.mm)					
Single polymer wafers	1:0	0:1			
1.0 (% w/w)	0.61 (± 0.20)	0.37 (± 0.03)	-	-	-
1.5 (% w/w)	0.23 (± 0.00)	0.35 (± 0.10)	-	-	-
2.0 (% w/w)	0.30 (± 0.02)	0.22 (± 0.04)	-	-	-
2.5 (% w/w)	0.41 (± 0.19)	-	-	-	-
3.0(% w/w)	0.23 (± 0.01)	-	-	-	-
Composite wafers	1:1	1:2	1:3	2:1	3:1
1.0 (% w/w)	0.38 (± 0.17)	0.72 (± 0.37)	0.45 (± 0.02)	0.23 (± 0.11)	0.30 (± 0.03)
1.5 (% w/w)	1.19 (± 0.12)	0.68 (± 0.31)	1.09 (± 0.48)	-	-
2.0 (% w/w)	0.47 (± 0.20)	0.54 (± 0.21)	1.91 (± 1.99)	-	0.67 (± 0.24)
DL loaded wafers	0.1% RL	0.2% RL	0.1% SL	5% SL	-
1:3 (1.5%)	0.59 (± 0.19)	0.78 (± 0.15)	0.59 (± 0.17)	0.54 (± 0.04)	

Table S12. Comparison of the mucoadhesive cohesiveness of single, composite and drug loaded wafers

Cohesiveness (mm)					
Single wafers	1:0	0:1	-	-	-
1 (% w/w)	3.61 (\pm 0.51)	2.92 (\pm 1.21)	-	-	-
1.5 (% w/w)	3.01 (\pm 0.33)	2.40 (\pm 0.54)	-	-	-
2 (% w/w)	4.03 (\pm 1.36)	1.61 (\pm 0.49)	-	-	-
2.5 (% w/w)	4.90 (\pm 2.38)	-	-	-	-
3 (% w/w)	2.29 (\pm 0.09)	-	-	-	-
Composite wafers	1:1	1:2	1:3	2:1	3:1
1 (% w/w)	2.05 (\pm 0.28)	3.14 (\pm 0.67)	3.62 (\pm 0.45)	1.50 (\pm 0.39)	3.50 (\pm 0.57)
1.5 (% w/w)	3.61 (\pm 0.43)	2.84 (\pm 0.86)	5.49 (\pm 3.31)	-	-
2 (% w/w)	2.16 (\pm 0.38)	2.98 (\pm 0.80)	4.91 (\pm 2.87)	-	3.30 (\pm 0.88)
DL loaded wafers	0.1% RL	0.2% RL	0.1% SL	5% SL	-
1.5%(1:3)	2.15 (\pm 0.44)	3.30 (\pm 1.73)	3.14 (\pm 2.15)	2.12 (\pm 0.29)	-

SUPPLEMENTARY FIGURES

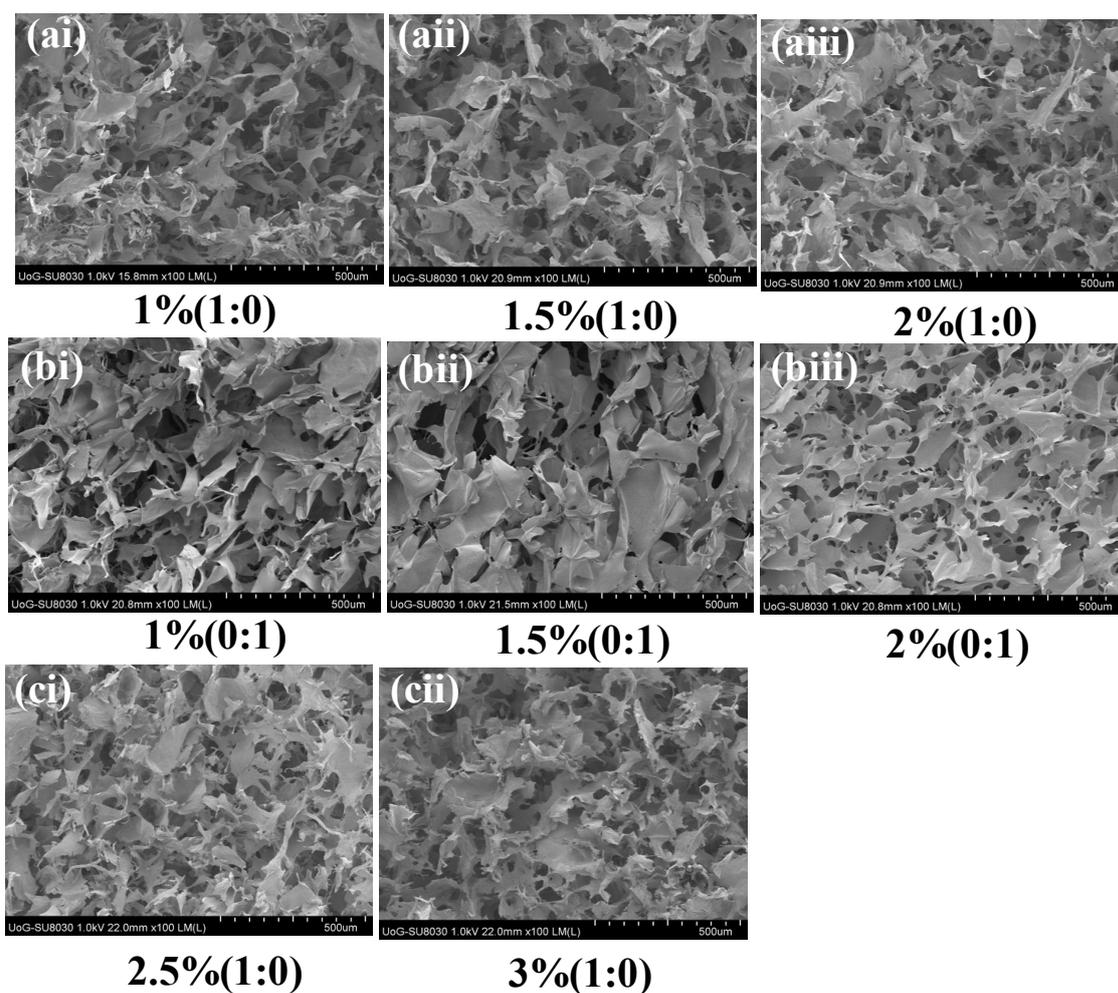


Figure S1. SEM comparison of selected single polymer wafers prepared from pure CARR (ai) 1%(1:0) (aii) 1.5%(1:0) (aiii) 2%(1:0) pure SA (bi) 1%(0:1) (bii) 1.5%(0:1) (biii) 2%(0:1) and higher total polymer weight pure CARR gels (ci) 2.5%(1:0) (cii) 3%(1:0).

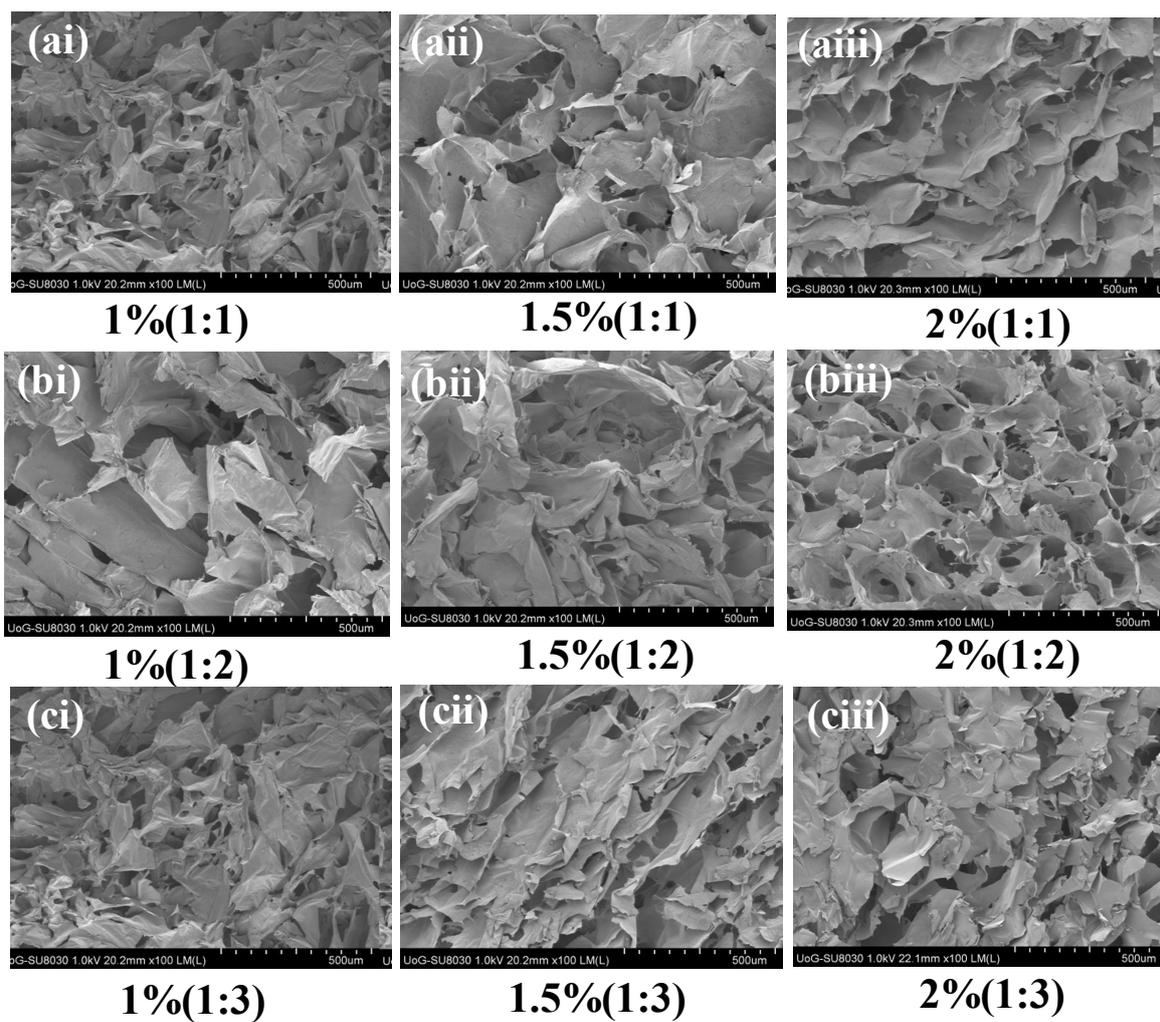


Figure S2. SEM images of composite wafers obtained from 1.0, 1.5 and 2.0 % (total polymer weight) CARR:SA gels at ratios of 1:0, 0:1, 1:1, 1:2 and 1:3 respectively.

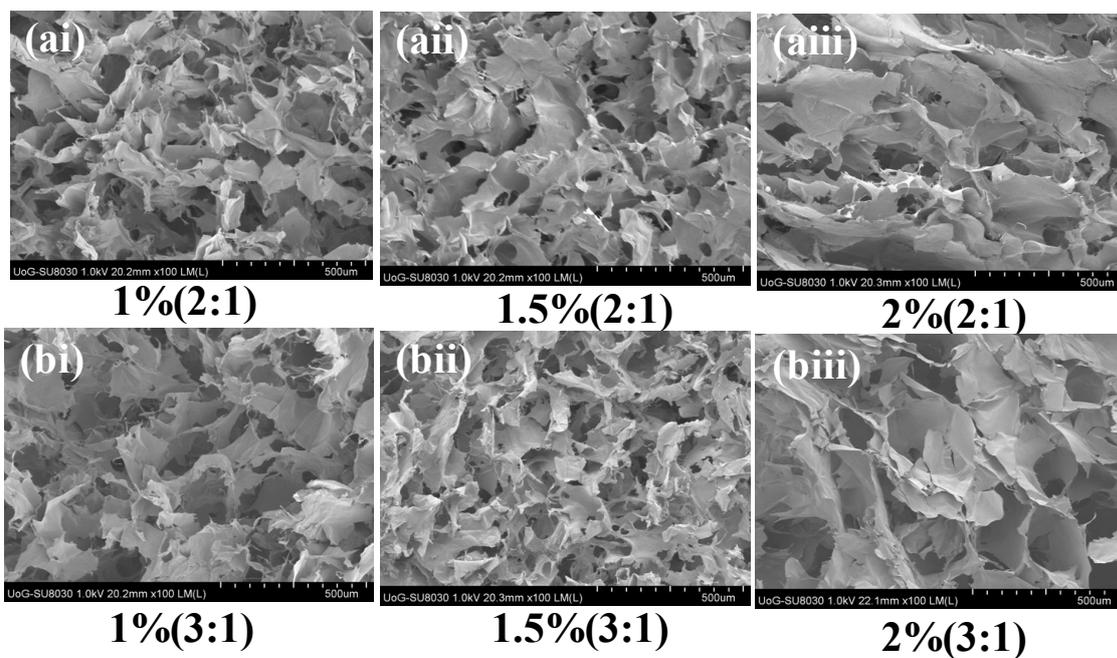


Figure S3. Comparison of (ai) 1%(2:1) (aii) 1.5%(2:1) (aiii) 2%(2:1) (bi) 1%(3:1) (bii)1.5%(3:1) (biii) 2%(3:1) CARR:SA wafers.

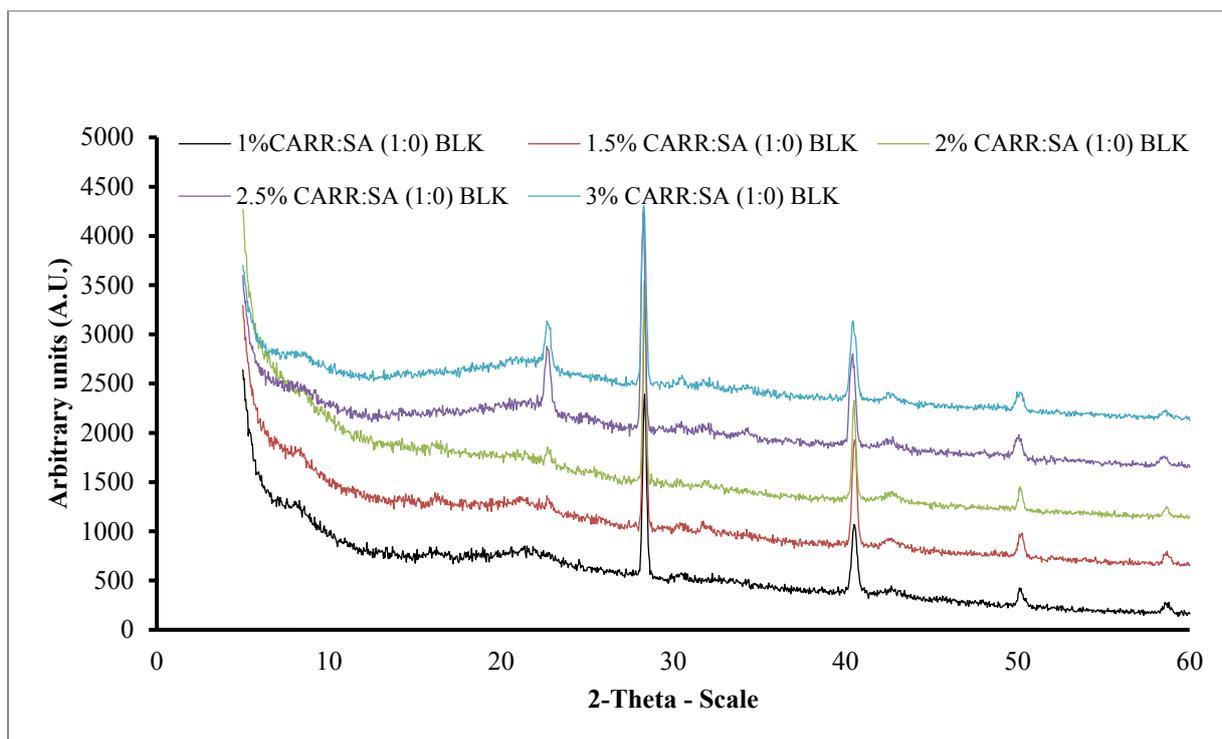


Figure S4. XRD diffractograms of 1 - 3% CARR:SA (1:0) BLK.

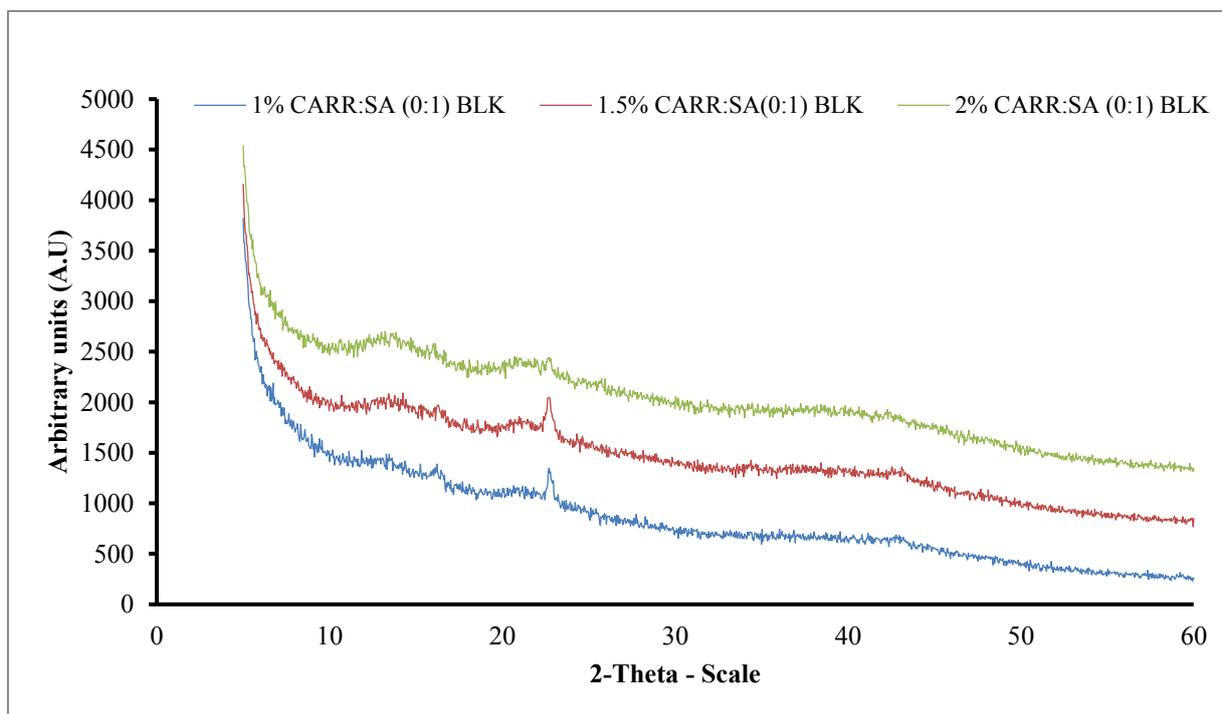


Figure S5. XRD diffractograms of 1 - 2% CARR:SA (0:1).

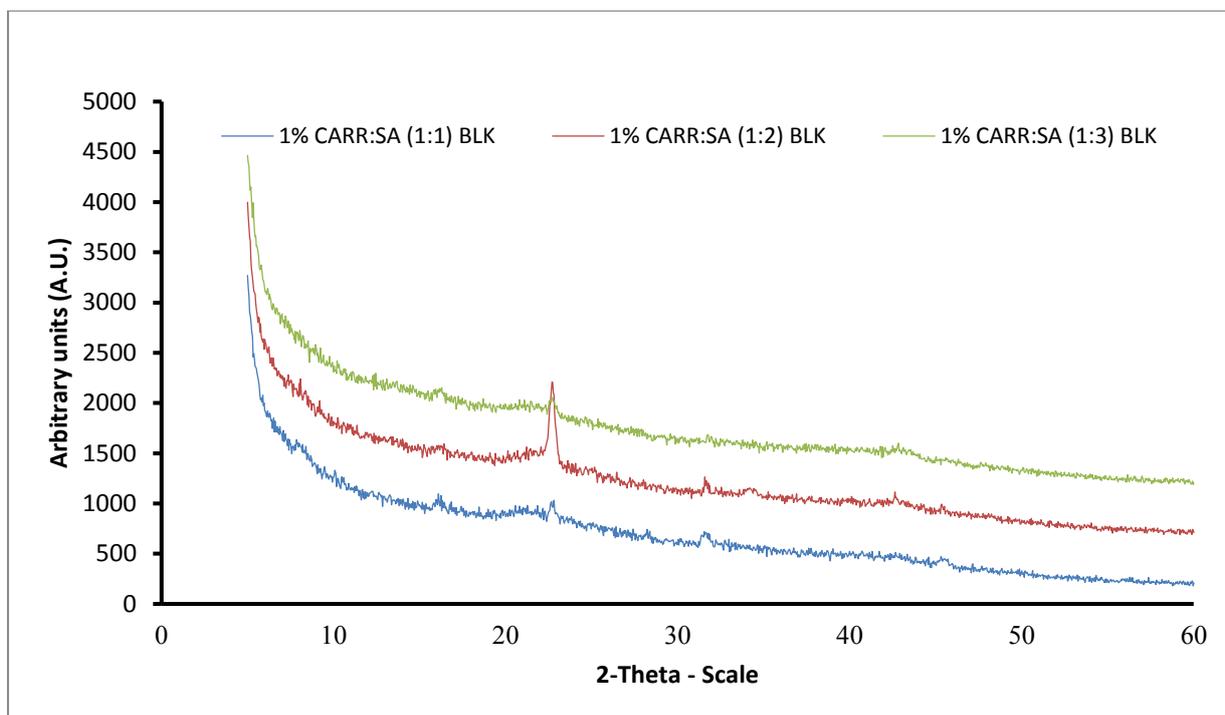


Figure S6. XRD diffractograms of 1% CARR:SA (1:1, 1:2 and 1:3).

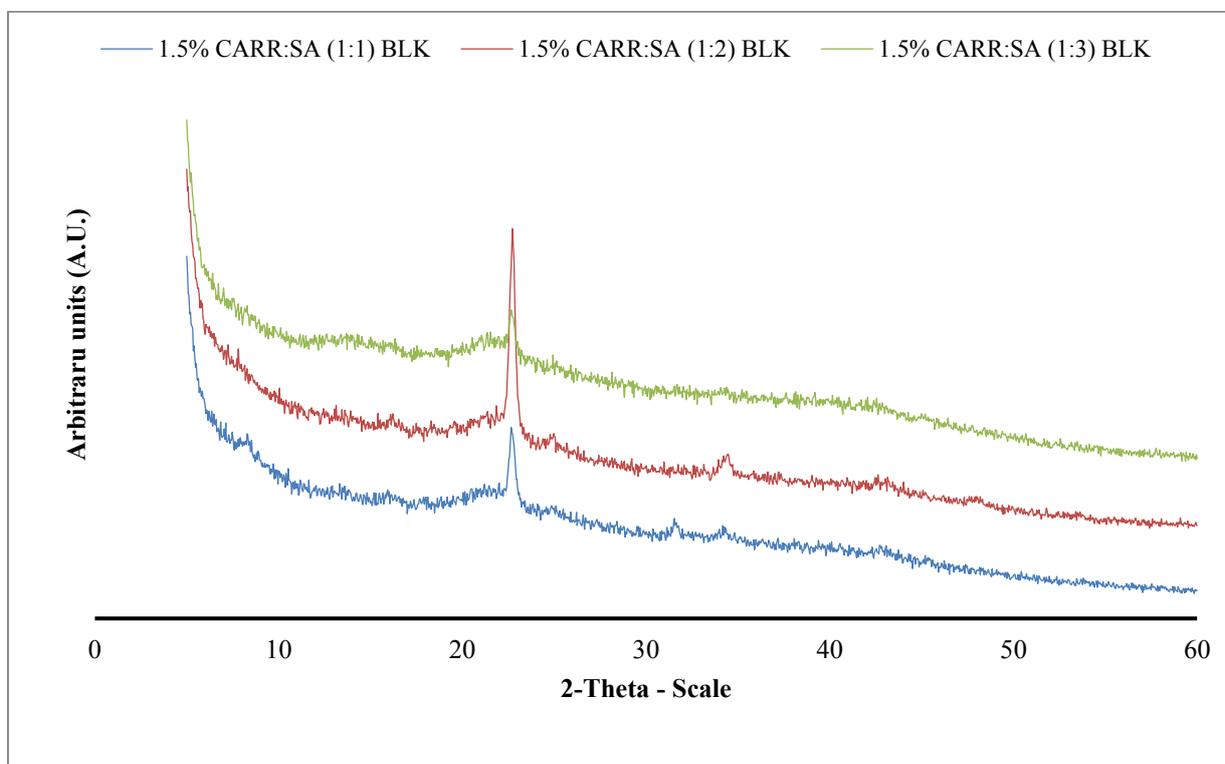


Figure S7. XRD diffractograms of 1.5%(1:1, 1:2 and 1:3) CARR:SA.

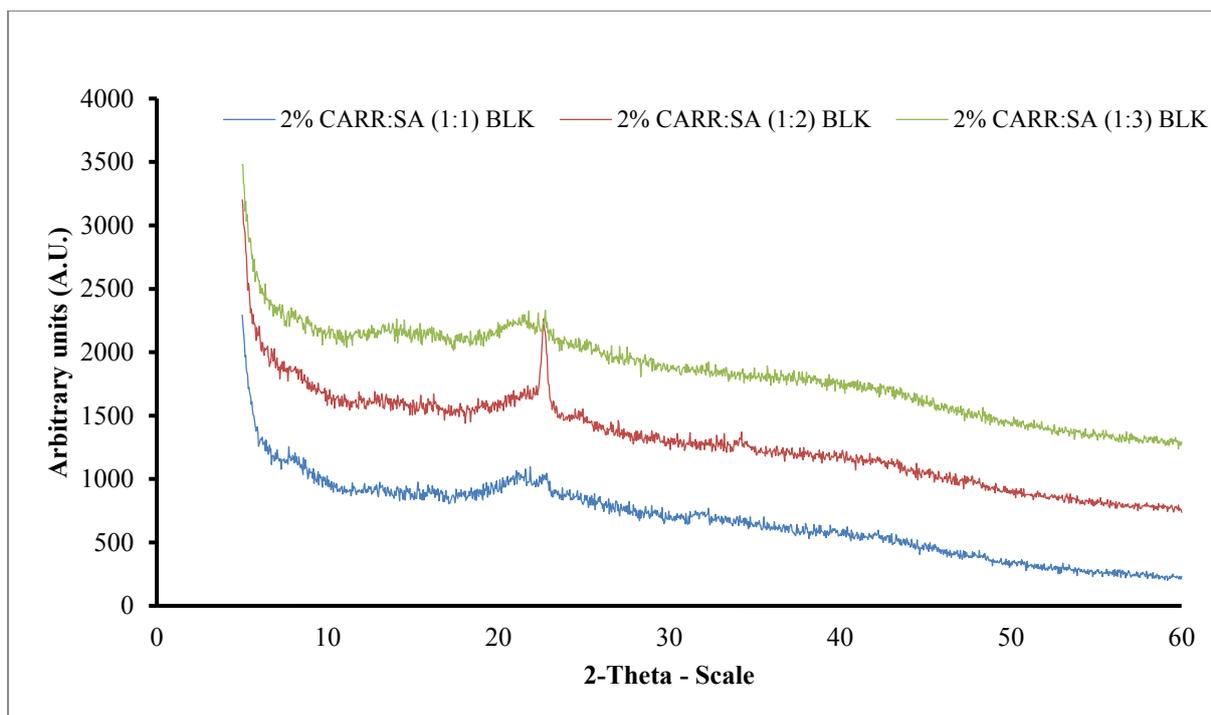


Figure S8. XRD diffractograms of 2% CARR:SA (1:1, 1:2 and 1:3) BLK.

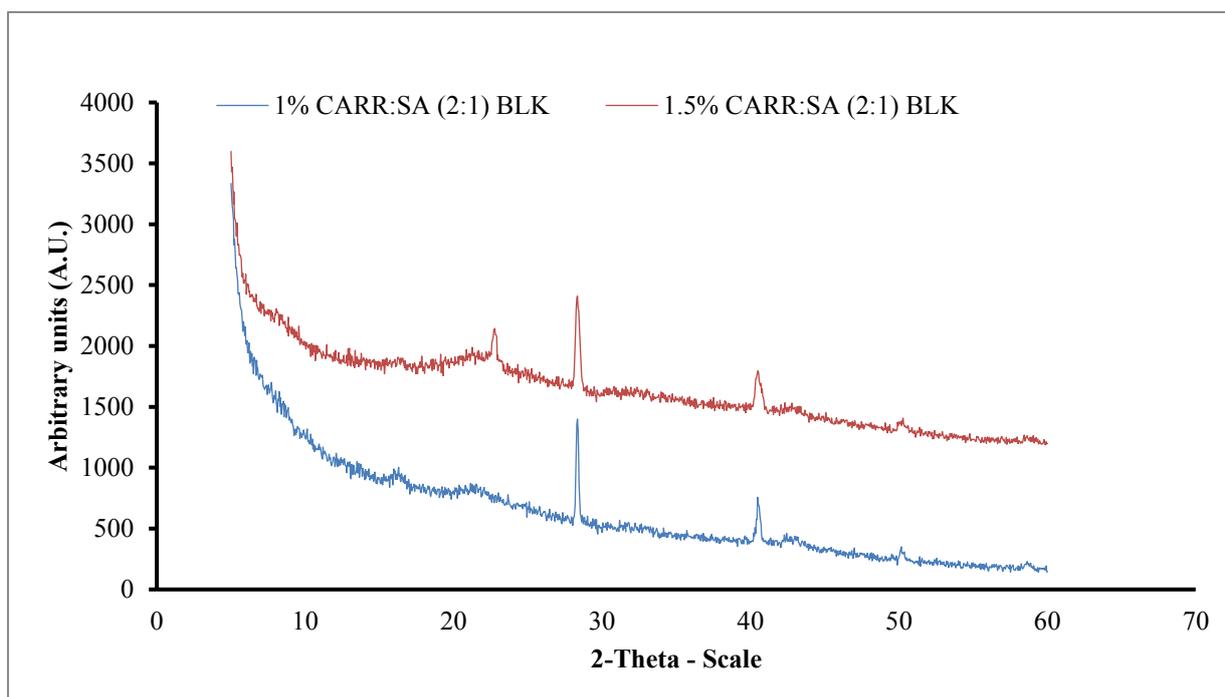


Figure S9. XRD diffractograms of 1% CARR:SA (2:1) BLK and 1.5% CARR:SA (2:1) BLK.

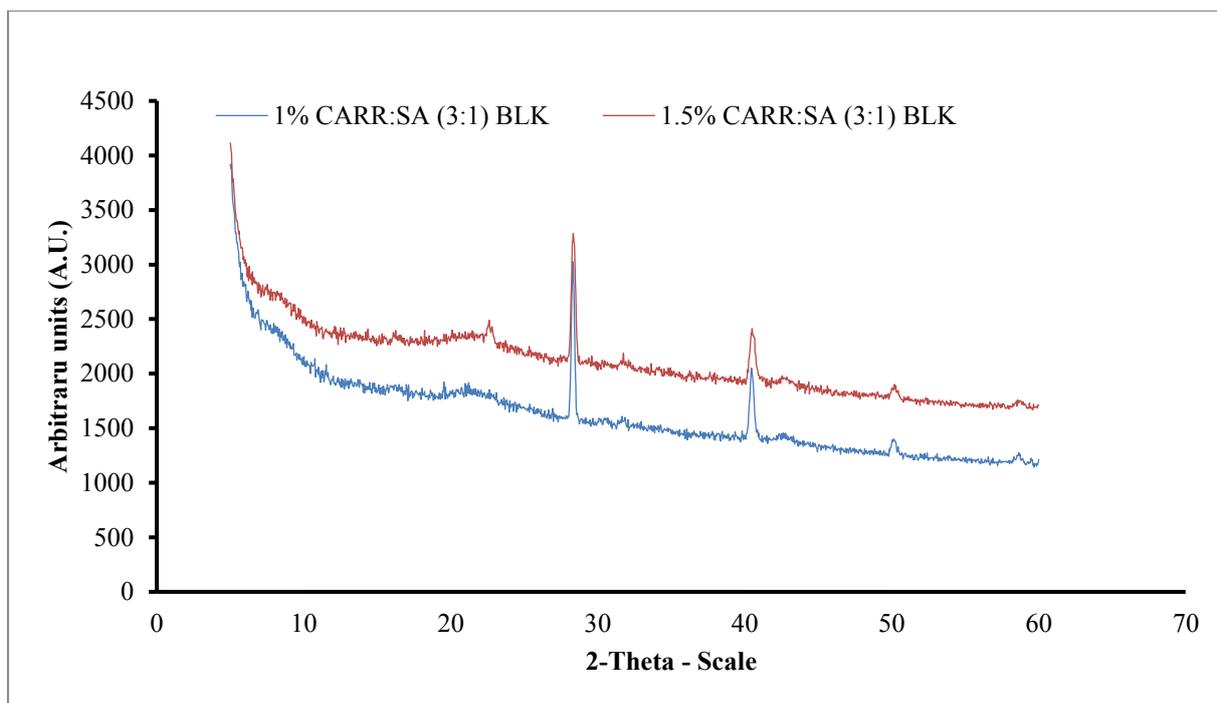


Figure S10. XRD diffractograms of 1% CARR:SA (3:1) BLK and 1.5% CARR:SA (3:1) BLK.

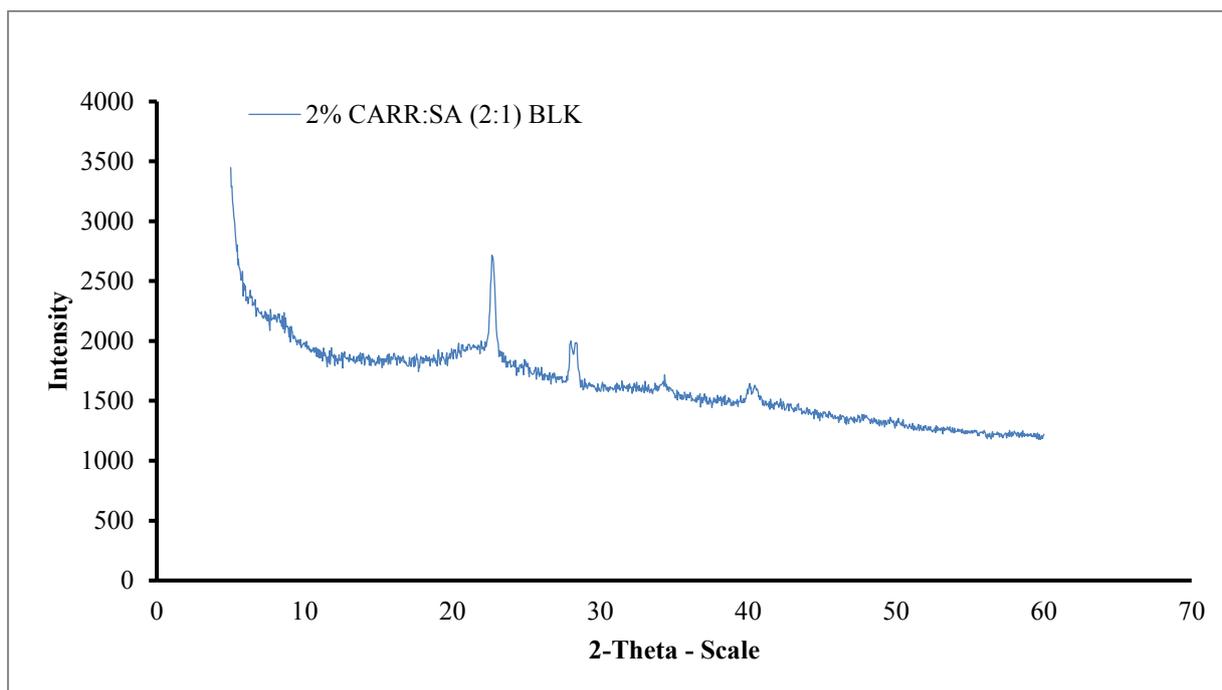


Figure S11. XRD diffractogram of 2% CARR:SA (2:1).