

## SUPPLEMENTARY INFORMATION

### **Valorization of *Opuntia dillenii* biomass into a reusable bio-based composite for sustainable and efficient methyl orange adsorption**

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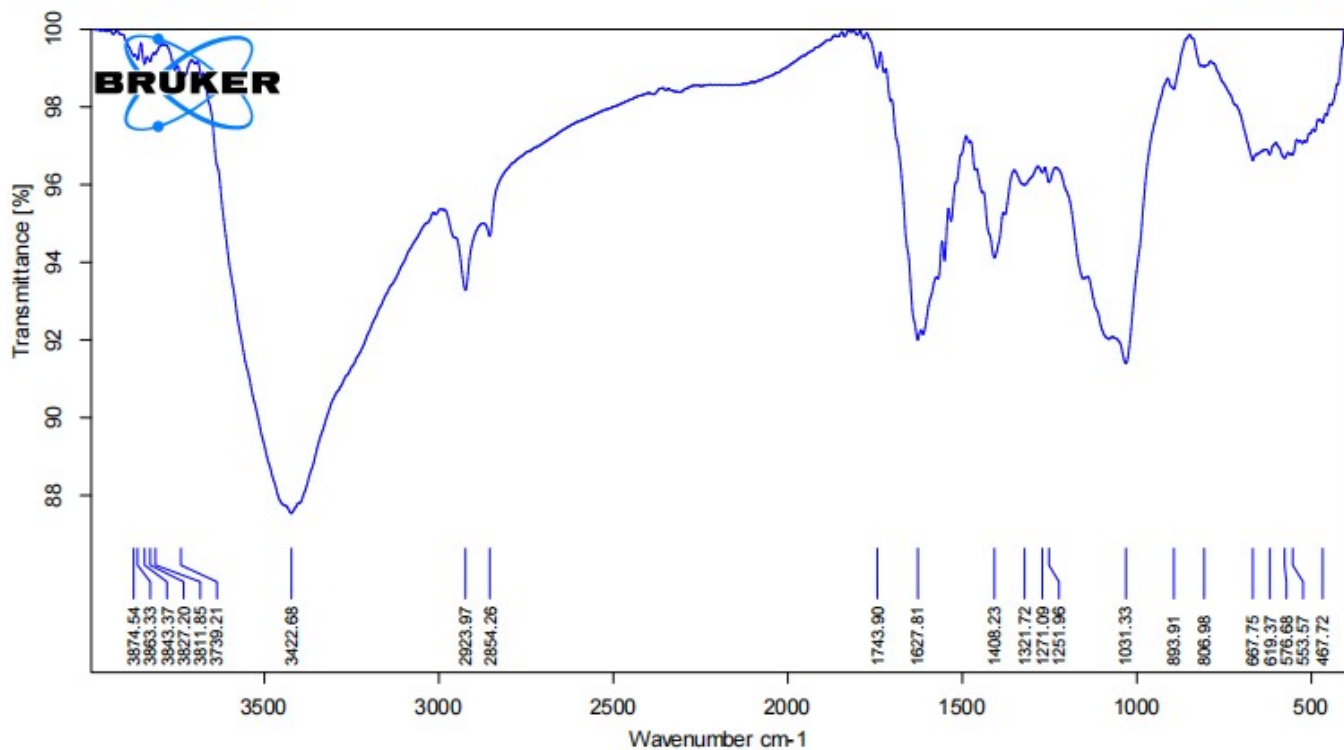
<sup>†</sup>These authors contributed equally

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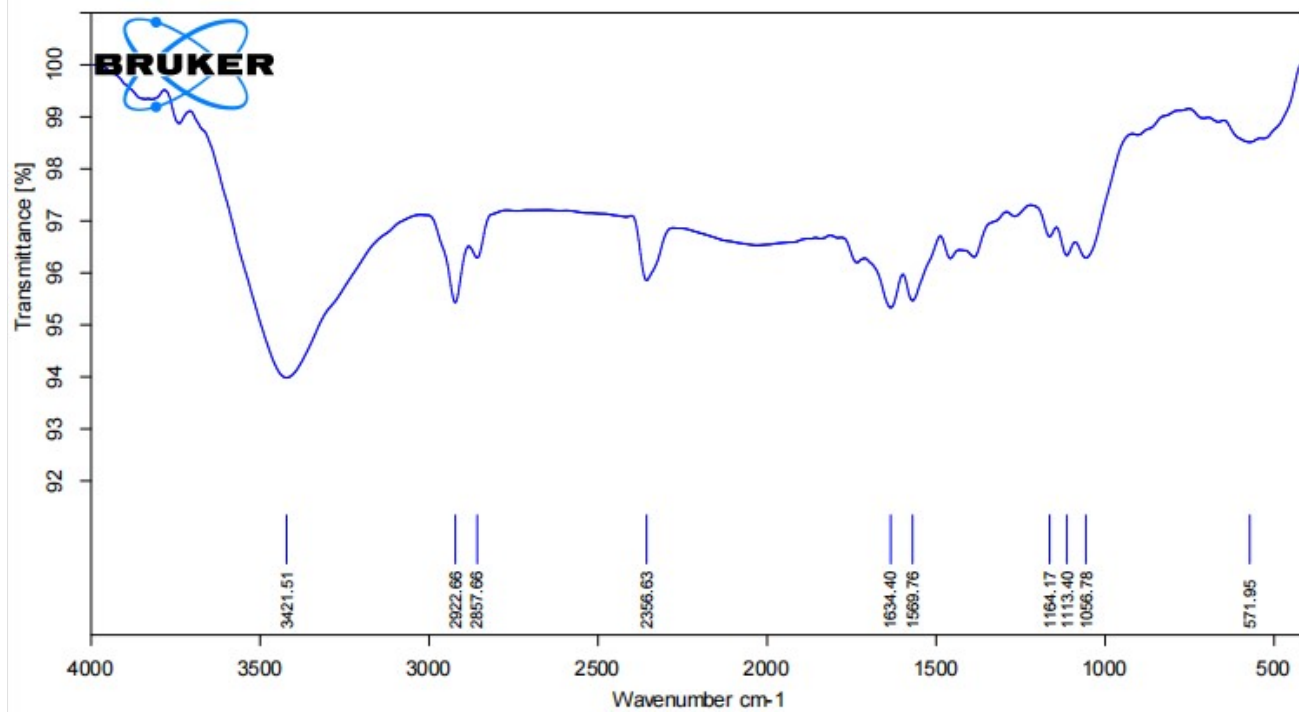
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Figure S1. FTIR spectrum of SPCA



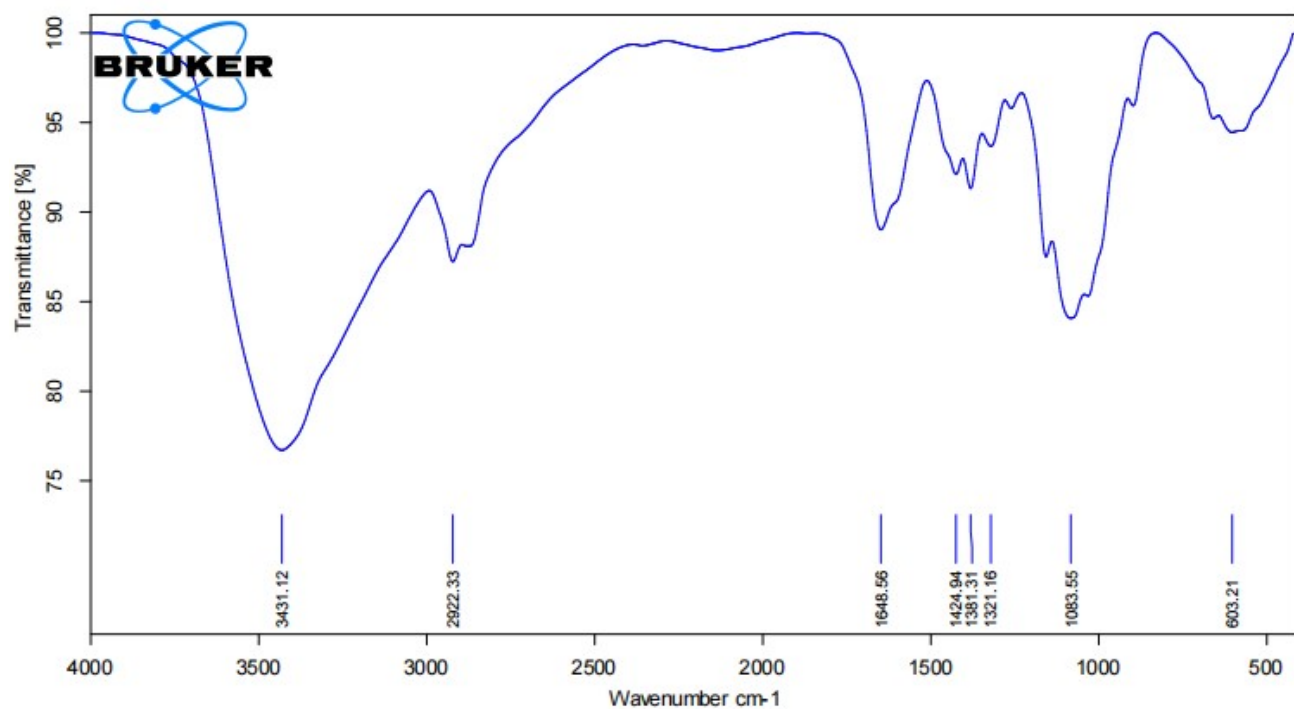
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Figure S2. FTIR spectrum of activated carbon



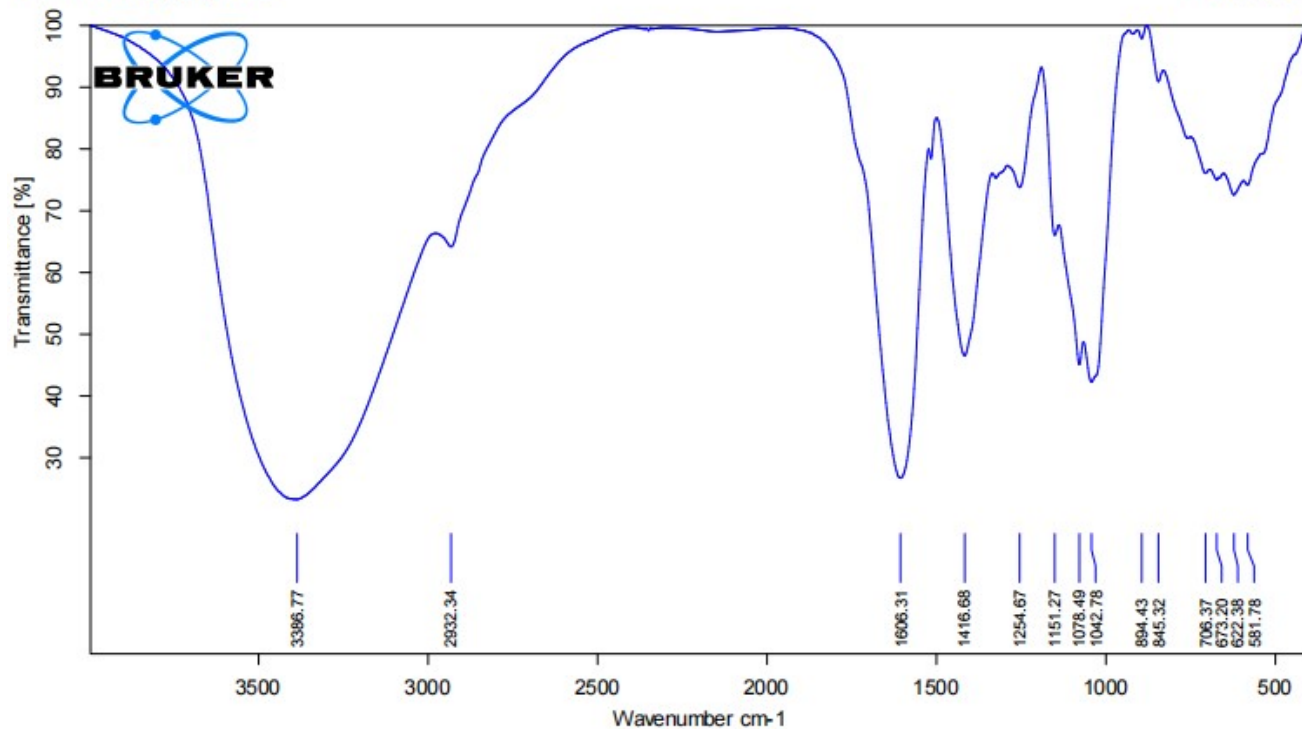
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chitosan

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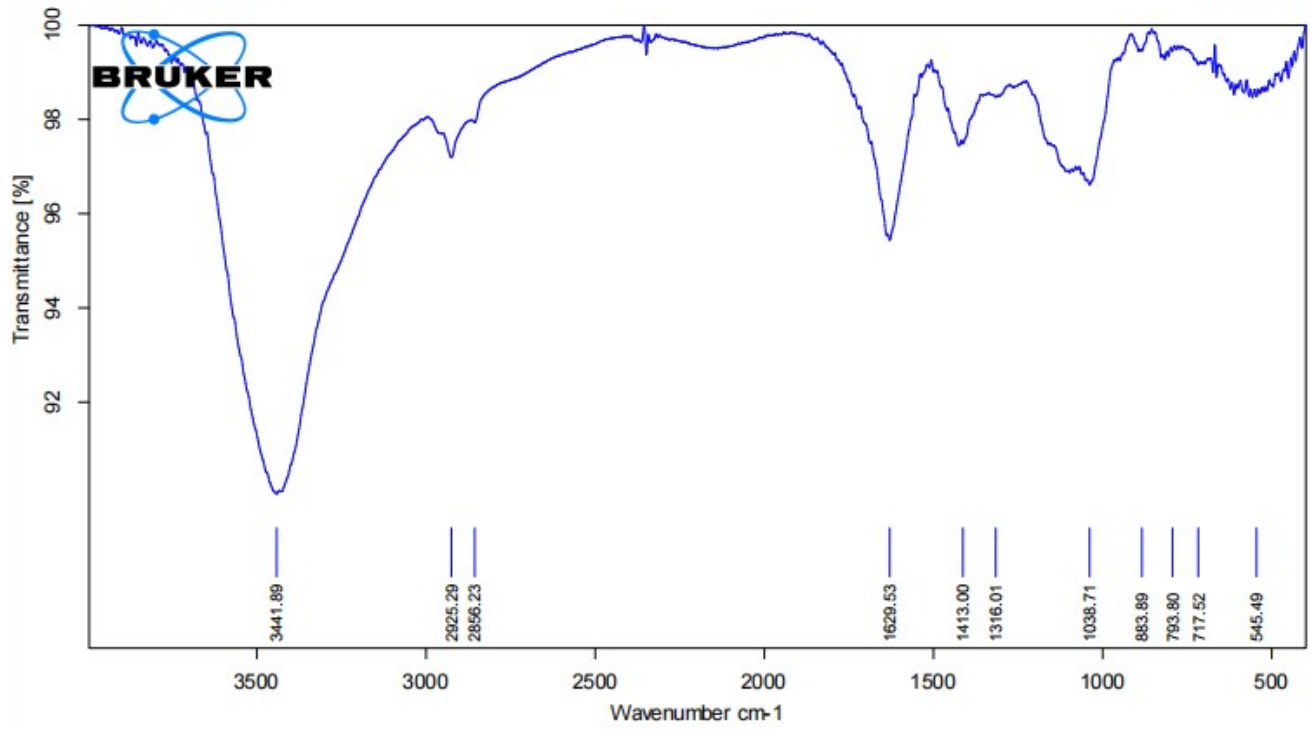
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**Figure S3.** FTIR spectrum of chitosan



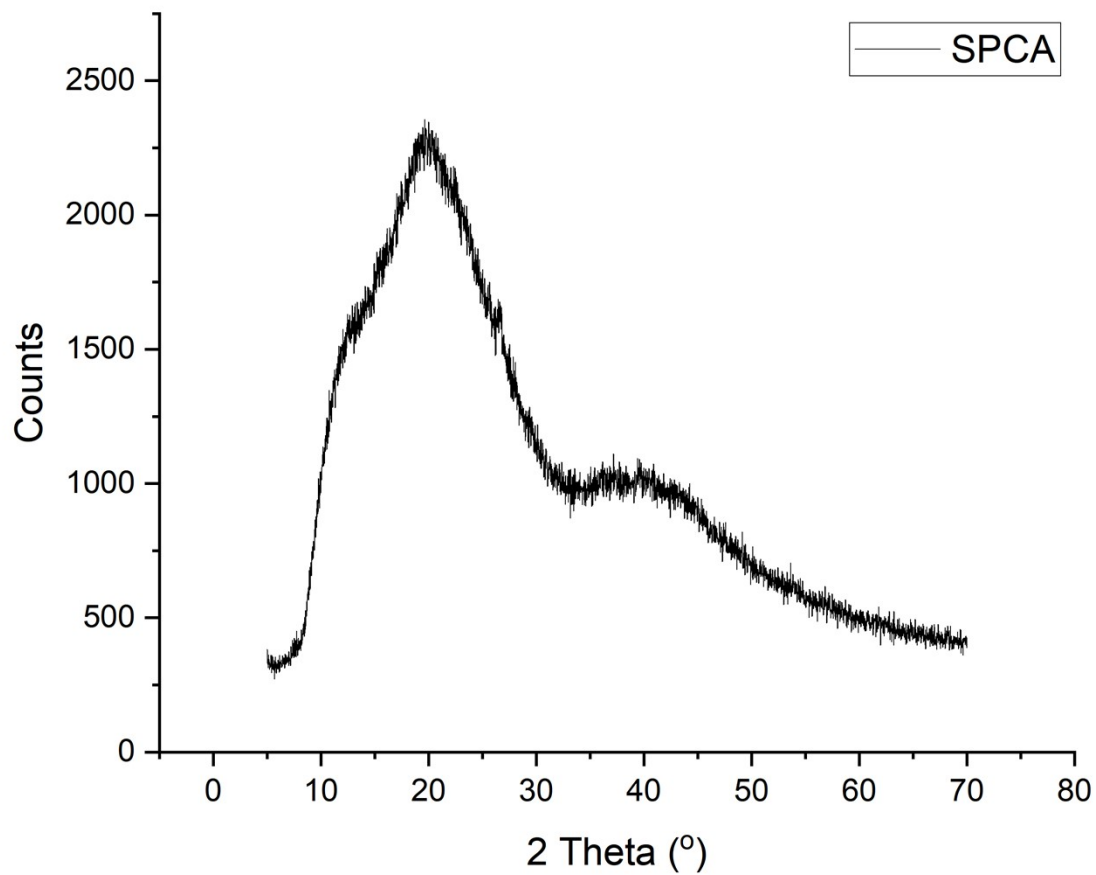
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Figure S4. FTIR spectrum of pectin cactus

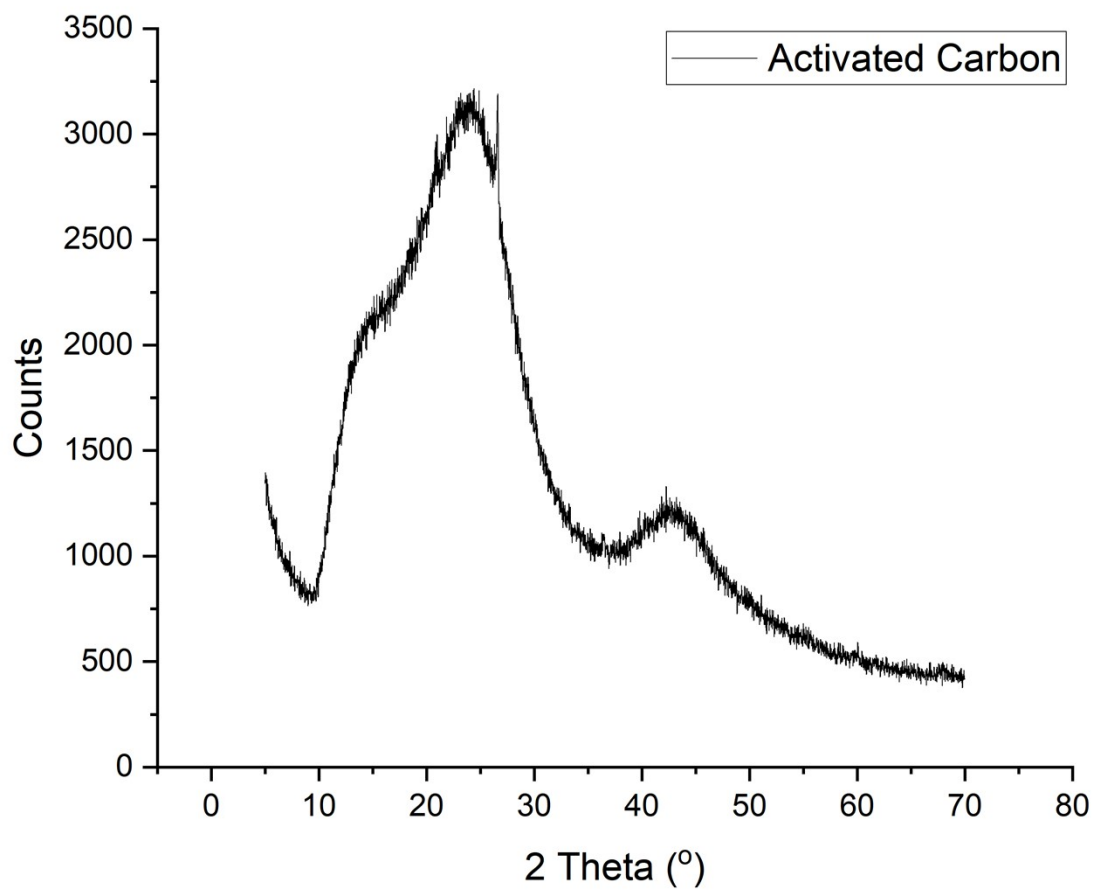


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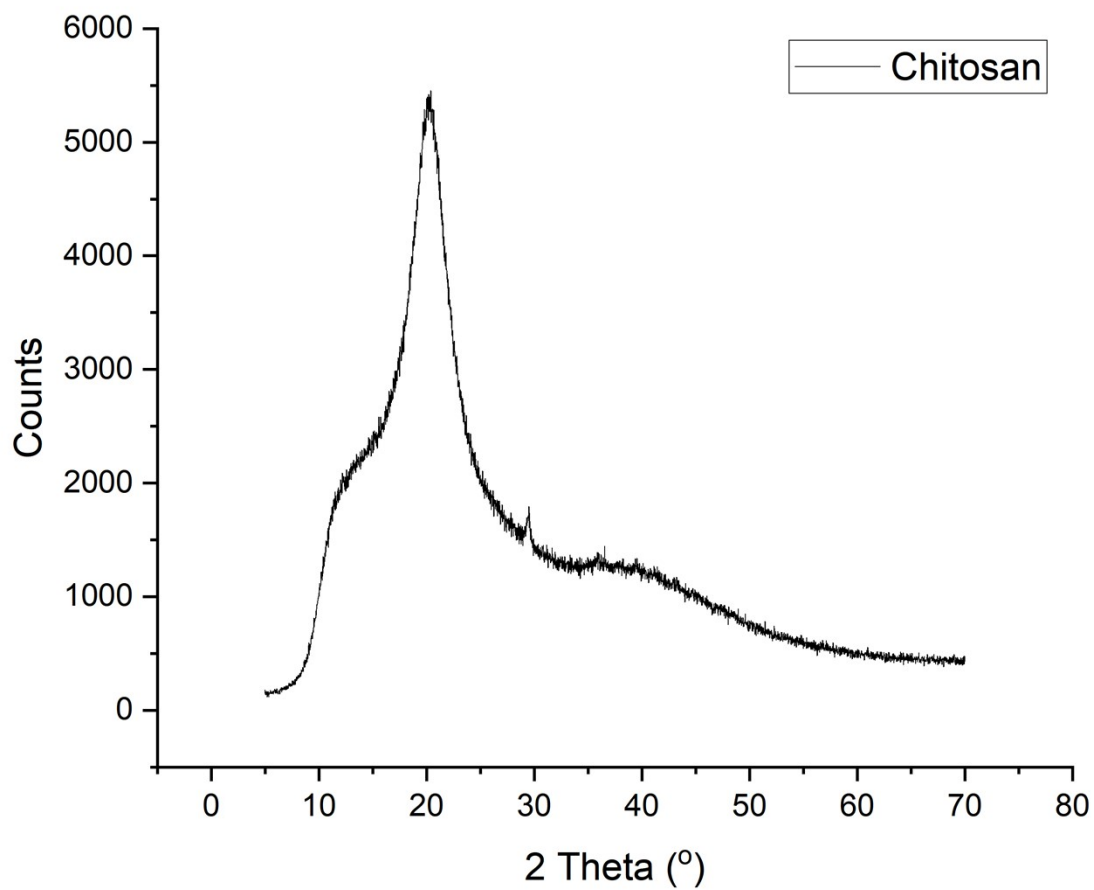
Figure S5. FTIR spectrum of alginate



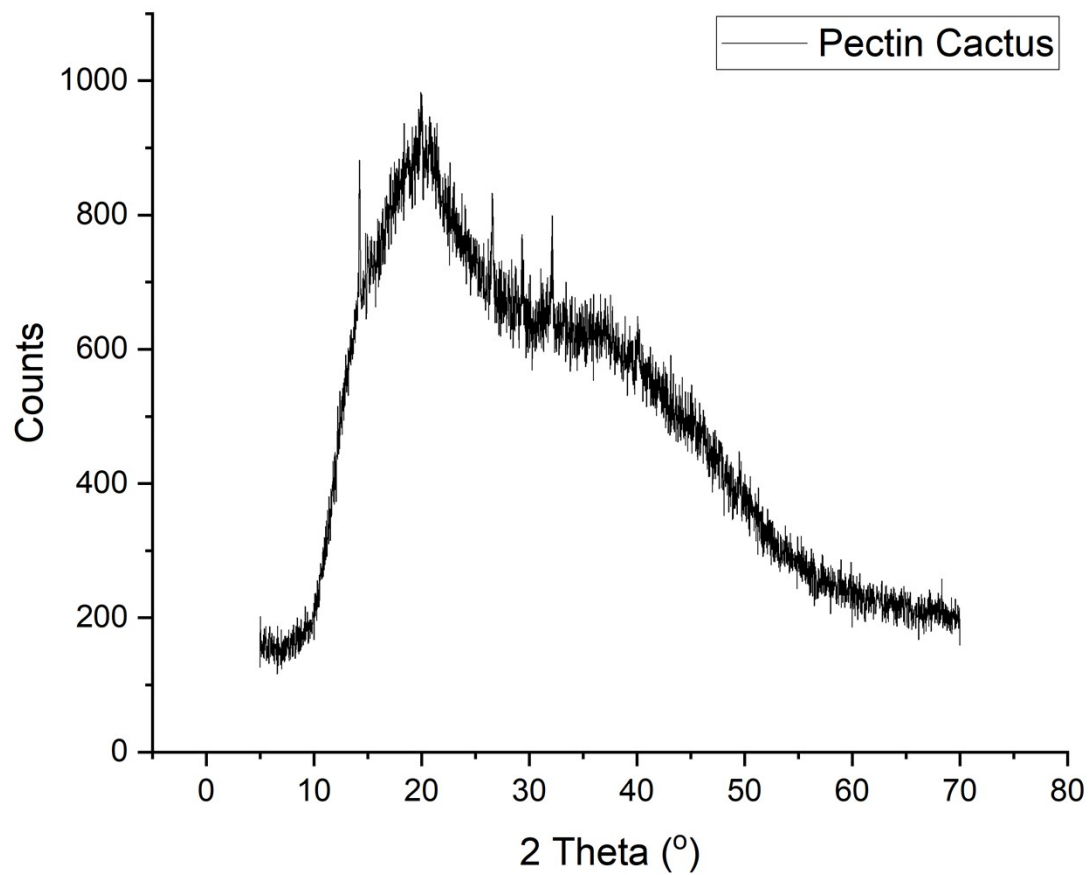
**Figure S6.** X-ray diffraction of SPCA



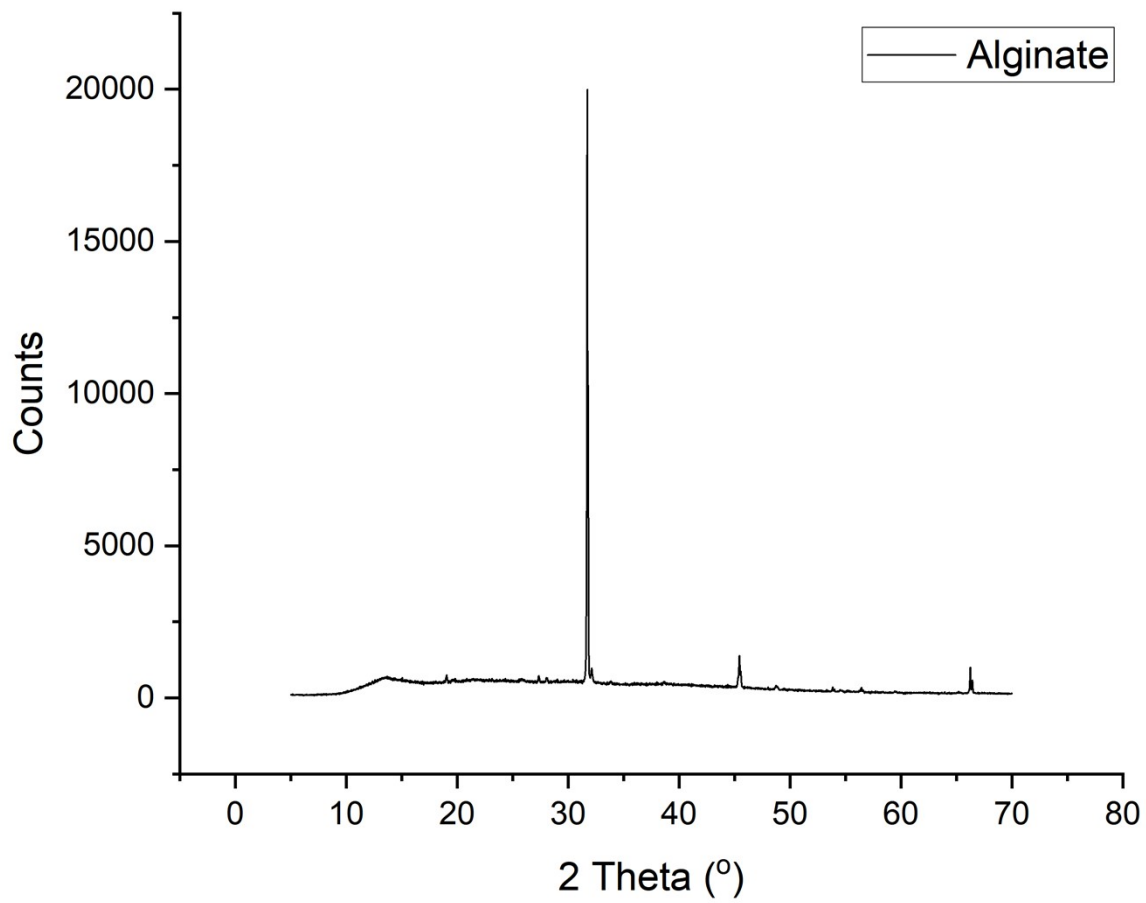
**Figure S7.** X-ray diffraction of activated carbon



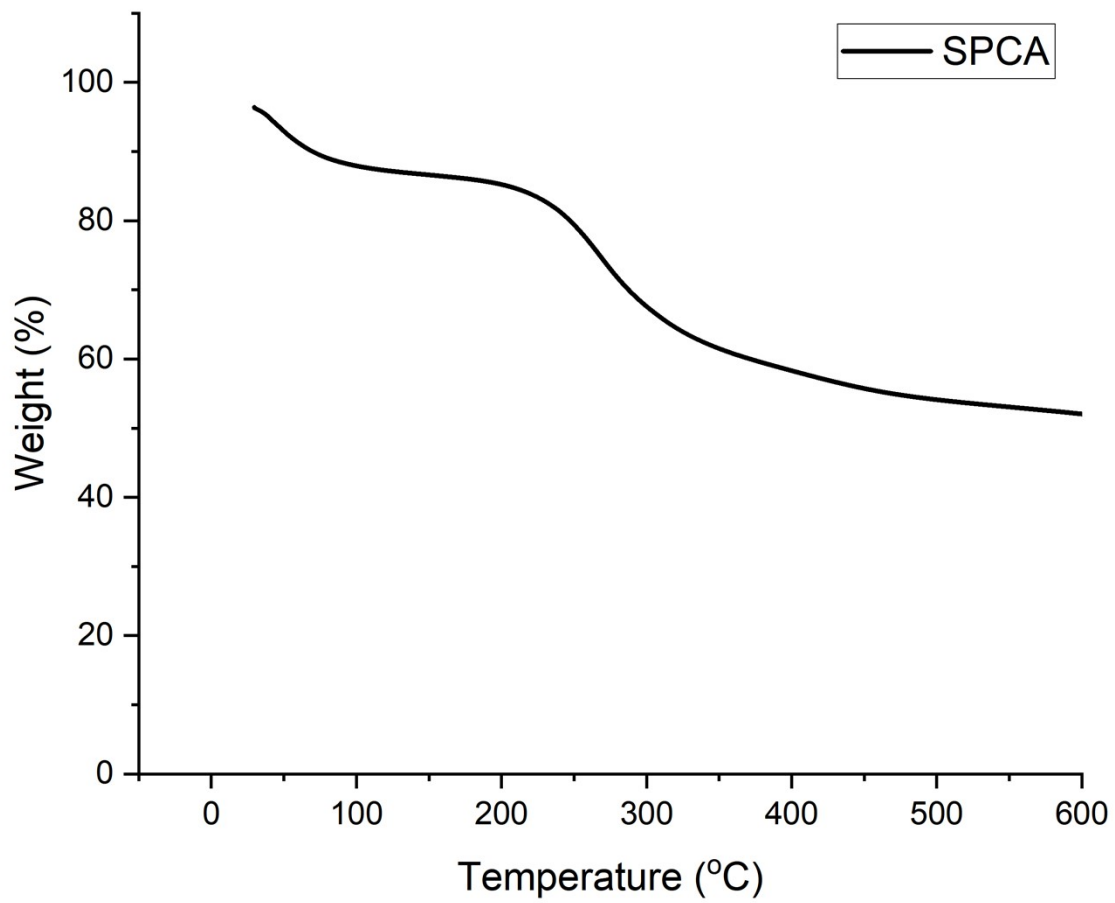
**Figure S8.** X-ray diffraction of chitosan



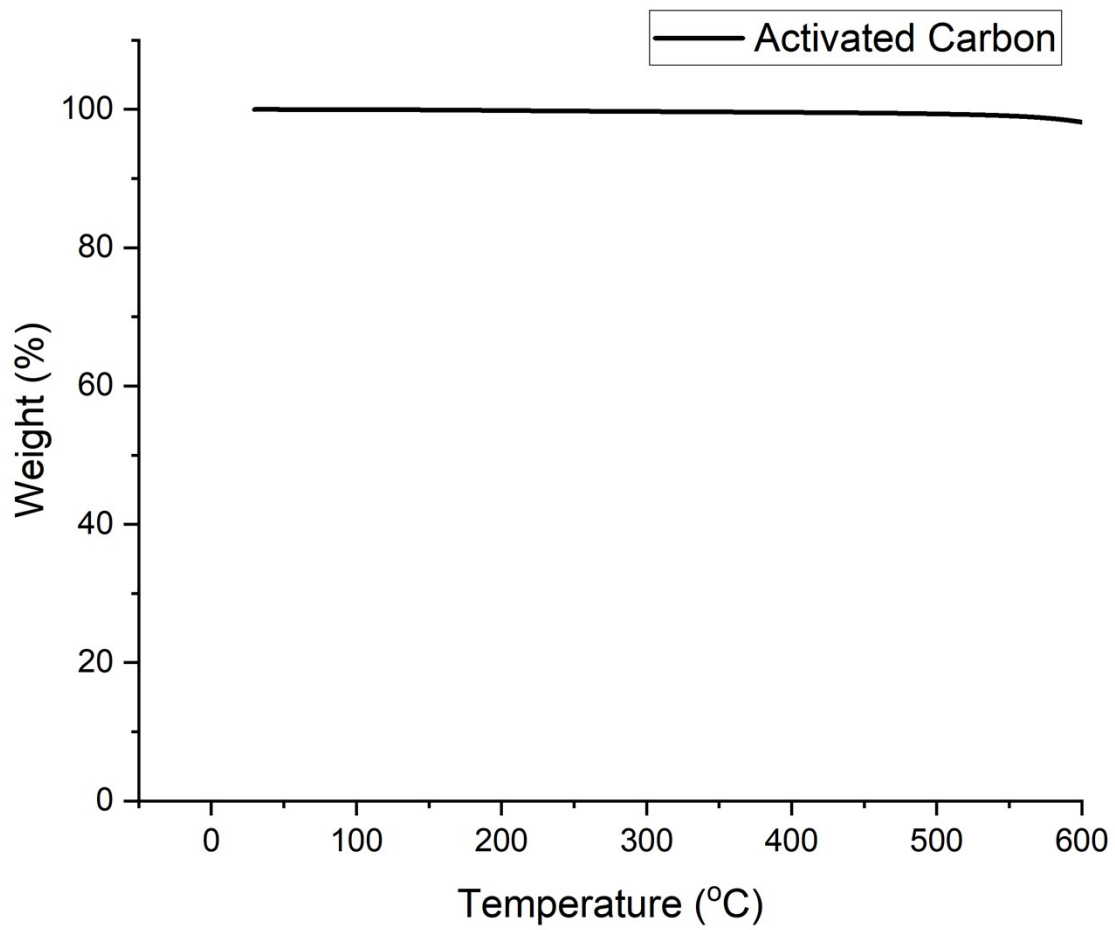
**Figure S9.** X-ray diffraction of pectin cactus



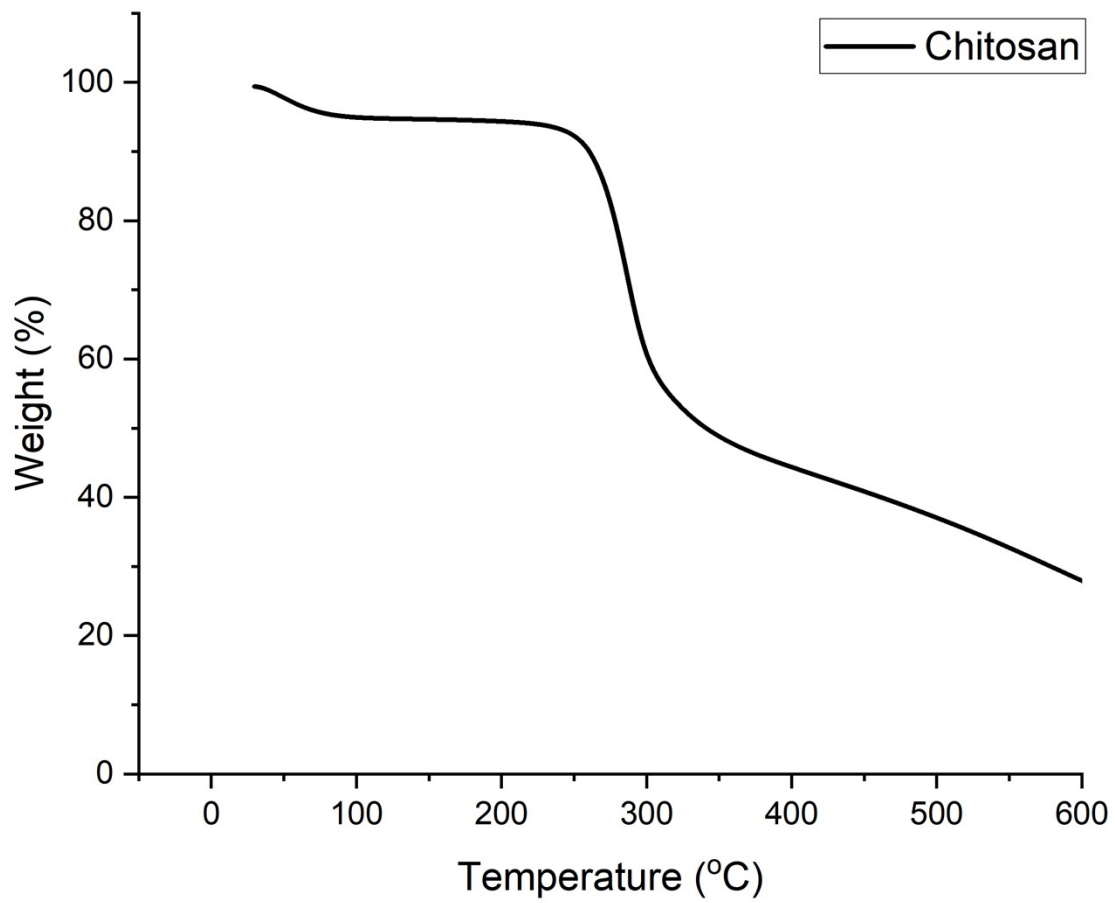
**Figure S10.** X-ray diffraction of alginate



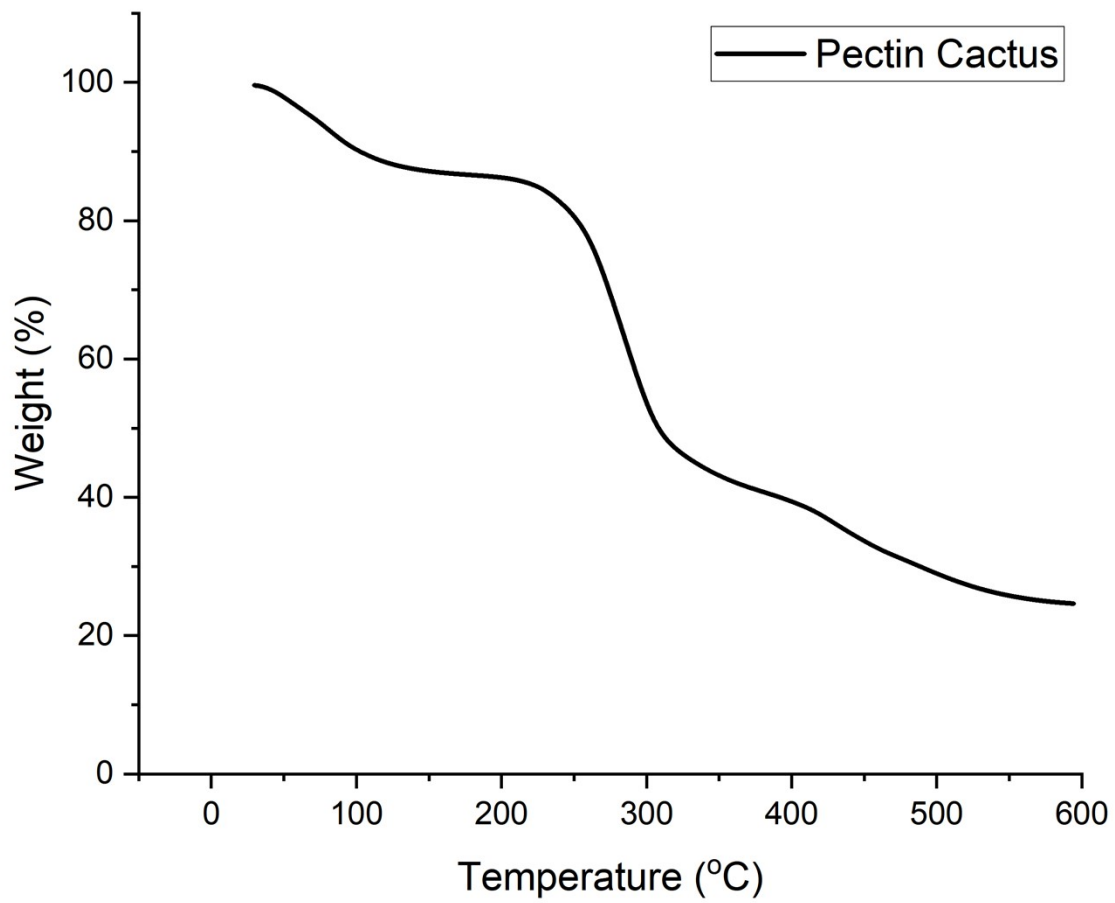
**Figure S11.** TGA of SPCA



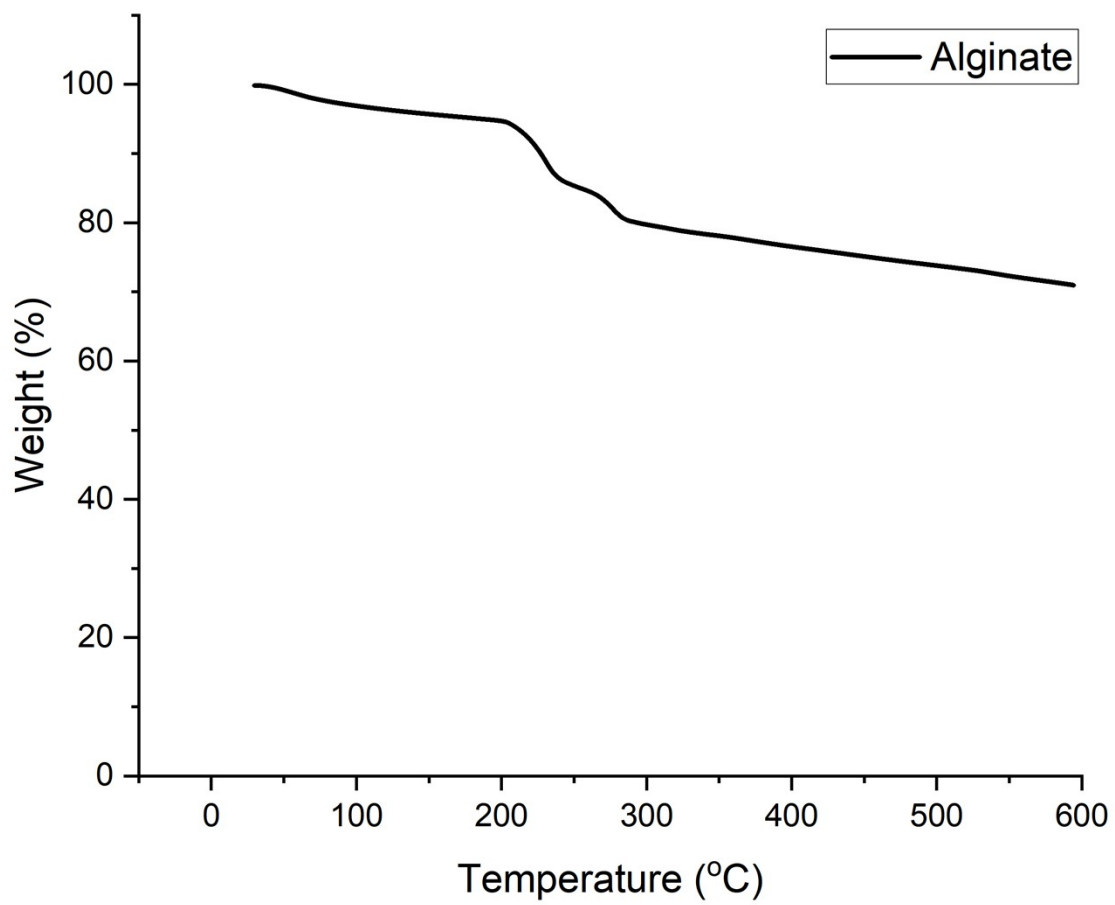
**Figure S12.** TGA of activated carbon



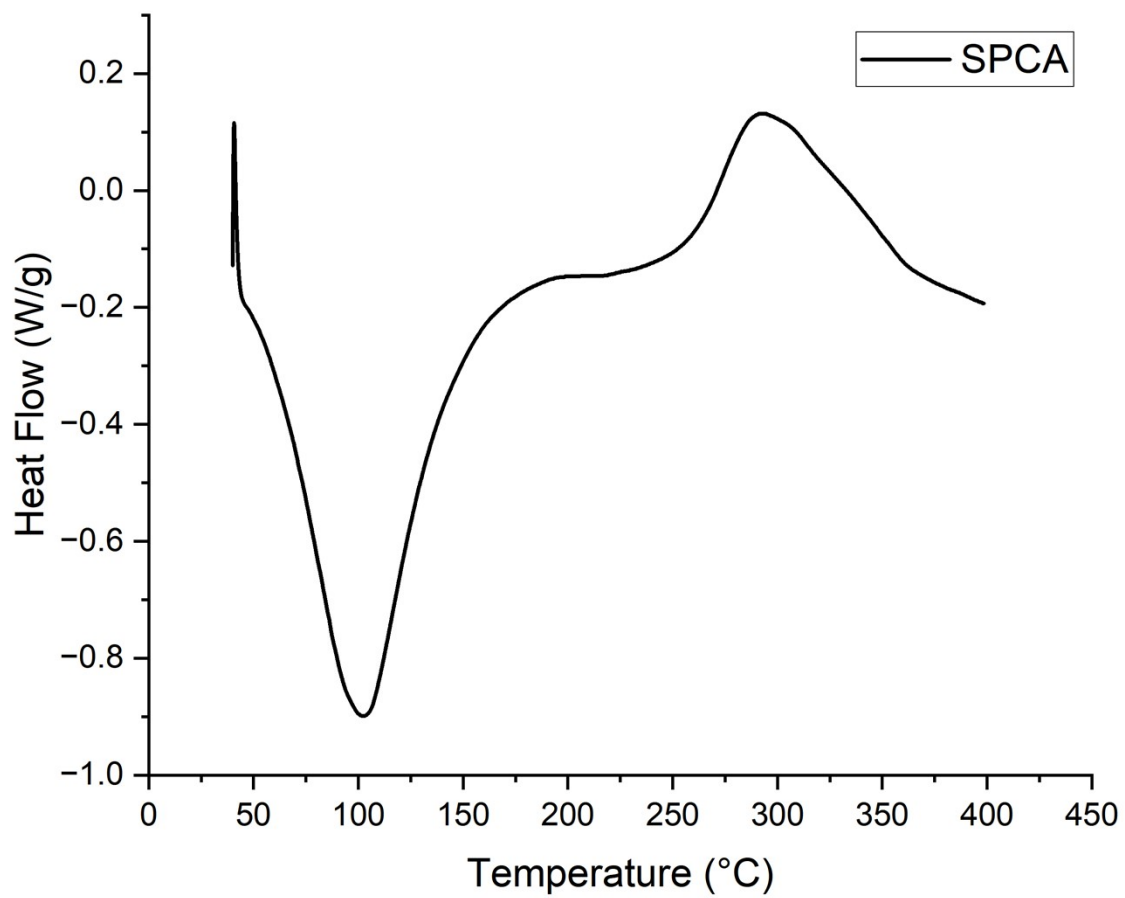
**Figure S13.** TGA of chitosan



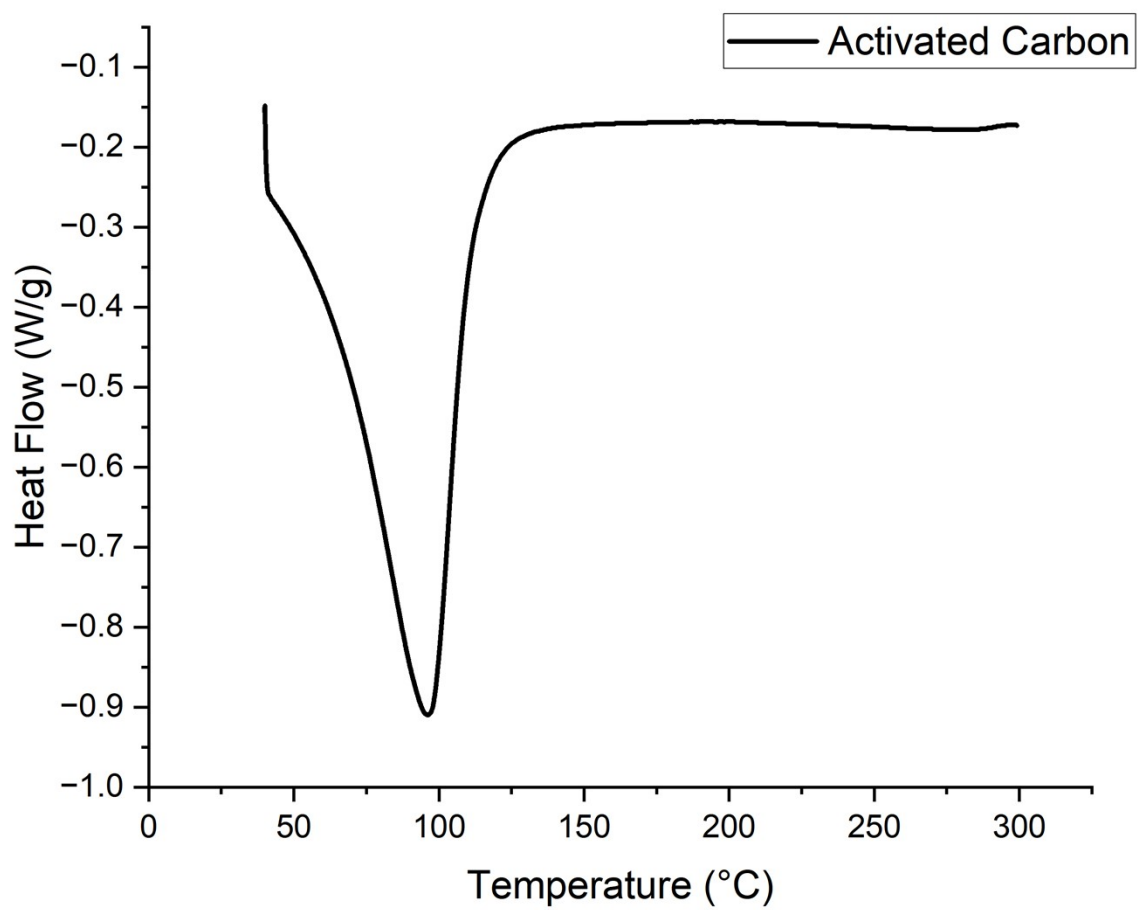
**Figure S14.** TGA of pectin cactus



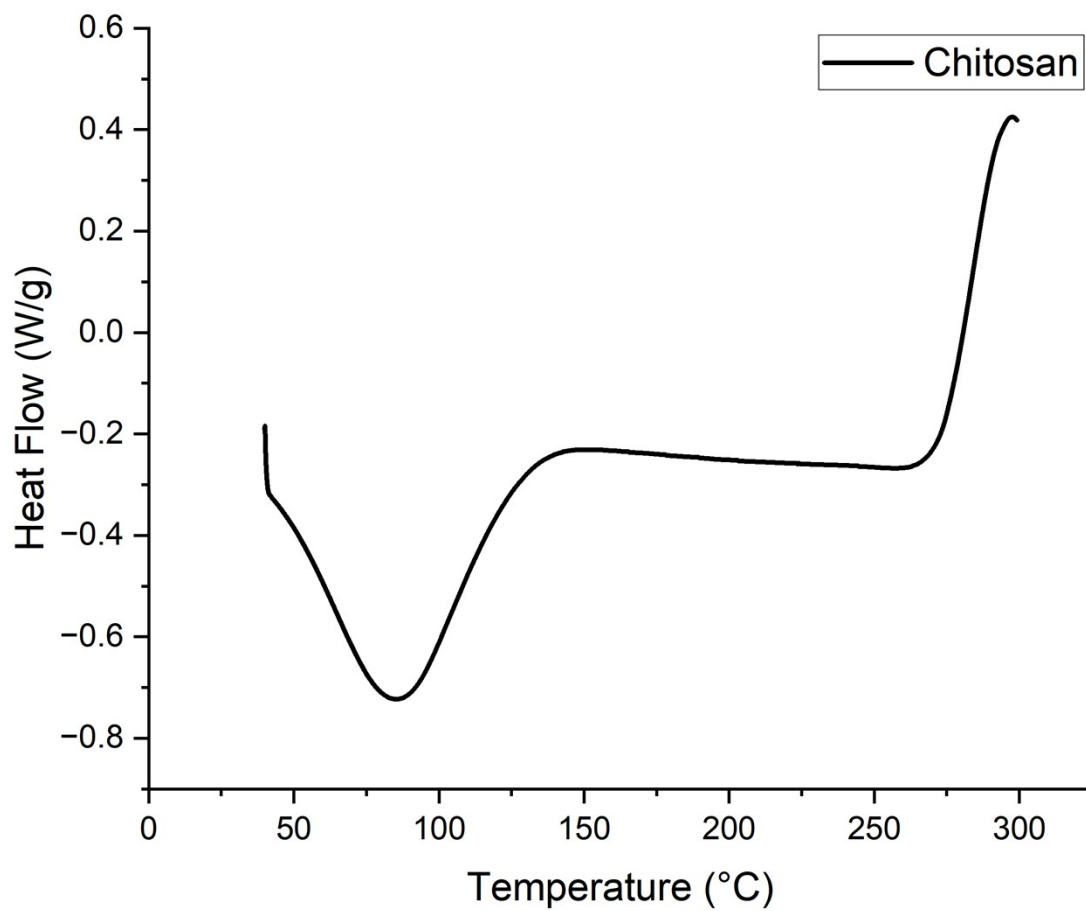
**Figure S15.** TGA of alginate



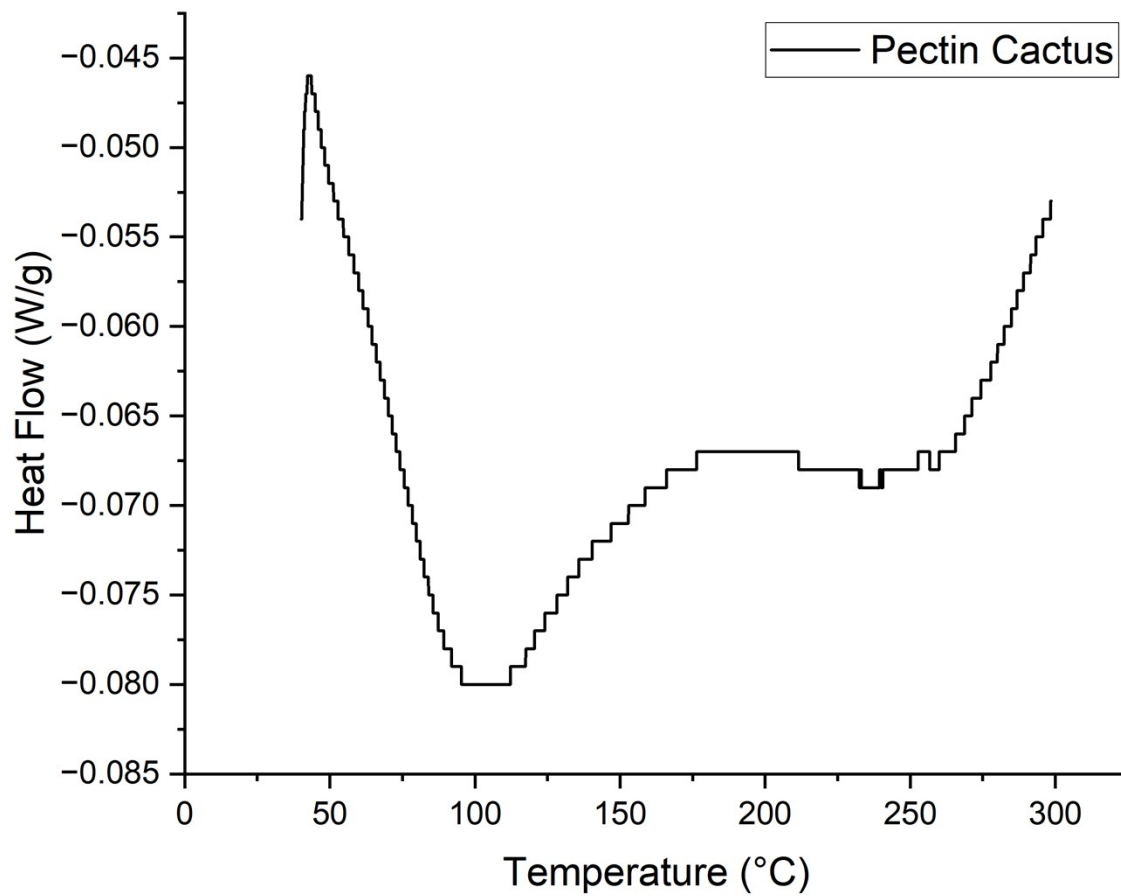
**Figure S16.** DSC of SPCA



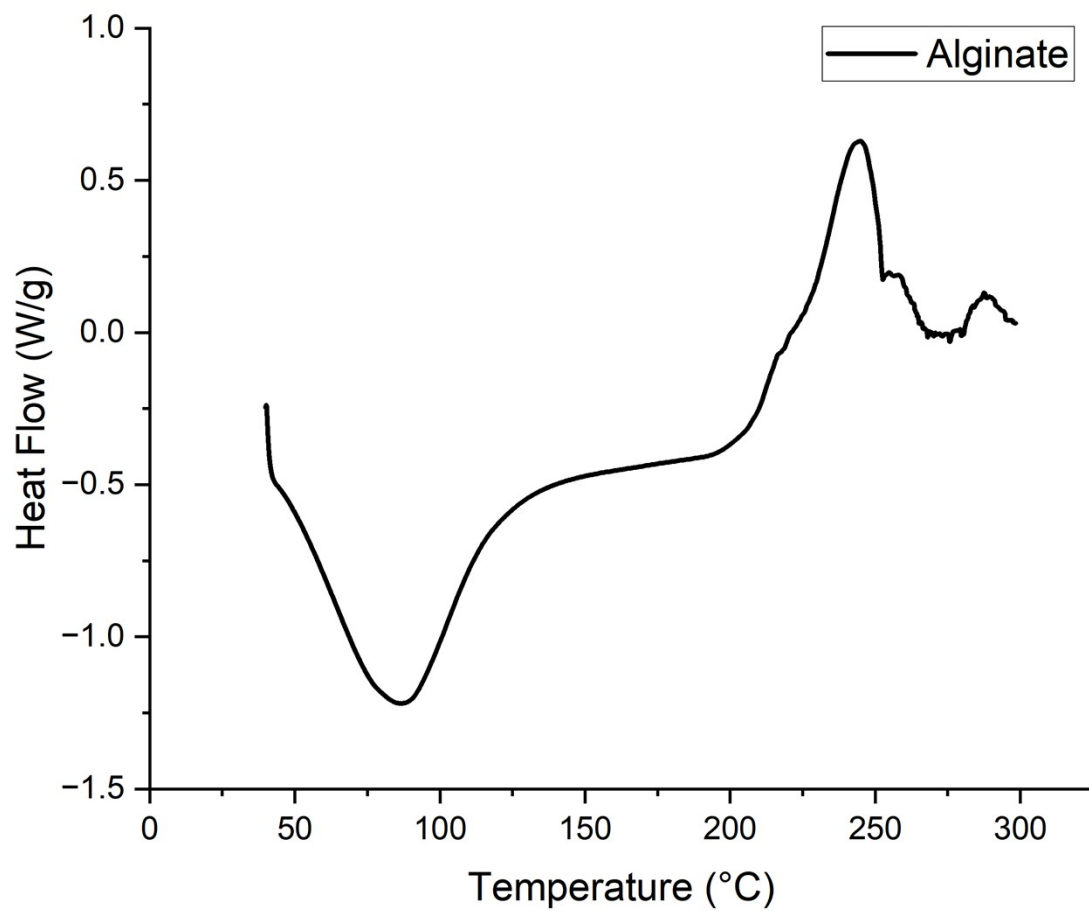
**Figure S17.** DSC of activated carbon



**Figure S18.** DSC of chitosan



**Figure S19.** DSC of pectin cactus



**Figure S20.** DSC of alginate

**Table S1.** Surface area, pore volume and pore diameter of SPCA before and after MO adsorption

Sample		Before MO adsorption	After MO adsorption
Surface area (m <sup>2</sup> /g)		255.878	254.213
Pore volume (cm <sup>3</sup> /g)	N <sub>2</sub> adsorption	0.119	0.099
	N <sub>2</sub> desorption	0.178	0.159
Average pore diameter (Å)	N <sub>2</sub> adsorption	25.45	22.17
	N <sub>2</sub> desorption	19.33	17.12

**Table S2.** Isotherm model parameters at 303 K

Parameters	Langmuir			Freundlich			Temkin		
	K <sub>L</sub>	q <sub>max</sub>	R <sup>2</sup>	K <sub>F</sub>	n	R <sup>2</sup>	B <sub>T</sub>	A <sub>t</sub>	R <sup>2</sup>
T = 303 K	0.40	21.46	0.9911	6.66	2.47	0.9945	4.20	4.98	0.9779

**Table S3.** Parameters of first-order pseudokinetic equations, second-order pseudokinetic equations, intra-particle diffusion equations, and Elovich equations

Parameters	PFO model			q <sub>e</sub> , reality	PSO model		
	K <sub>1</sub> (1/h)	q <sub>e</sub> , calculation	R <sup>2</sup>		K <sub>2</sub> (g/mg.h)	q <sub>e</sub> , calculation	R <sup>2</sup>
100 ppm	1.35	7.26	0.9856	9.51	0.22	10.42	0.9985
Intraparticle diffusion model				Elovich model			
K <sub>p</sub> (mg/g.h <sup>0.5</sup> )		C (mg/g)	R <sup>2</sup>	α (mg/g.h)		β (g/mg)	R <sup>2</sup>
2.03		5.74	0.8361	234.43		0.6621	0.9020