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Biochar from Vegetable Wastes: Agro-Environmental Characterization

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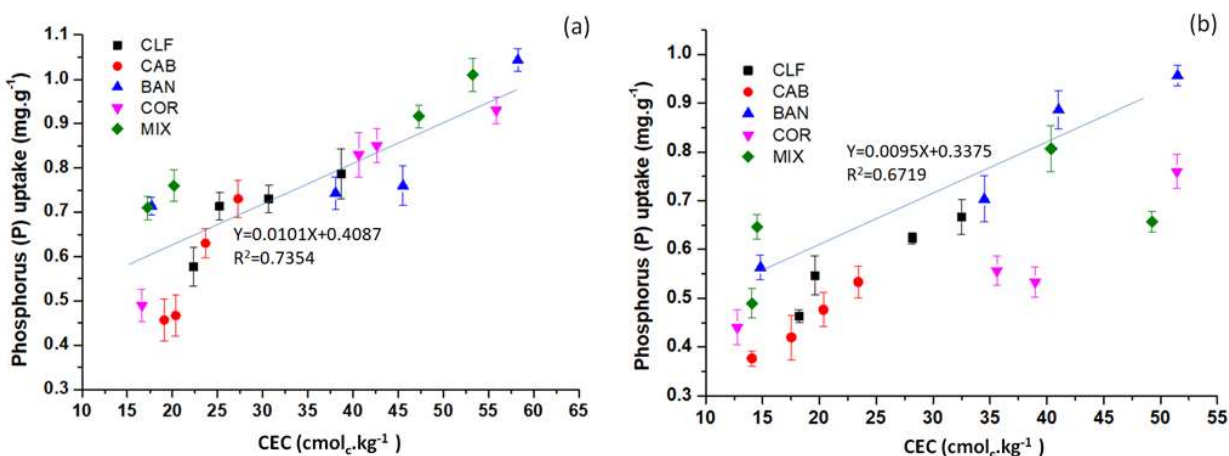


Fig. S1: Scatter plot showing the correlation between CEC with phosphorus uptake at (a) 75 μm particle size and (b) 125μm particle size of various biochar at different pyrolysis temperature.

CLF: cauliflower wastes; CAB: cabbage wastes; BAN: banana peels; COR: corn residue; MIX: mixture of cauliflower, cabbage, banana and corn wastes.

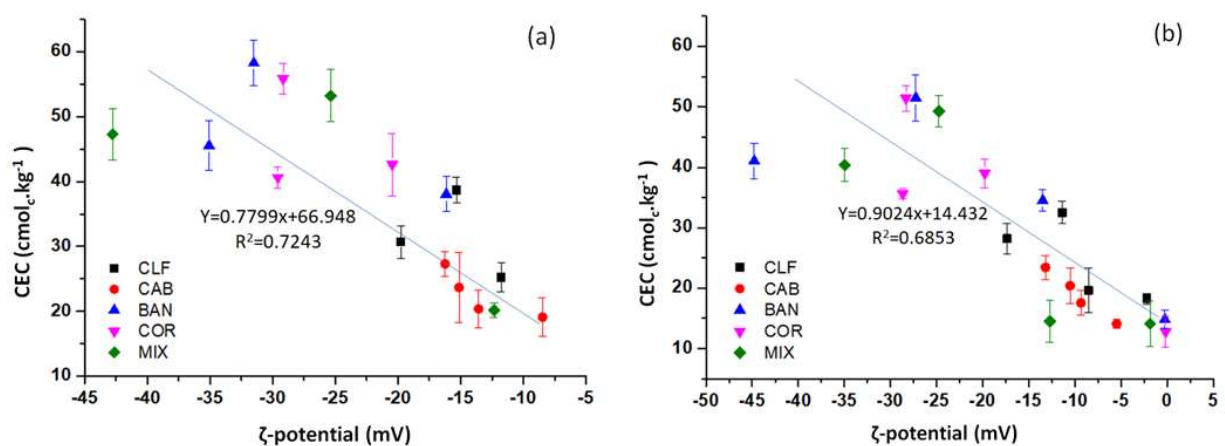


Fig. S2: Scatter plot showing the correlation between zeta (ζ) potential and CEC at (a) 75 μm particle size and (b) 125 μm particle size of various biochar at different pyrolysis temperature. *CLF*: cauliflower wastes; *CAB*: cabbage wastes; *BAN*: banana peels; *COR*: corn residue; *MIX*: mixture of cauliflower, cabbage, banana and corn wastes.

Table S1 FTIR bands and functional groups obtained from different vegetable waste biomass and biochar based on information from Sigma-Aldrich (<https://www.sigmaaldrich.com/technical-documents/articles/biology/ir-spectrum-table.html>)

Biomass and biochar	*Frequency range (cm ⁻¹)	Frequency from FTIR spectrum (cm ⁻¹)	Group	Class of Compound
CLF	3550-3310	3421	O-H stretching, N-H stretching	Polymeric O-H, secondary Amine
	3000-2840	2925	C-H stretching	Alkane
	3000-2840	2869	C-H stretching, N-H stretching	Alkanes, amine salt
	1620-1570	1579	C=C stretching	Cyclic alkene
	1420-1380	1401	S=O stretching, O-H bending	Sulfonyl chloride, alcohol
	1210-1163	1184	C-O stretching	Esters
	1120-1020	1052	C-O stretching, S=O stretching	Alcohols, esters, ethers, sulfoxide
CAB	3550-3200	3415	O-H stretching, N-H stretching	Alcohols, primary amine
	3000-2840	2926	C-H stretching	Alkane
	1620-1570	1610	C=C stretching, N-H bending	Cyclic alkene, amine
	1483-1020	1483, 1183	S=O stretching, O-H bending, C-O stretching	Sulfonyl chloride, alcohol, esters, ethers
BAN	3550-3200	3415	O-H stretching, N-H stretching	Alcohols, primary amine
	3000-2840	2929	C-H stretching	Alkane
	1620-1570	1589	C=C stretching	Cyclic alkene
	1420-1124	1381, 1126	S=O stretching, O-H bending, C-O stretching	Sulfonyl chloride, alcohol, aromatic ester
	895-885	894	C=C bending	Alkene
COR	3550-3200	3419	O-H stretching, N-H stretching	Alcohols, primary amine
	3000-2840	2924	C-H stretching	Alkane
	1650-1566	1635	C=C stretching	Cyclic alkene
	1485-1395	1483	O-H bending	Phenol
	1070-1030	1037	S=O stretching	Sulfate
MIX	3550-3200	3419	C-H stretching	Alkane
	3000-2840	2924	C-H stretching	Alkane
	1620-1570	1583	C=C stretching	Cyclic alkene
	1420-1250	1375	C-O stretching, S=O stretching	Aromatic ester, sulfate
	1124-1087	1116	C-O stretching	Secondary alcohol
	750±20	750	C-H bending	Monosubstituted

CLF: cauliflower wastes; CAB: cabbage wastes; BAN: banana peels; COR: corn wastes; MIX: mixture of cauliflower, cabbage, banana and corn wastes

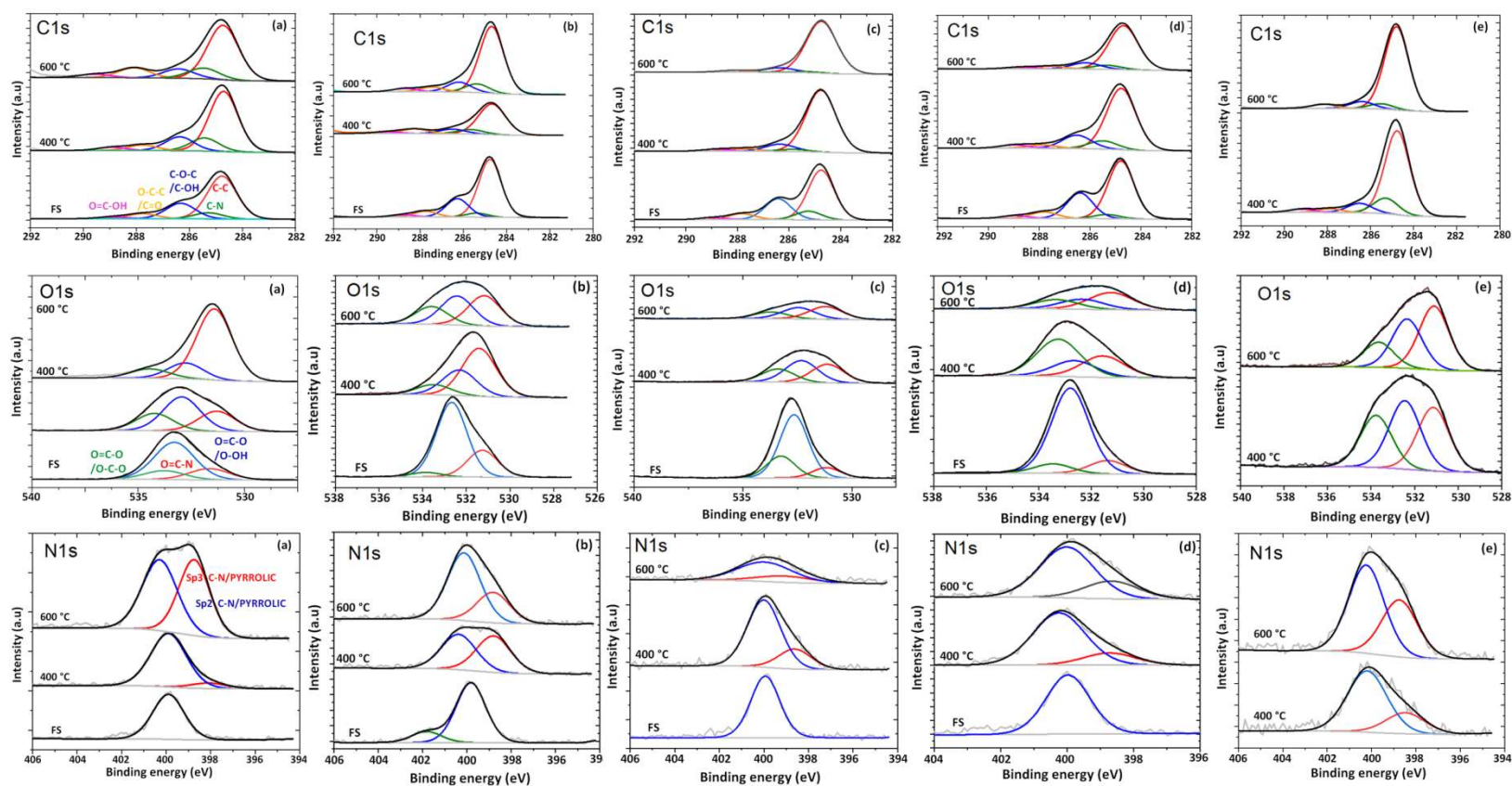


Fig. S3: XPS (C1s, O1s and N1s) spectrum of feedstocks and biochar at 400 and 600 °C of. FS: feedstock; (a) cauliflower wastes feedstock and biochar; (b) cabbage wastes feedstock and biochar; (c) banana peels feedstock and biochar; (d) corn wastes feedstock and biochar and (e) mixture of cauliflower, cabbage, banana and corn wastes feedstock and biochar.