
Article

Hydrothermal Carbonization as Sustainable Process for the Complete Upgrading of Orange Peel Waste into Value-Added Chemicals and Bio-Carbon Materials

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SUPPLEMENTARY INFORMATION

FIGURES AND TABLES

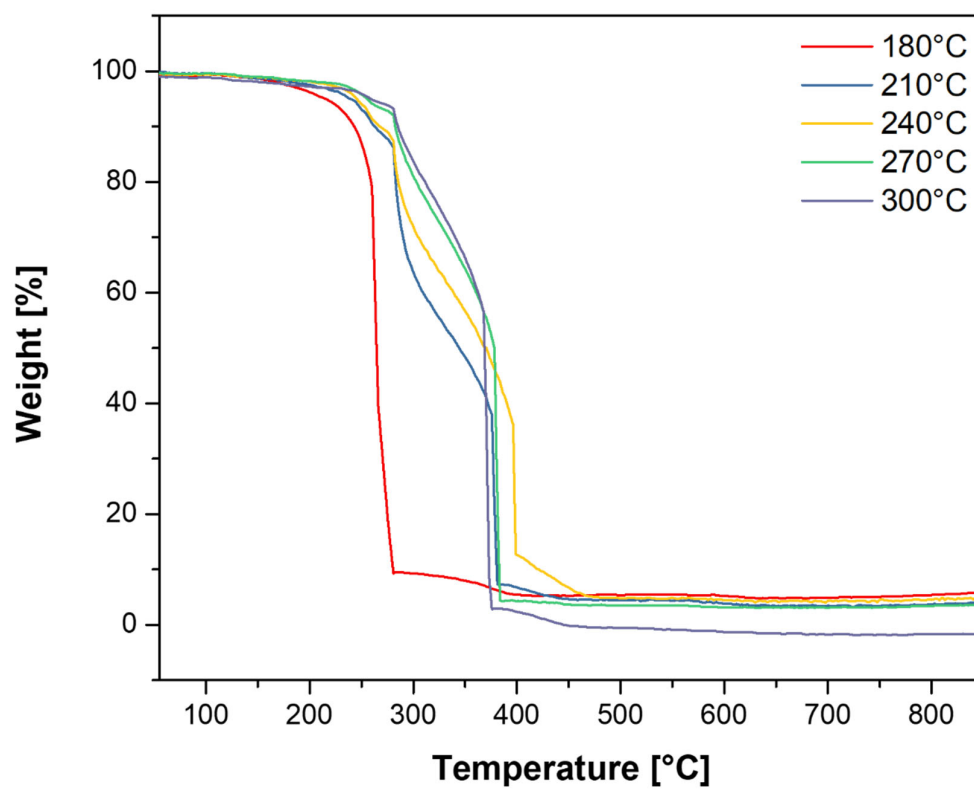


Figure S1. TGA curve in air of the hydrochar samples.

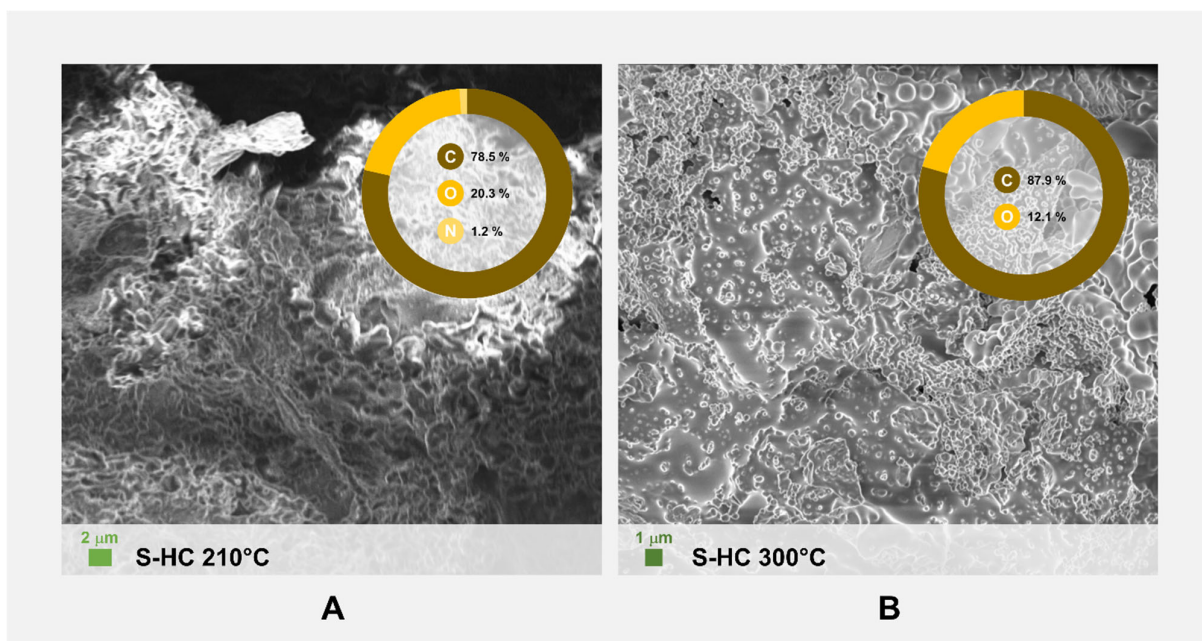


Figure S2. SEM-EDS analyses of a) S-HC₂₁₀₋₆₀ and b) S-HC₃₀₀₋₆₀. The inset shows the elemental analysis of these samples.

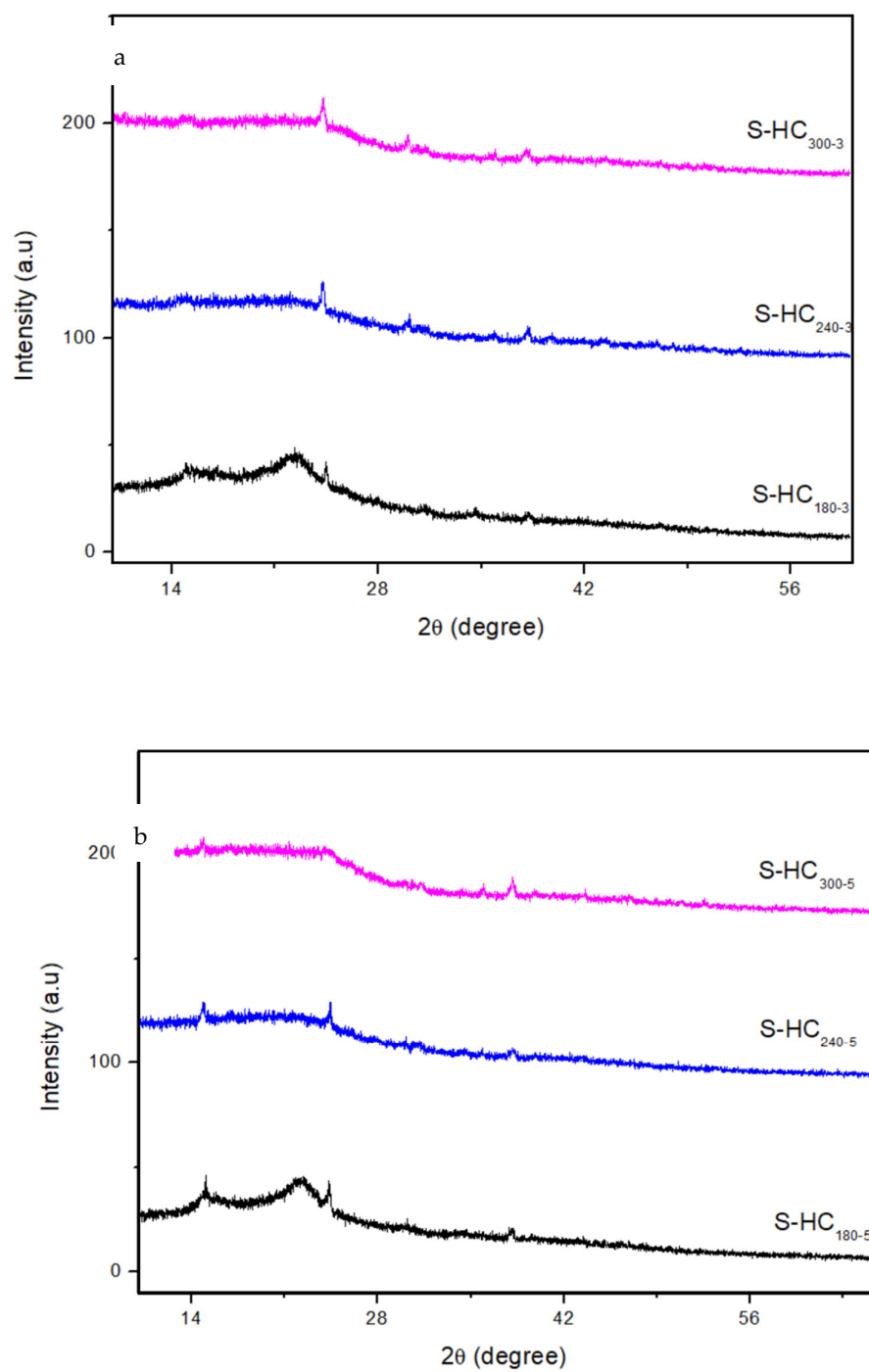
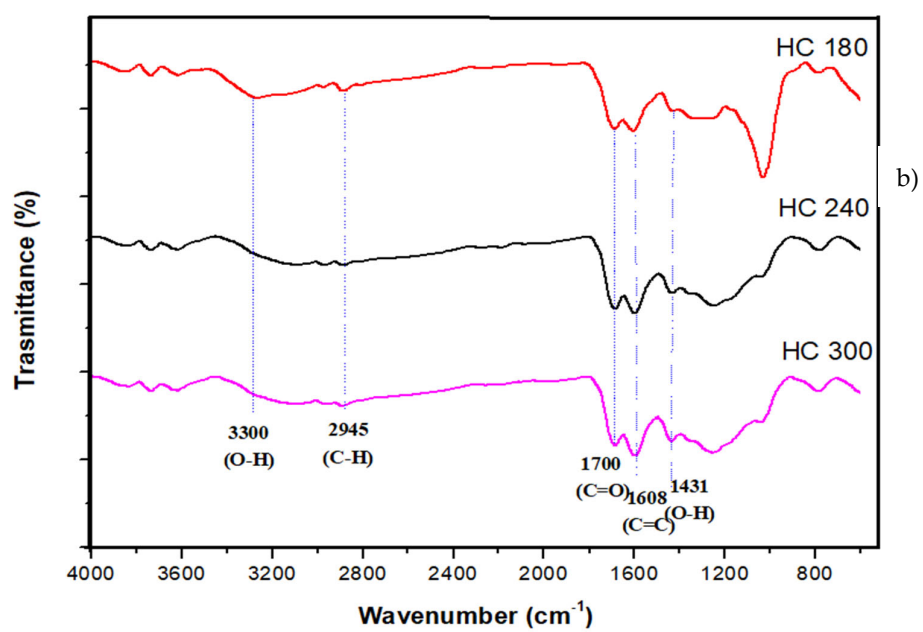
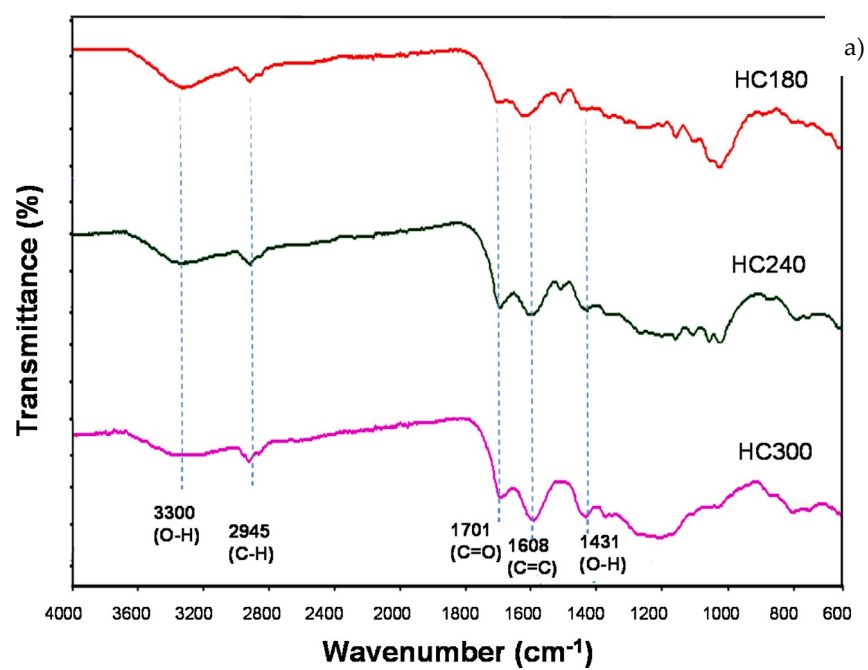


Figure S3. X-ray diffractograms of the hydrochar obtained at different temperature after a) 180 min of reaction time and b) 300 min of reaction time.



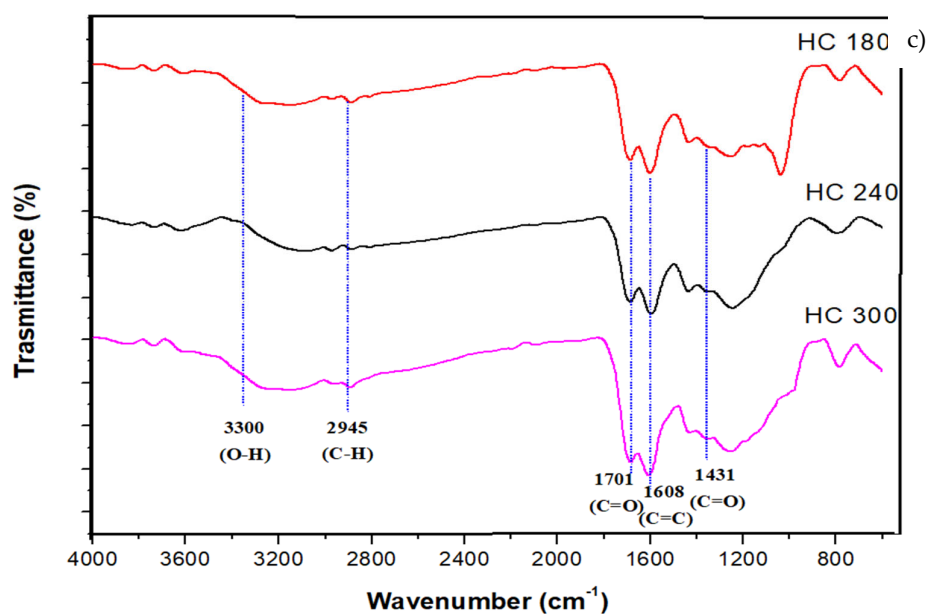


Figure S4. FT-IR analysis of the hydrochar samples at a) 60 min of reaction time; b) 180 min of reaction time; c) 300 min of reaction time.

Sample	L:S ratio	HC yield (wt%)
S-HC ₁₈₀₋₆₀	4:1	16.25
S-HC ₁₈₀₋₆₀	6:1	18.74
S-HC ₁₈₀₋₁₈₀	12:1	18.21
S-HC ₁₈₀₋₃₀₀	24:1	16.54
S-HC ₂₁₀₋₆₀	48:1	17.23

Table S1. Hydrochar yield as function of L/S ratio.

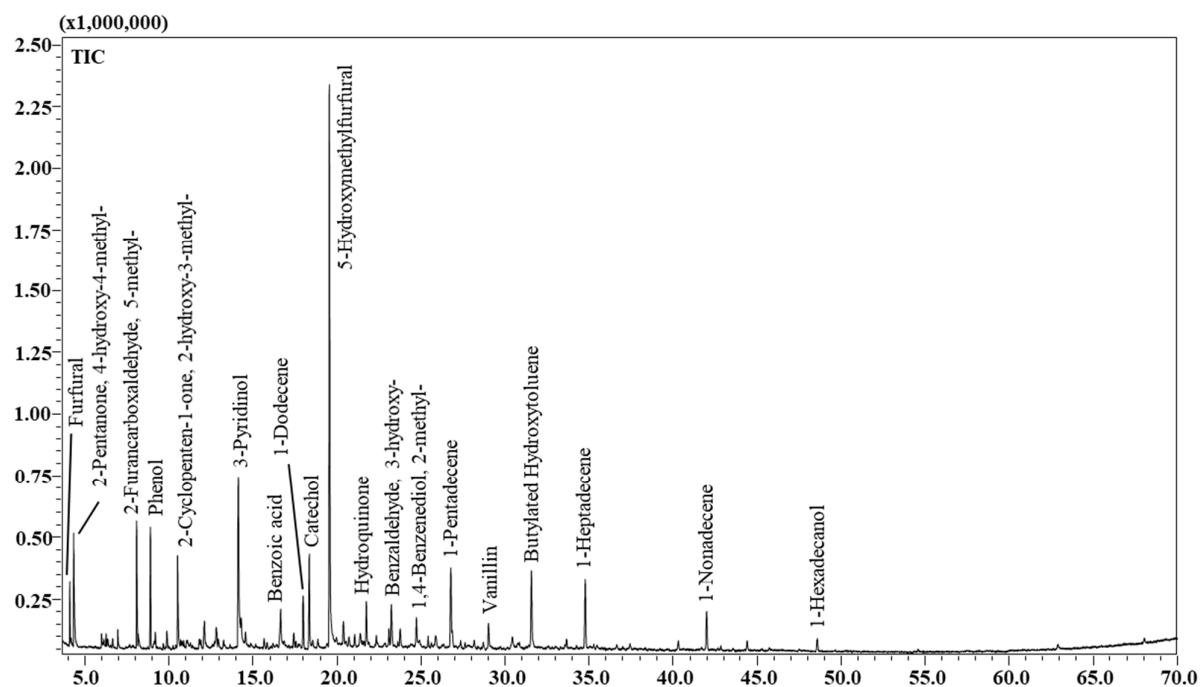


Figure S5. The chromatogram of the light bio-oil refers to an experiment carried out at 240 °C - 60 min by GC-MS. Main peaks are labeled.