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Supplementary Information

A Carbon Dot-Catalyzed Transesterification Reaction for the Production of Biodiesel

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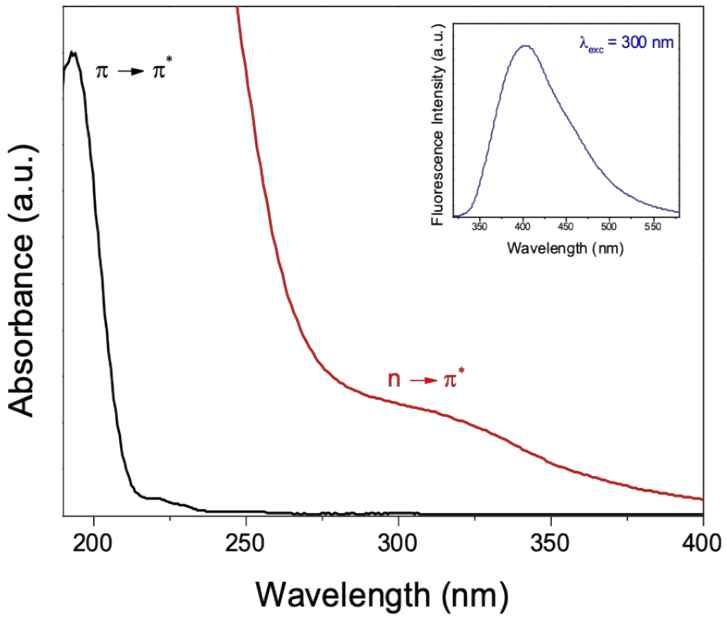


Figure S1: Absorbance and fluorescence spectra of glycine-citric acid CDs. The absorbance spectrum presents two bands with the first attributed to the $\pi \rightarrow \pi^*$ transition corresponding to alkene and aromatic sp^2 domains (black) and the second to the $n \rightarrow \pi^*$ transition associated with functional groups, such as carboxyl and amides (red). PL spectrum (inset, blue) shows a maximum λ_{em} at 400 nm following λ_{ex} = 300 nm.

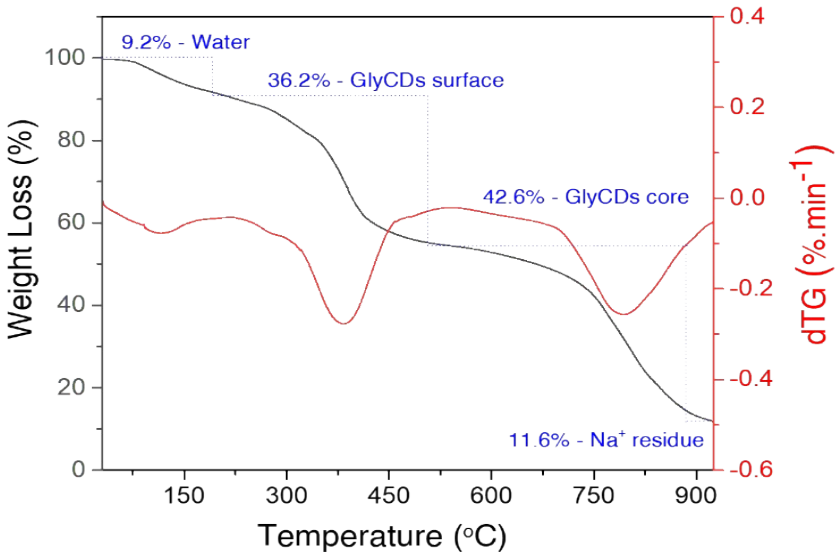
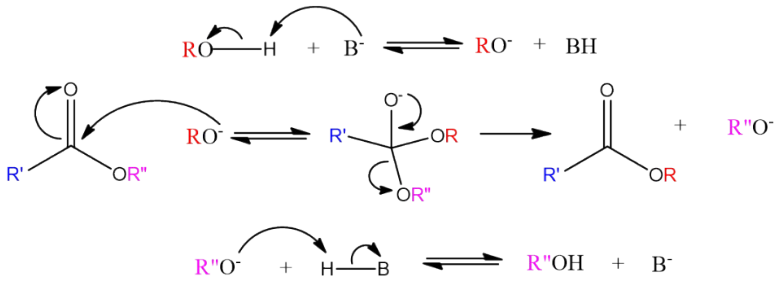


Figure S2: Thermogravimetric analysis of GlyCDs showing a three-step decomposition weight loss pattern. The first weight loss (9.2%) occurs at 140°C and can be attributed to water loss. The second weight loss (36.2%) occurs at 385°C, and is related to decomposition of the surface moieties. Finally, the third weight loss (42.6%) occurs at 795°C and is associated with the decomposition of the carbon core.

(A) Base-catalyzed transterification reaction



(B) Acid-catalyzed transterification reaction

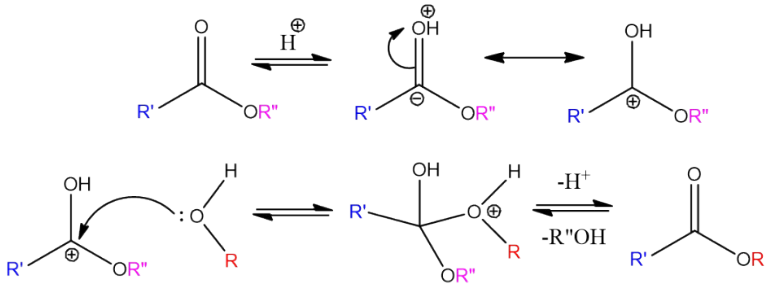
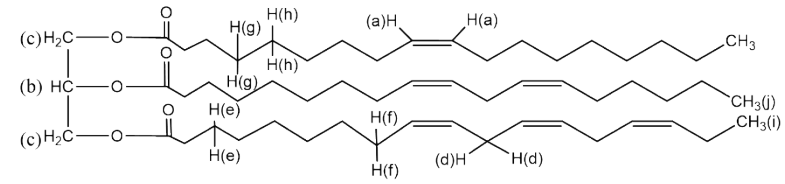
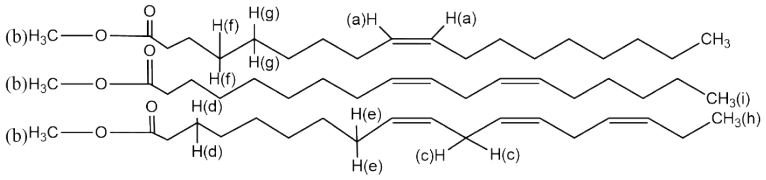


Figure S3: (A) Base-catalyzed transesterification reaction mechanism. The reaction starts with the abstraction of methanol proton by the OH^- anion, forming an extremely reactive CH_3O^- species that will further react to form the tetahedral intermediate that collapses to form the biodisel. (B) Acid-catalyzed transesterification reaction mechanism. The acid-catalyzed reaction involves the formation of a carbocation, followed by the attack of the oxygen present on the alcohol. A tetahedral intermediate is formed and then collapses to form the biodisel.

(A) Canola Oil ^{1}H NMR assignments



(B) Biodiesel ^{1}H NMR assignments



Assignments	Canola Oil Chemical Shift (ppm)	Biodiesel Chemical Shift (ppm)
H(a)	5.33	5.34
H(b)	4.29	3.65
H(c)	4.13	3.40
H(d)	2.79	2.95
H(e)	2.31	2.00
H(f)	2.02	1.62
H(g)	1.61	1.28
H(h)	1.30	0.97
H(i)	0.97	0.88
H(j)	0.88	-

Figure S4: ^{1}H NMR assignments for canola oil (A) and biodiesel (B). The original NMR spectra are presented on Figure 2 of the manuscript.

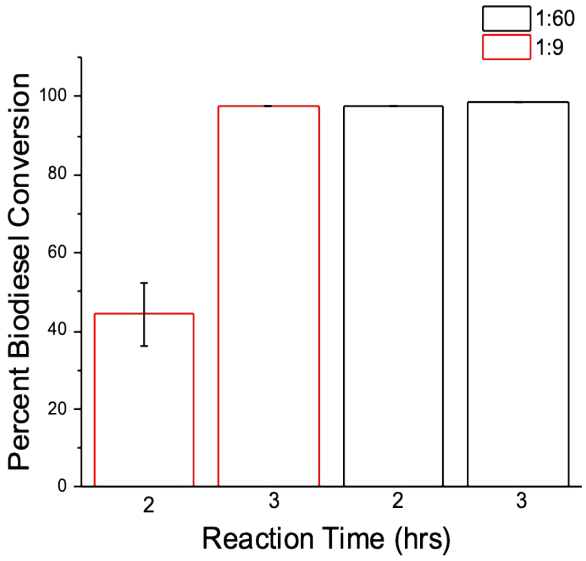


Figure S5: Transesterification reaction using 1% GlyCDs at 2 and 3 hour reaction times and 1:60 and 1:9 oil to methanol ratios. At lower methanol concentrations, a reaction time of 3 hours is requried to ensure conversion at ~97%.

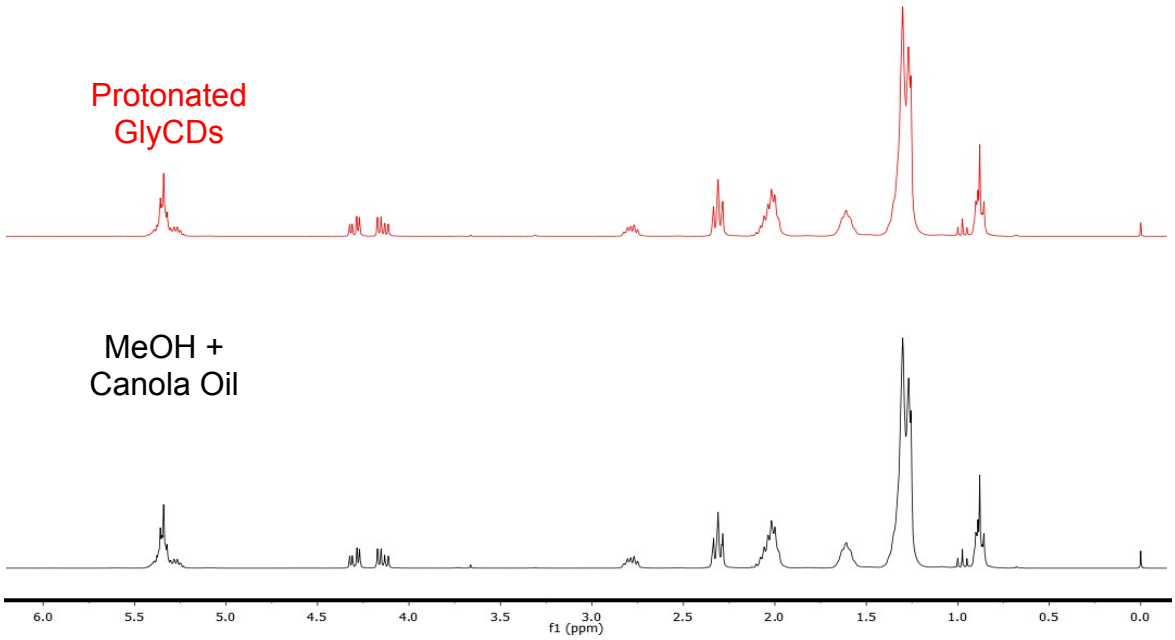


Figure S6: Negative controls to ensure the biodiesel formation stems from the GlyCD catalysts. From the ^{1}H NMR spectra, protonated GlyCDs (red) and the reaction of methanol and canola oil (black), in the absence of the CD catalyst, did not result in any significant biodiesel conversion.

Figure S7: 1% Agarose gel electrophoresis performed at pH 7.4 for the GlyCDs at two different concentrations. The result shows the GlyCDs migrating towards the positively charged anode indicating that they are negatively charged.