Direct Use of Natural Antioxidant-rich Agro-wastes

as Thermal Stabilizer for Polymer: Processing and Recycling

Krishnan A. Iyer[1], Lanhe Zhang[2] and John M. Torkelson[1,2,*]

[1]Dept. of Chemical and Biological Eng., Northwestern University, Evanston, IL 60208, USA

[2]Dept. of Materials Science and Eng., Northwestern University, Evanston, IL 60208, USA

*Corresponding author. *email address:* j-torkelson@northwestern.edu

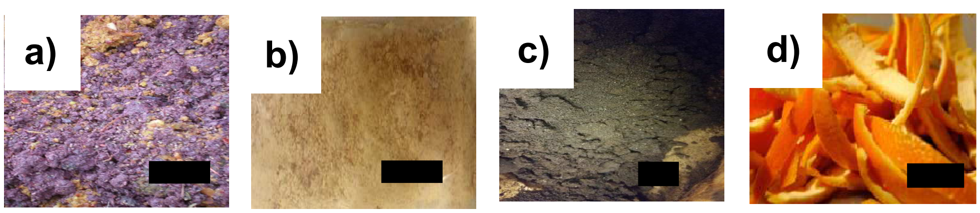

Figure S1. Appearances of antioxidant rich agro-wastes used as fillers in this study: a) Grape pomace waste (GW), b) Turmeric shavings waste (TW), c) Spent Coffee grounds (CG), and Orange peel waste (OW). (Scale bar represents 5 mm.)

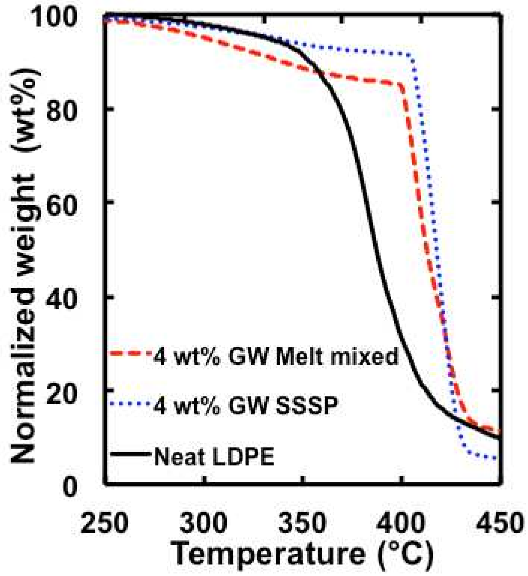

Figure S2. Thermal degradation behavior in air of neat LDPE and LDPE hybrids with 4 wt% grape waste prepared via SSSP and melt mixing.

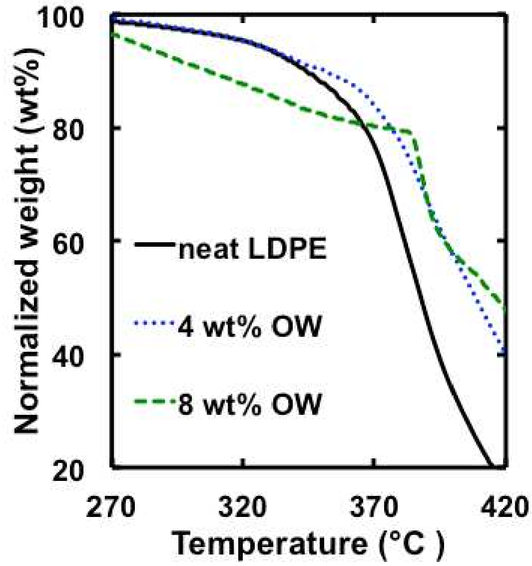

Figure S3. Thermal degradation behavior in air of neat LDPE and LDPE hybrids with orange peel waste (OW).

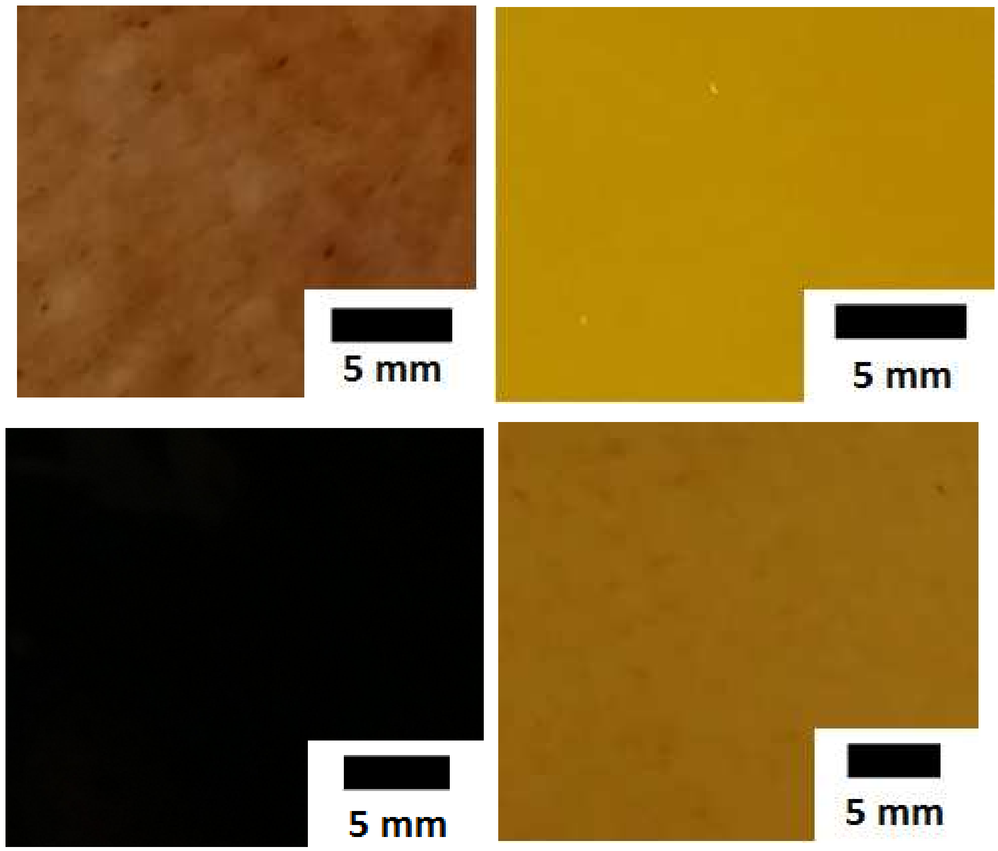

Figure S4. Photographs of LDPE hybrids with a) 4 wt% grape waste, b) 8 wt% turmeric waste, c) 12 wt% coffee grounds, and d) 8 wt% orange peel waste.

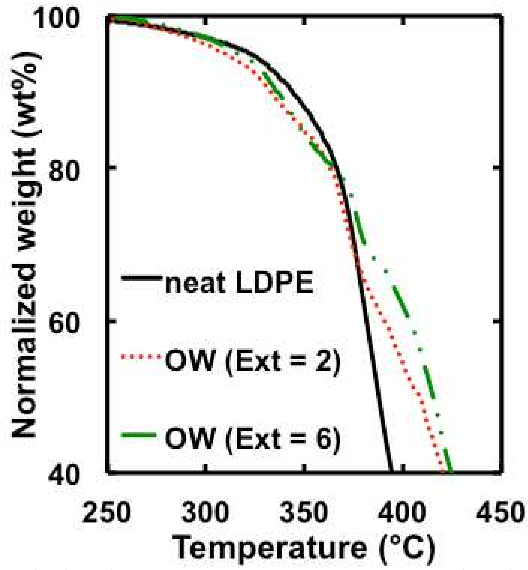

Figure S5. Thermal degradation behavior in air of LDPE hybrids with 8 wt% orange peel waste after multiple extrusion cycles.

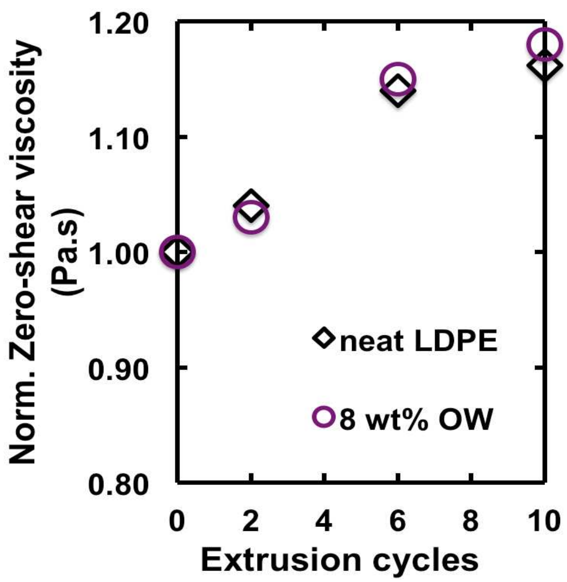

Figure S6. Dependence of normalized zero-shear viscosity measured at 140 °C on the number of extrusion cycles for neat LDPE (diamond) and LDPE hybrid with 8 wt% OW (orange peel waste; circle).

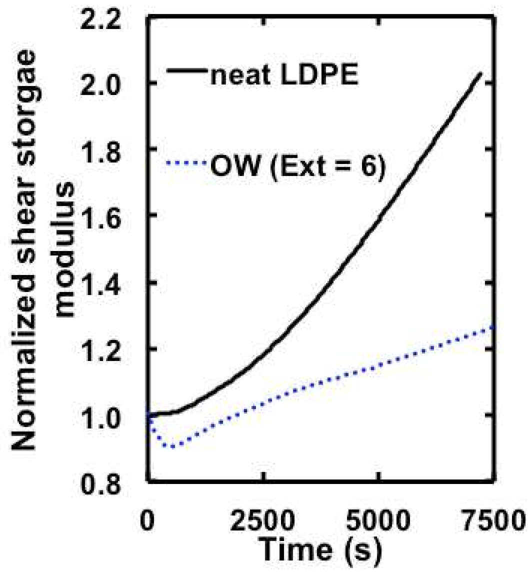

Figure S7. Evolution of normalized shear storage modulus for neat LDPE and 92/8 wt% LDPE/OW hybrid as a function of time under oscillatory shear at 200 °C.

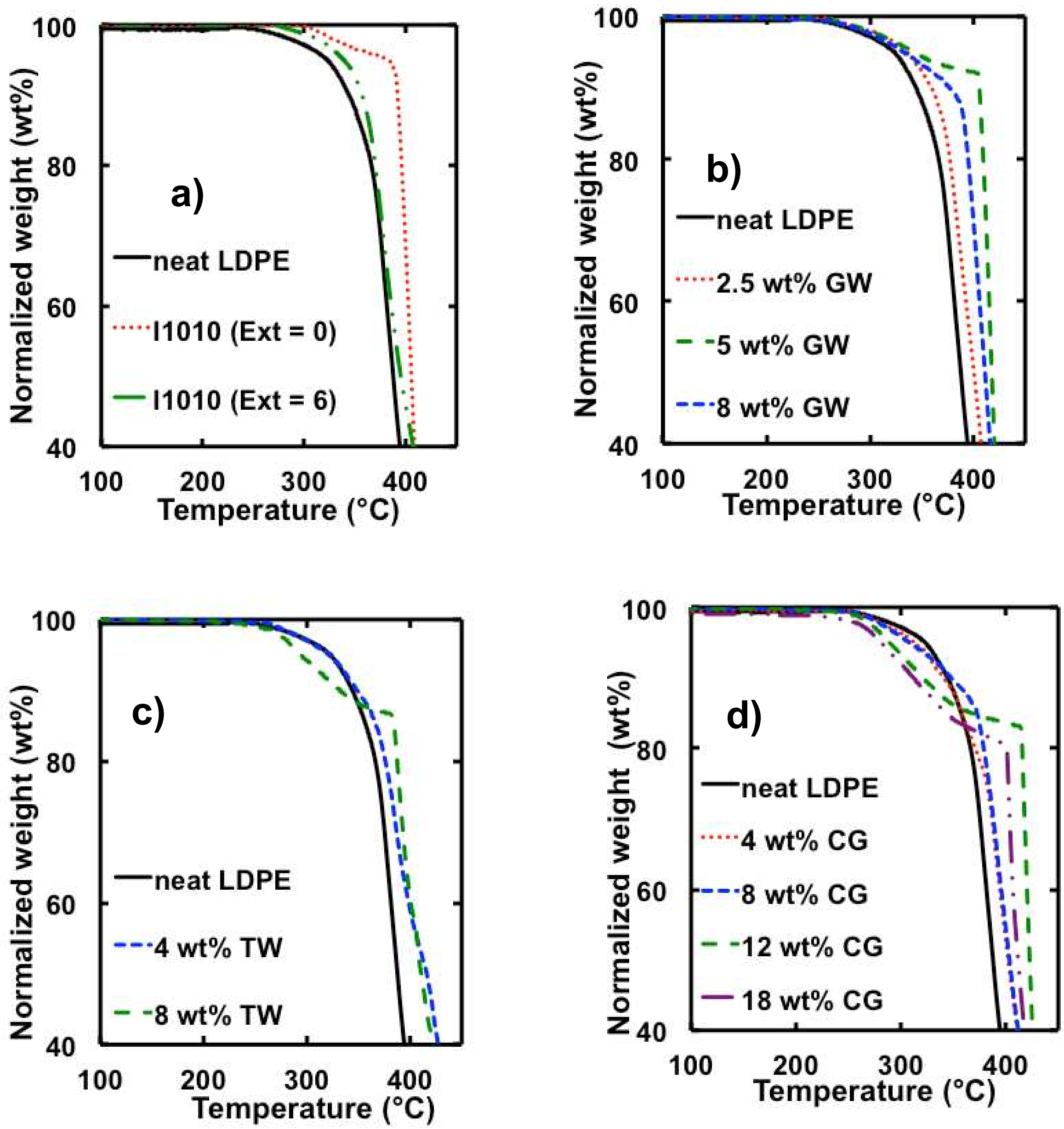

Figure S8. Thermal degradation behavior in air of neat LDPE and LDPE hybrids with a) Irganox I1010, b) GW (grape waste), c) TW (turmeric waste), and d) CG (coffee grounds). (Note. Samples with agro-wastes are not pre-dried.)

Table S1. Zero-shear viscosities measured at 140 °C for neat LDPE, LDPE after SSSP processing and LDPE/antioxidant hybrids prepared via SSSP.

Sample	Zero-shear-rate viscosity η_o (Pa.s)
neat LDPE	1.30×10^5
LDPE-SSSP processed	1.10×10^5
99/1 wt% LDPE/I1010	1.30×10^5
96/4 wt% LDPE/GW	1.25×10^5
92/8 wt% LDPE/TW	1.16×10^5
88/12 wt% LDPE/CG	1.10×10^5
92/8 wt% LDPE/OW	1.13×10^5