Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Sugar-based amphiphiles: easily accessible and efficient crude oil spill thickening agents

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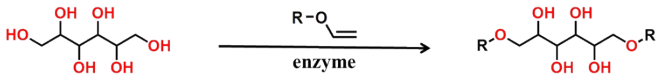
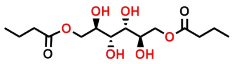
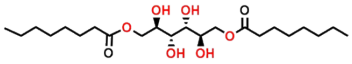
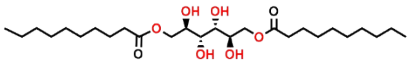
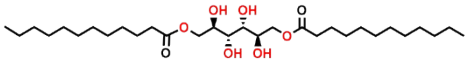
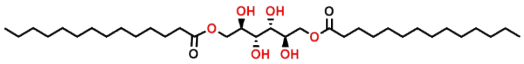
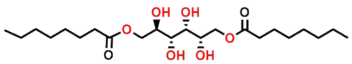
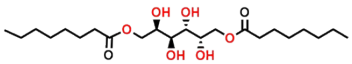
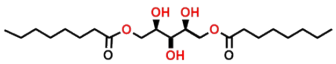
Table S1. Structures of the synthesized amphiphiles with their abbreviations, compound numbers, and both common and systematic names.



a) Mannitol-derived amphiphiles

Abbr.	Comp. #	Structure	Common Name	Systematic Name
M-4	5a		mannitol dibutyrate	(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dibutyrate
M-8	5b		mannitol dicaprylate	(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate
M-10	5c		mannitol dicaprate	(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl bis(decanoate)
M-12	5d		mannitol dilaurate	(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl didodecanoate
M-14	5e		mannitol dimyristate	(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl ditetradecanoate

b) Vinyl caprylate-derived amphiphiles

Abbr.	Comp. #	Structure	Common Name	Systematic Name
S-8	6b		sorbitol dicaprylate	(2R,3R,4R,5S)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate
G-8*	7b		galactitol dicaprylate	(2R,3S,4R,5S)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate
X-8	8b		xylitol dicaprylate	(2R,3r,4S)-2,3,4-trihydroxypentane-1,5-diyl dioctanoate

a) All reactions were carried out at 50 °C for 24 to 48 hrs; b) Abbr. = abbreviation & Comp. = compound;
*G-8 product was never obtained under the enzymatic conditions; hence, the structure shown here is the attempted product rather than the synthesized product.

Table S2. Classification and composition of the three used crude oils: South Louisiana Crude Oil (SLCO), Arabian Light Crude Oil (ALCO) and Prudhoe Bay Crude Oil (PBCO).[1, 2]

Crude oil:	South Louisiana Crude Oil (SLCO)	Arabian Light Crude Oil (ALCO)	Prudhoe Bay Crude Oil (PBCO)
Physical Properties			
API gravity*	36.61	31.95	26.46
Density (g/cm^3)	0.840	0.864	0.894
Dynamic Viscosity (cP) (at 15 °C)	7	14	39
Classification	Very Light	Light	Heavy
Chemical Composition			
Sulfur (wt %) (classification)	0.0 (sweet)	2.0 (sour)	0.9 (sour)
Paraffins (% vol)	79	63	27
Naphthenes (% vol)	45	18	36
Aromatics (% vol)	19	19	28
Classification	Paraffinic	Paraffinic	Naphthenic

* API gravity $= \frac{141.5}{SG} - 131.5$, where SG is specific gravity of the crude oil at 15.6 °C (60 °F).

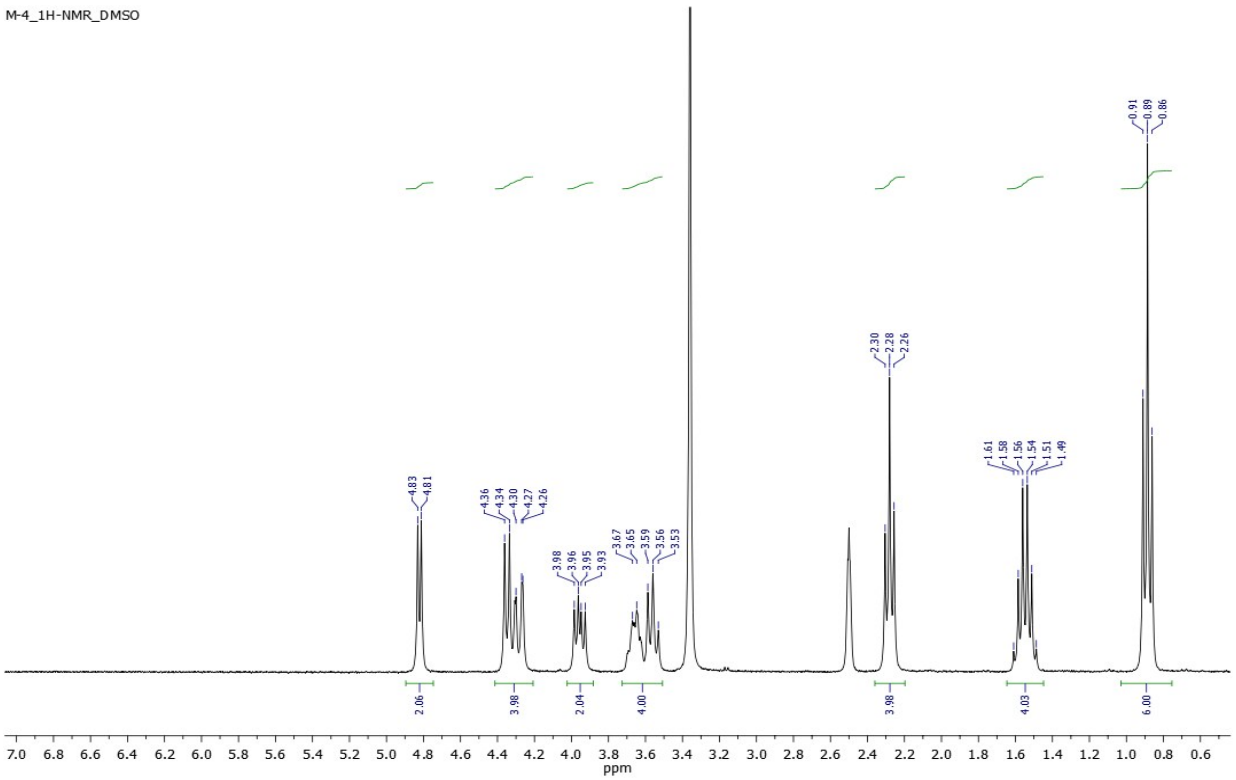


Fig. S1 ^{1}H-NMR of M-4 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dibutyrate].

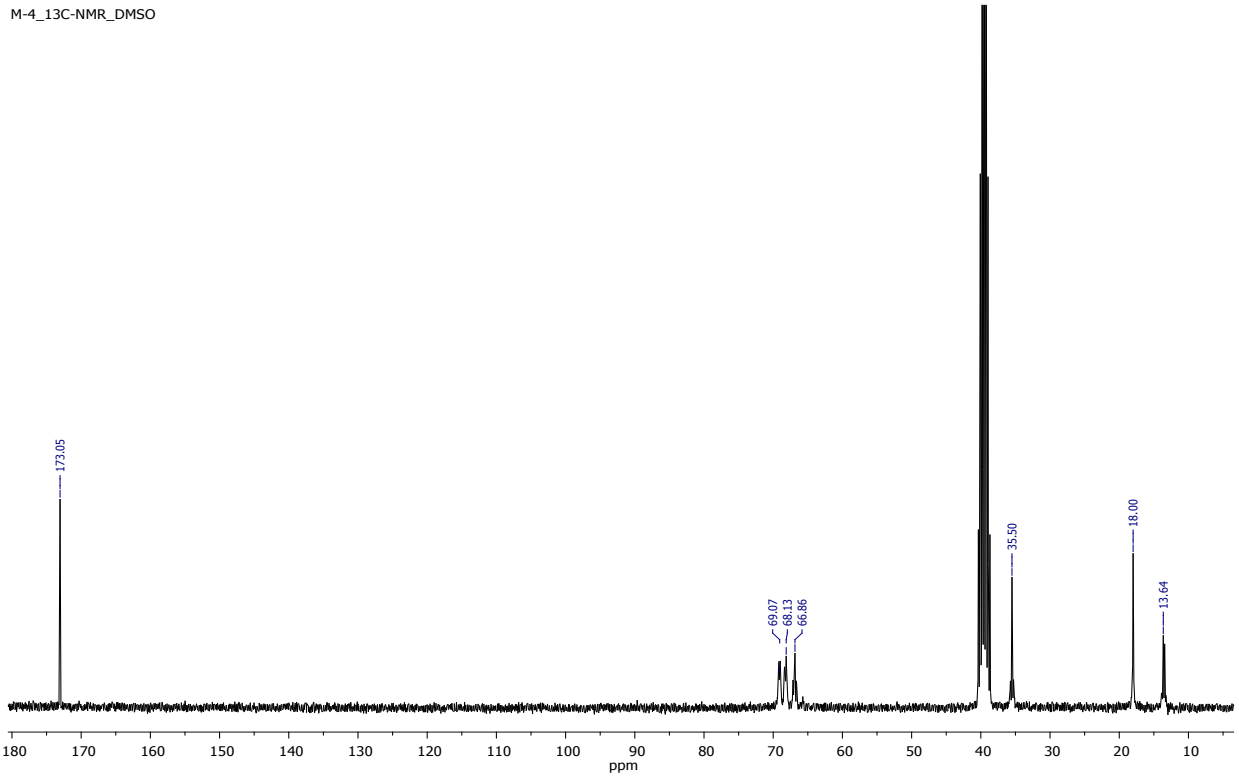


Fig. S2 ^{13}C-NMR of M-4 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dibutyrate].

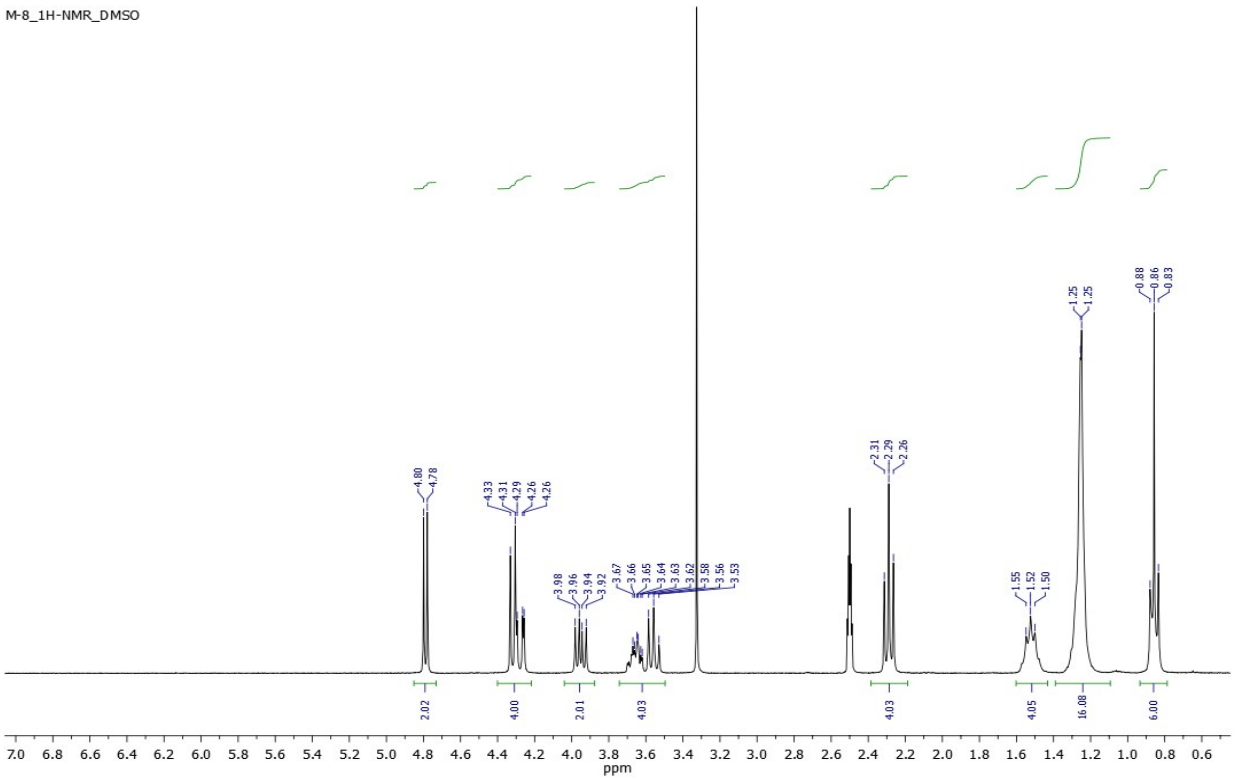


Fig. S3 ^{1}H-NMR of M-8 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate].

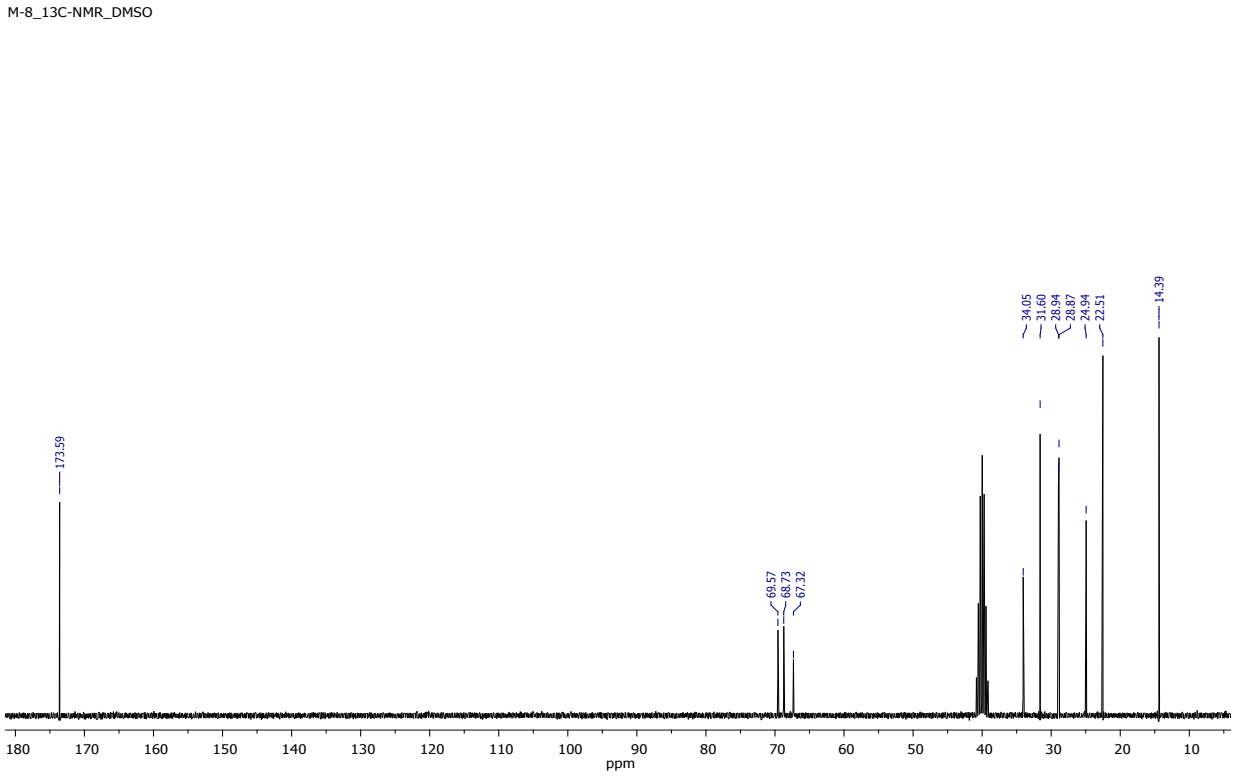


Fig. S4 ^{13}C-NMR of M-8 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate].

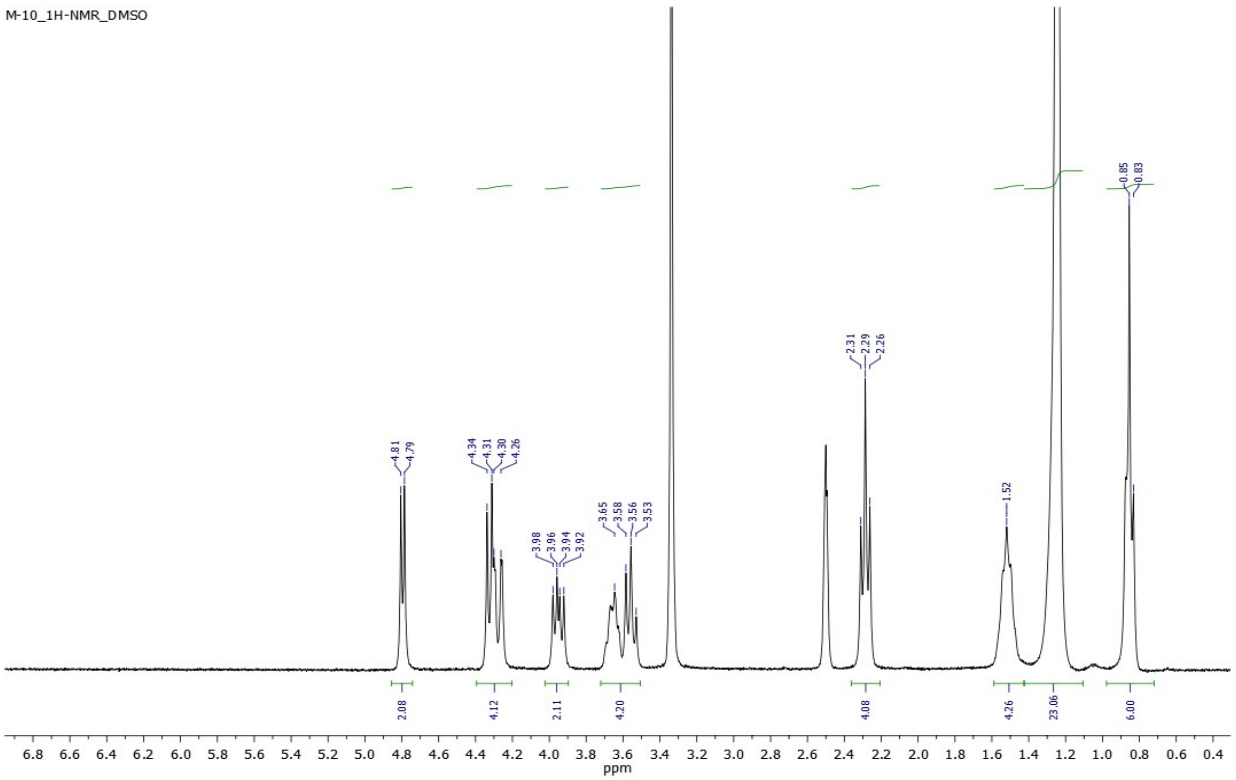


Fig. S5 ^{1}H-NMR of M-10 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl bis(decanoate)].

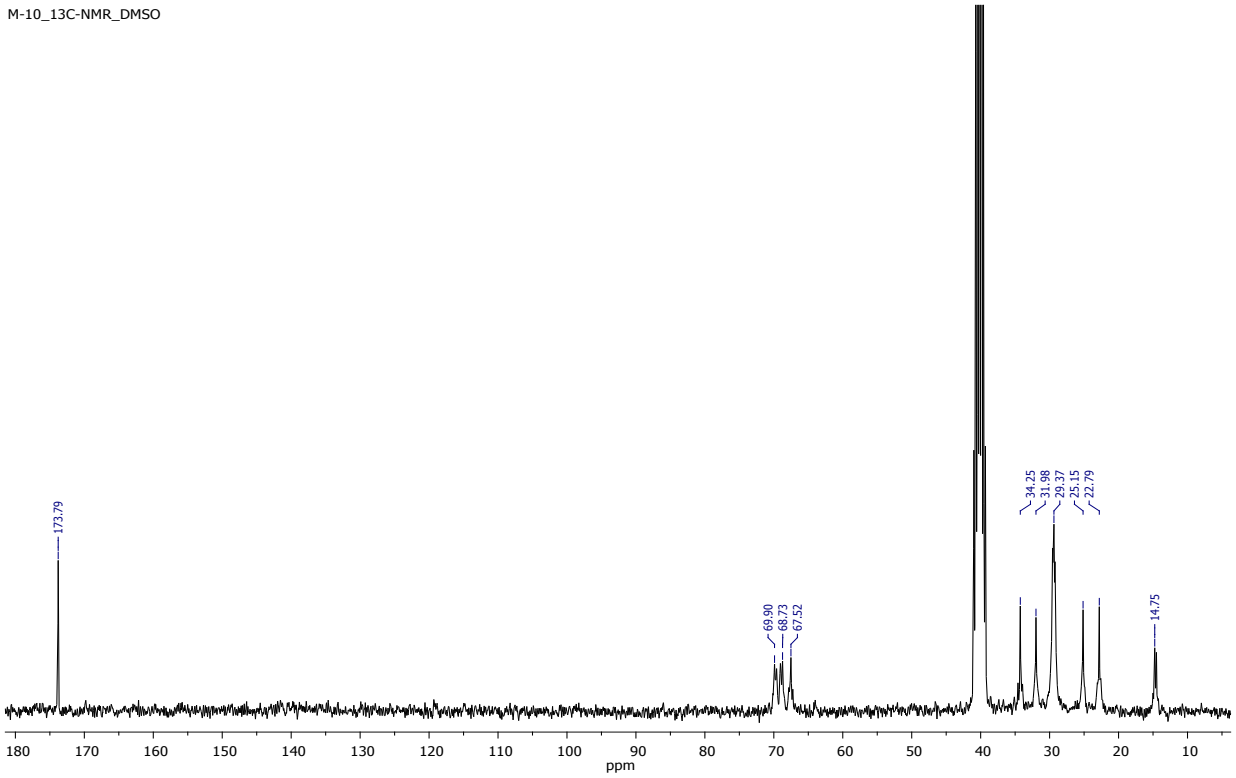


Fig. S6 ^{13}C-NMR of M-10 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl bis(decanoate)].

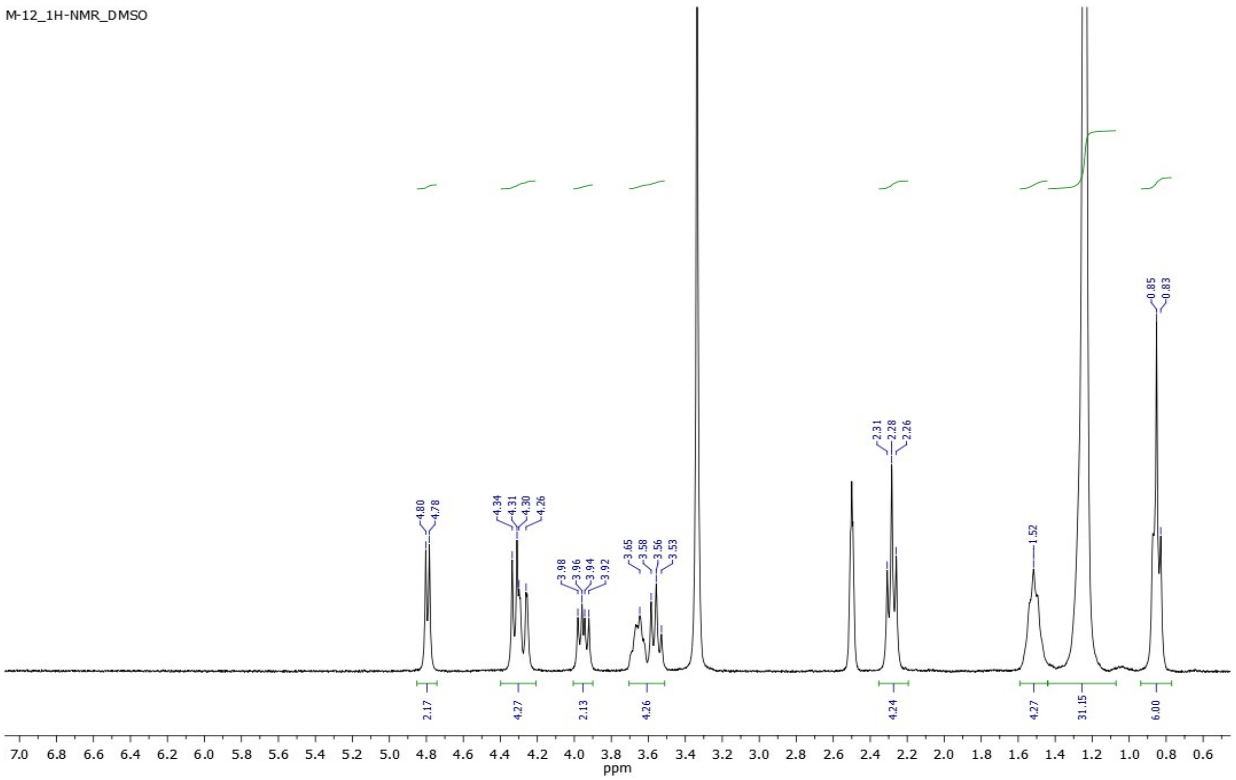


Fig. S7 ^{1}H-NMR of M-12 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl didodecanoate].

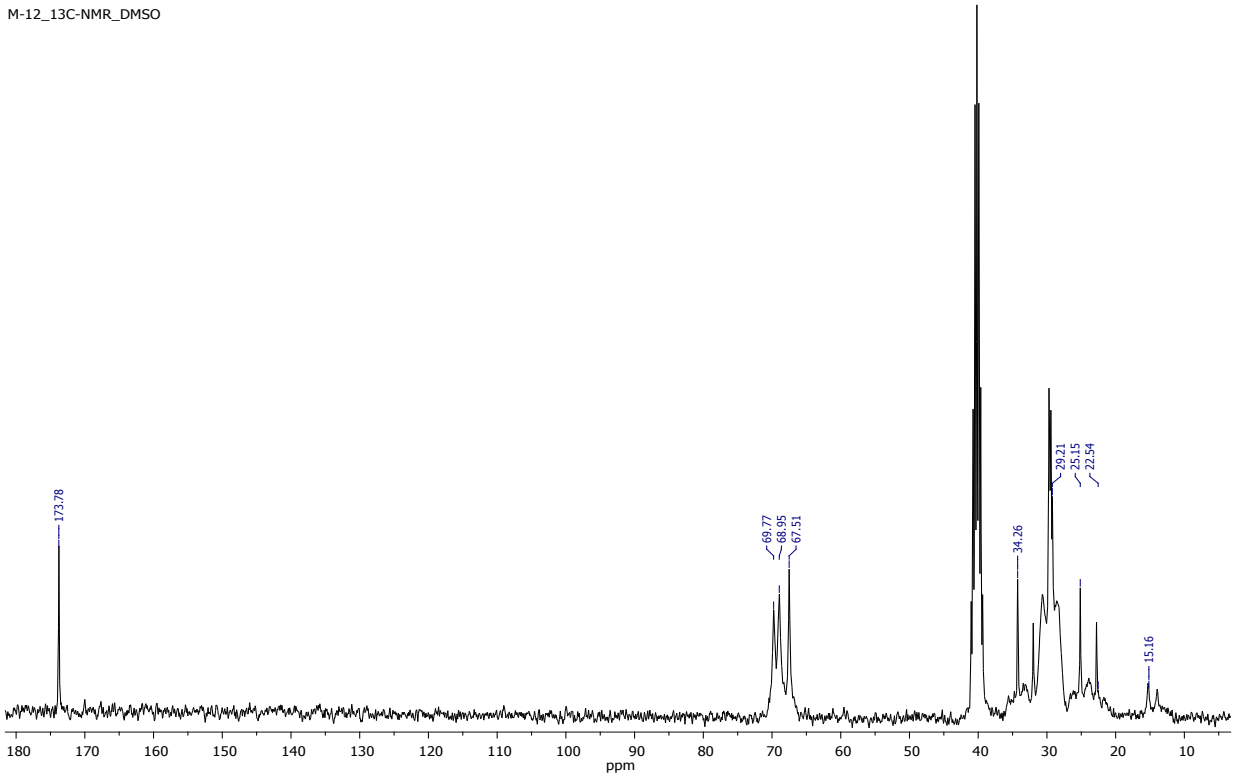


Fig. S8 ^{13}C-NMR of M-12 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl didodecanoate].

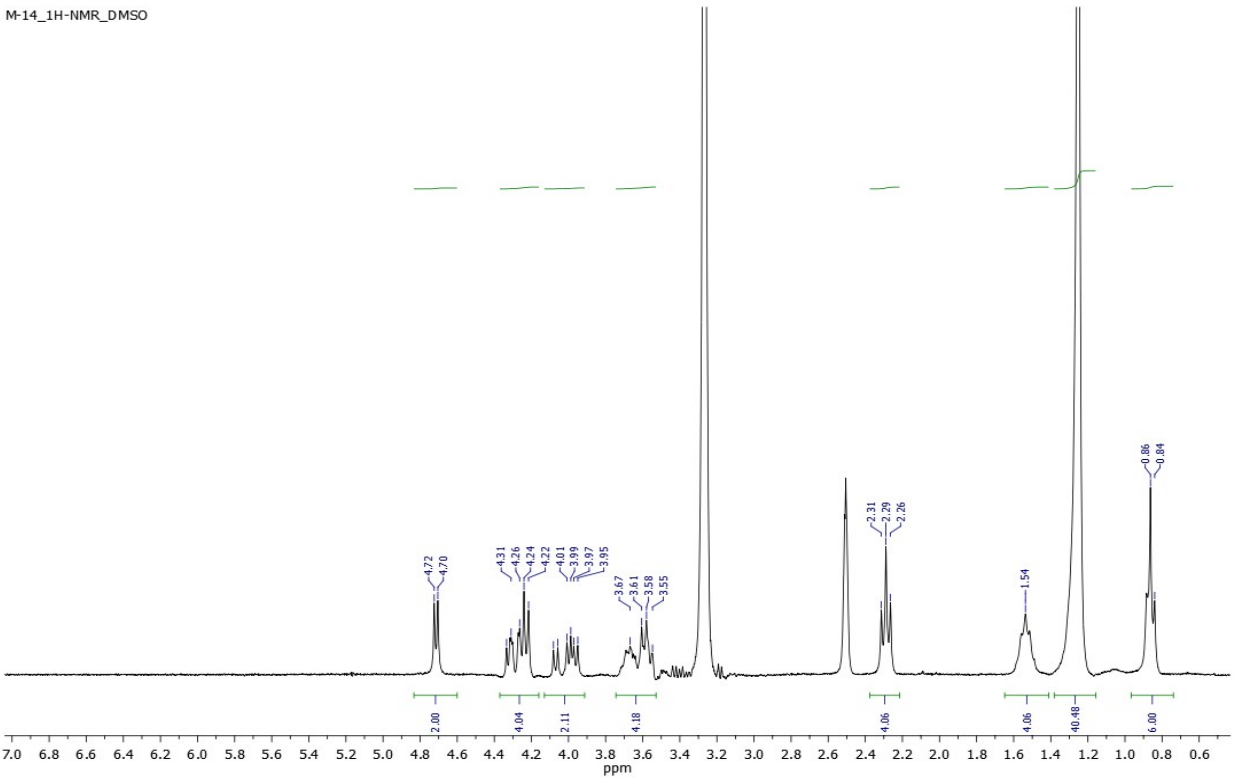


Fig. S9 ^{1}H-NMR of M-14 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl ditetradecanoate].

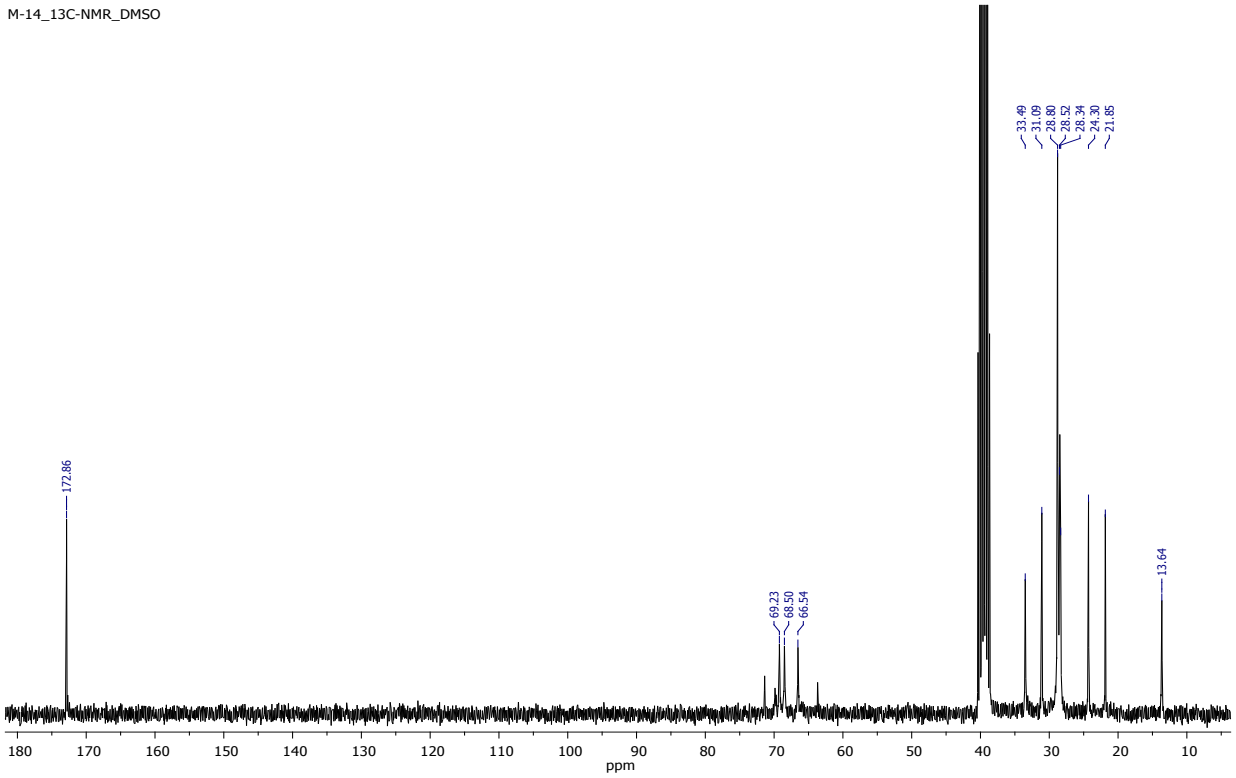


Fig. S10. ^{13}C-NMR of M-14 [(2R,3R,4R,5R)-2,3,4,5-tetrahydroxyhexane-1,6-diyl ditetradecanoate].

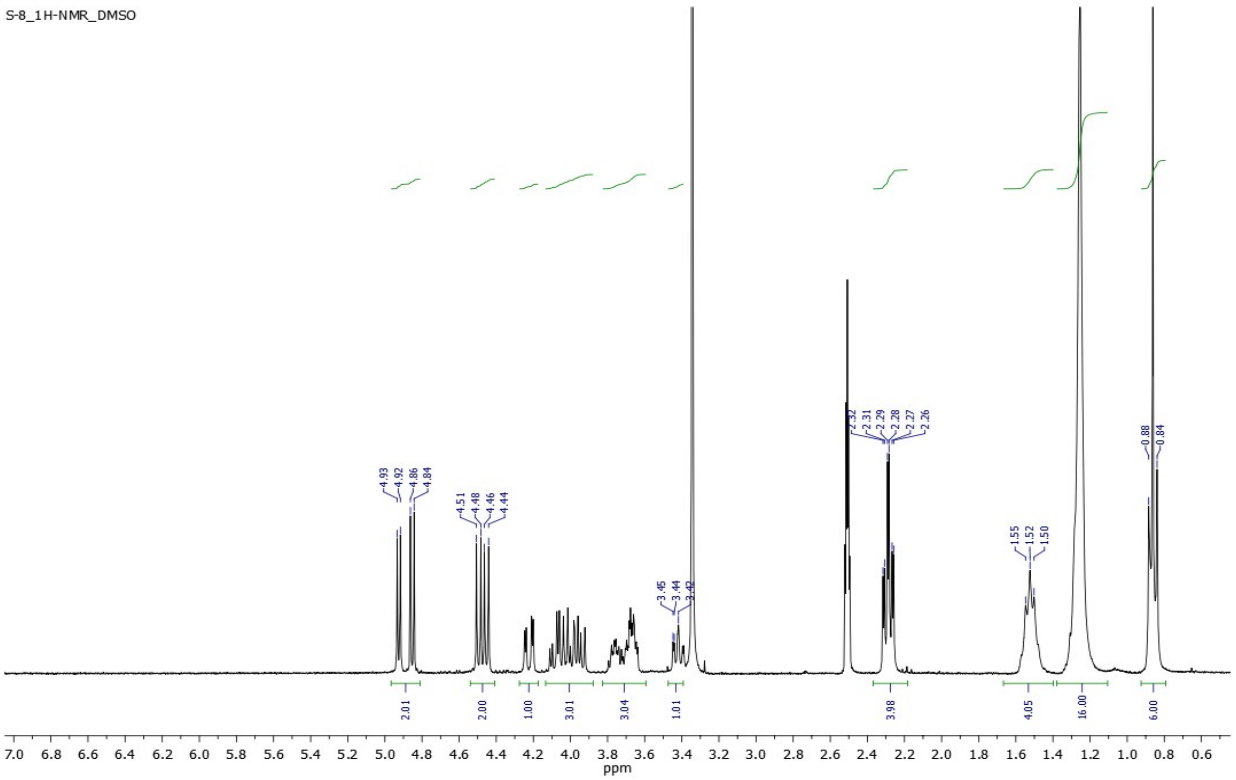


Fig. S11 ^{1}H-NMR of S-8 [(2R,3R,4R,5S)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate].

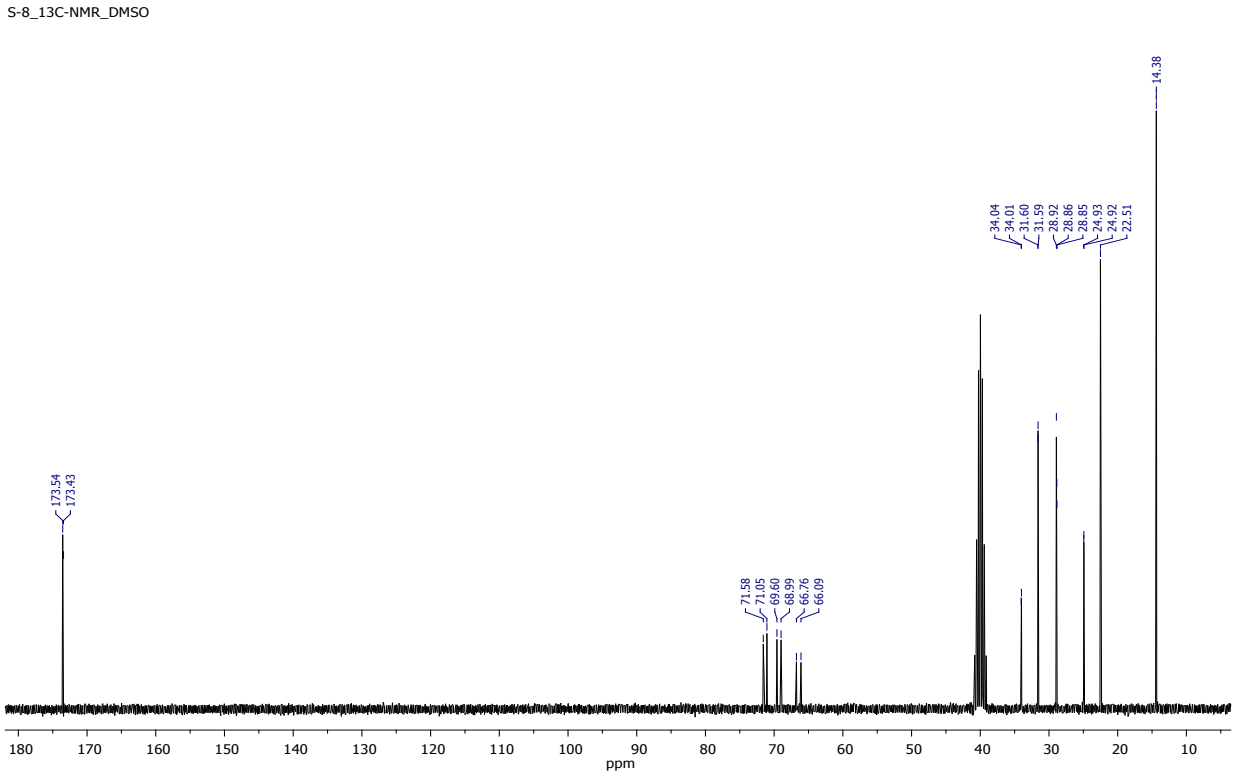


Fig. S12 ^{13}C-NMR of S-8 [(2R,3R,4R,5S)-2,3,4,5-tetrahydroxyhexane-1,6-diyl dioctanoate]

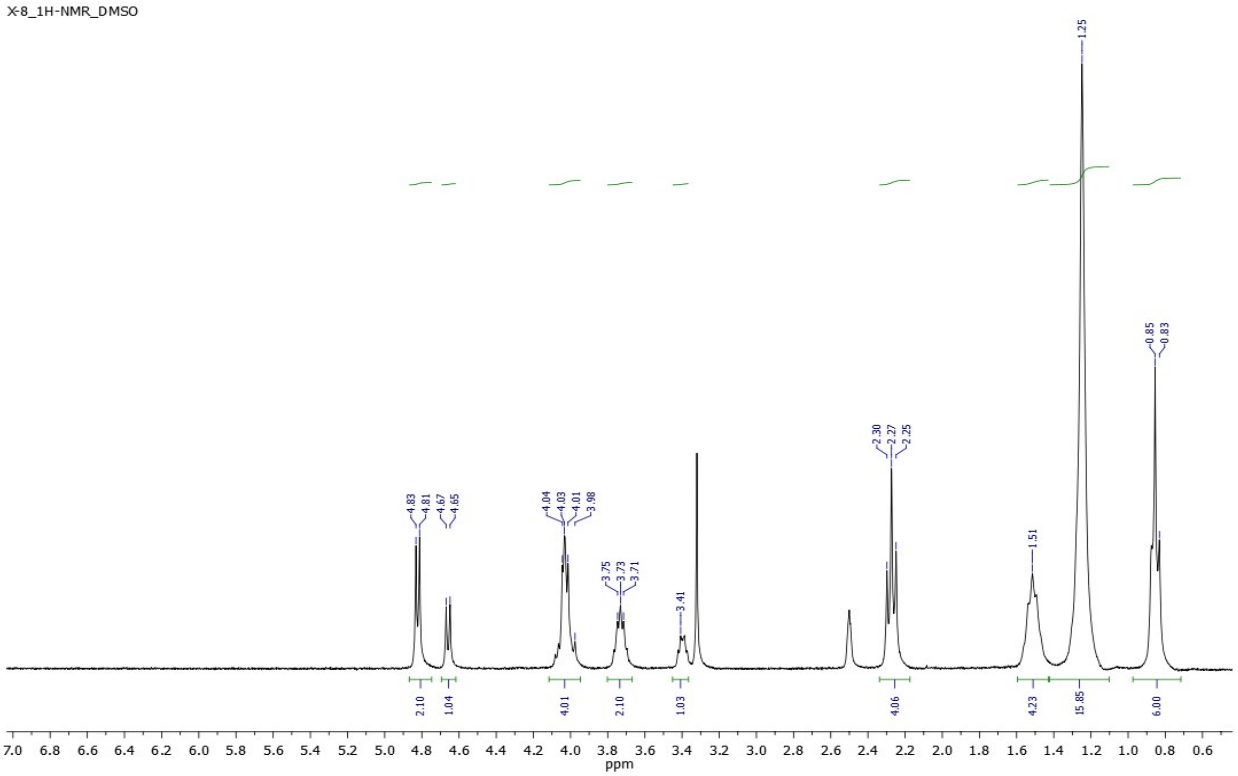


Fig. S13 ^{1}H-NMR of X-8 [(2R,3r,4S)-2,3,4-trihydroxypentane-1,5-diyl dioctanoate].

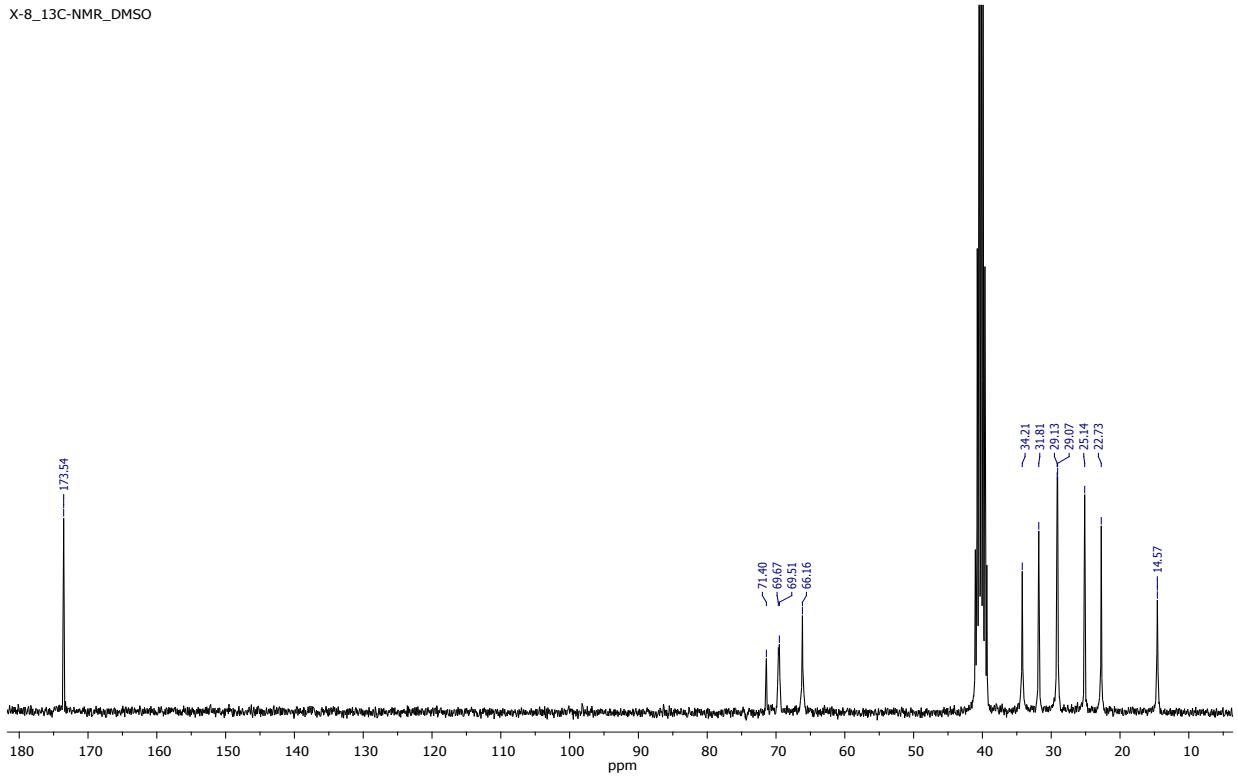


Fig. S14 ^{13}C-NMR of X-8 [(2R,3r,4S)-2,3,4-trihydroxypentane-1,5-diyl dioctanoate].

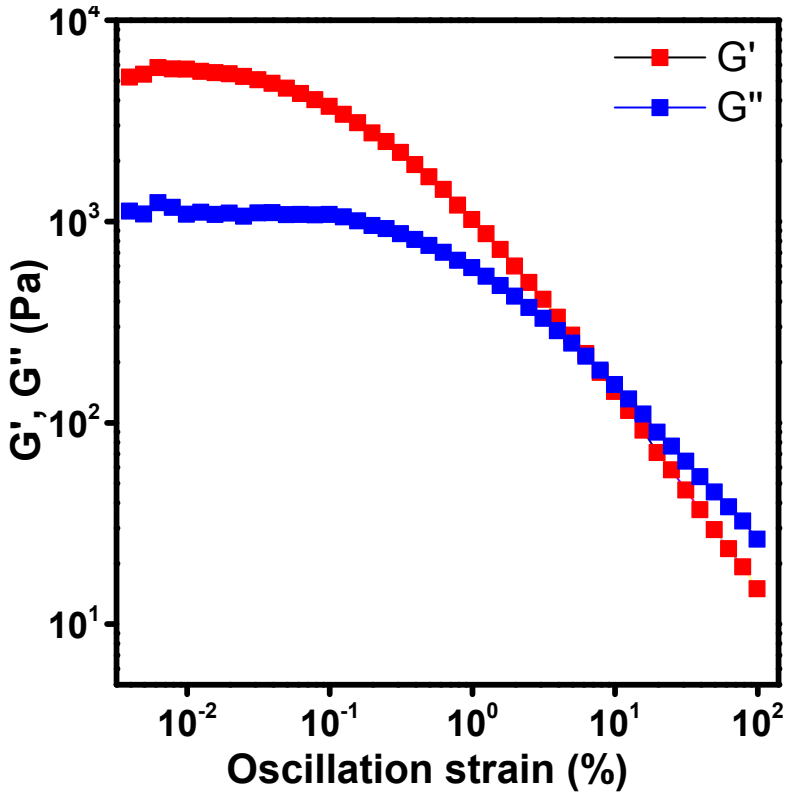


Fig. S15 Rheology data of 5% M-8 in crude oil (SLCO): strain sweep.

References

1. E. L. Holder, R. N. Conmy and A. D. Venosa, *J. Environ. Prot. (Irvine, Calif.)*, 2015, **06**, 628-639.
2. The American Petroleum Institute Petroleum HPV Testing Group, *US EPA: HIGH PRODUCTION VOLUME (HPV) CHEMICAL CHALLENGE PROGRAM*, 2011, **Consortium Registration # 1100997**, 1-108.