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*Supplementary materials*

# Conversion of D-fructose to 5-acetoxymethyl-2-furfural using immobilized lipase and cation exchange resin

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## 1. Characterization methods:

### *1.1 Nuclear Magnetic Resonance (NMR):*

NMR analysis was performed on a Bruker Spectrospin 300 (Bruker Corporation, Germany). Figure S1 shows $^{1}$H NMR of DAF (300 MHz, $CDCl_3$): 4.44-4.33 (m, 1H on C2), 4.30-4.23 (m, 2H of C5-$CH_2$), 4.21-4.13 (m, 2H on C3 and C4), 4.05-4.00 (m, 2H of C2-$CH_2$), 2.17-2.12 (m, 6H of 2 –$COOCH_3$; major anomer: 2.14 and 2.13; minor anomer: 2.17 and 2.12). $^{13}$C NMR of DAF (300 MHz, DMSO-$d_6$): 170.83-170.47 (d, 2C in –COO– groups), 100.86 (s, C5 in the ring), 78.85 (s, C2 in the ring), 76.49 (s, C4 in the ring), 75.57 (s, C3 in the ring), 66.16 (s, C6 in –$CH_2$ group), 64.62 (s, C1 in –$CH_2$ group), 21.04 (m, 2C in –$CH_3$ groups) (Figure S2).

AMF was also analyzed with NMR and Figure S4 shows $^{1}$H NMR of AMF (300 MHz, THF-$d_8$): 9.62 (s, 1H on –CHO), 7.31-7.30 (d, 1H of C4 on furan ring), 6.68-6.67 (d, 1H of C3 on furan ring), 5.13 (s, 2H of –$CH_2$), 2.06 (s, 3H of –$CH_3$). $^{13}$C NMR of AMF (300 MHz, THF-$d_8$): 176.91 (s, C in –CHO group), 169.23 (s, C in –COO– group), 155.57 (s, C2 in the furan ring), 155.37 (s, C5 in the furan ring), 120.62 (s, C4 in the furan ring), 112.06 (s, C3 in the furan ring), 57.27 (s, C in –$CH_2$ group), 19.32 (s, C in –$CH_3$ group) (Figure S5).

### *1.2 High performance liquid chromatography (HPLC):*

HPLC analysis of the dehydration products was performed on an Agilent 1200 series equipped with a Bio-Rad Animex HPX-87P column and an RID detector (at 254 nm). $H_2O$ was used as mobile phase and the flow rate was adjusted at 0.6 mL/min. The retention times for AMF and HMF are 54.2 min. and 29.3 min. respectively (shown in figure S7).

### *1.3 Liquid chromatography combined with mass spectroscopy (LC-MS):*

LC-MS analysis of the DAF was performed on an Agilent 1260 Infinity II series equipped with an InfinityLab LC/MSD mass spectrometer detector. HCOOH 0.001 M in $H_2O$ was used as mobile phase and the flow rate was adjusted at 0.5 mL/min. DAF was ionized in API-ES positive mode and the mass spectrum was shown in Figure S3.

### *1.4 Gas chromatography combined with mass spectroscopy (GC-MS):*

GC-MS analysis of the dehydration products was performed on a Shimadzu GC-2010 Plus system equipped with QP2010 Ultra mass spectrometer detector. AMF and HMF formation (Figure S8) is verified by comparing spectrum with GC-MS NIST 2011 database.

**2. Analysis results:**

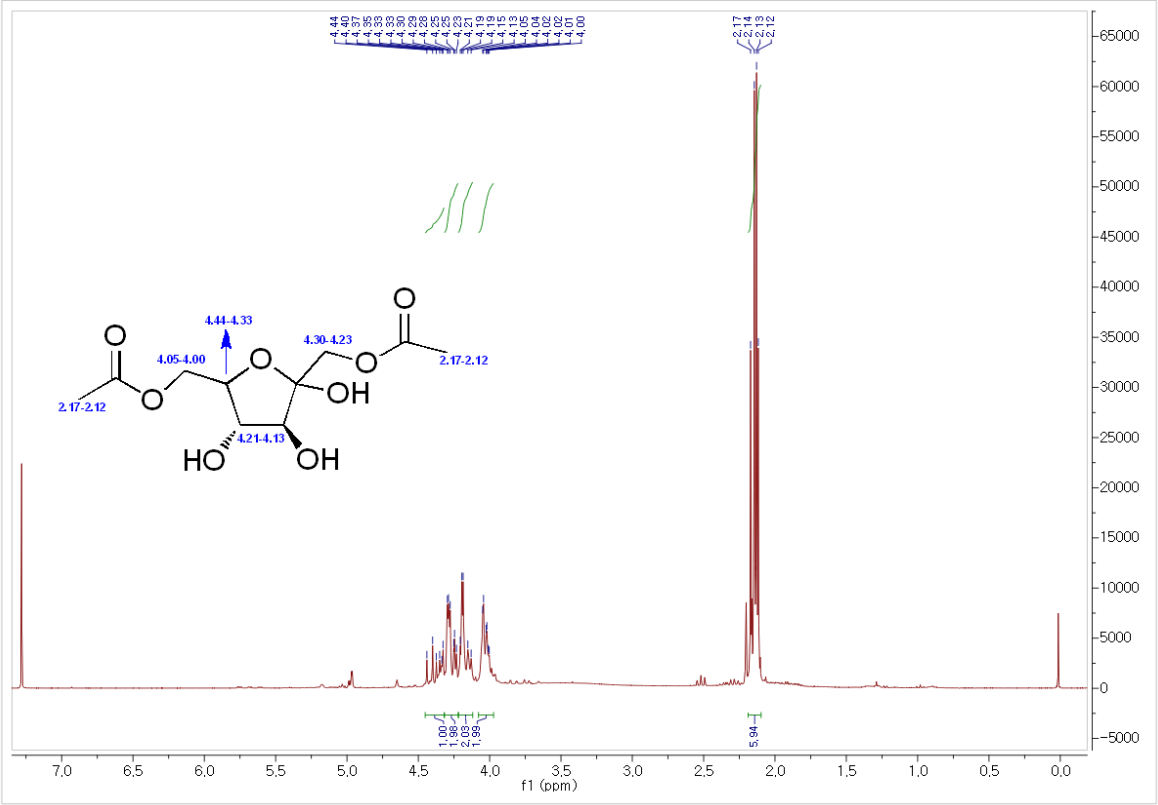



**Figure S1.** $^{1}$H NMR analysis of DAF

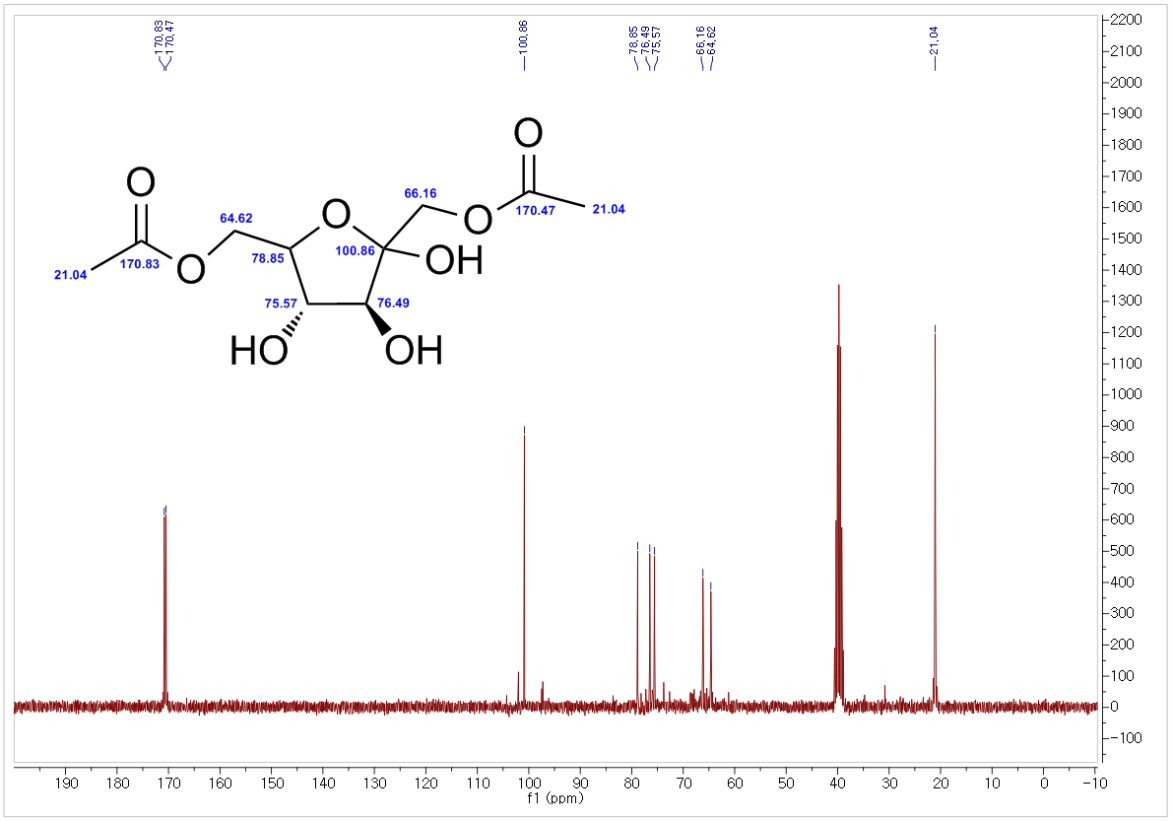



**Figure S2.** $^{13}C$ NMR analysis of DAF

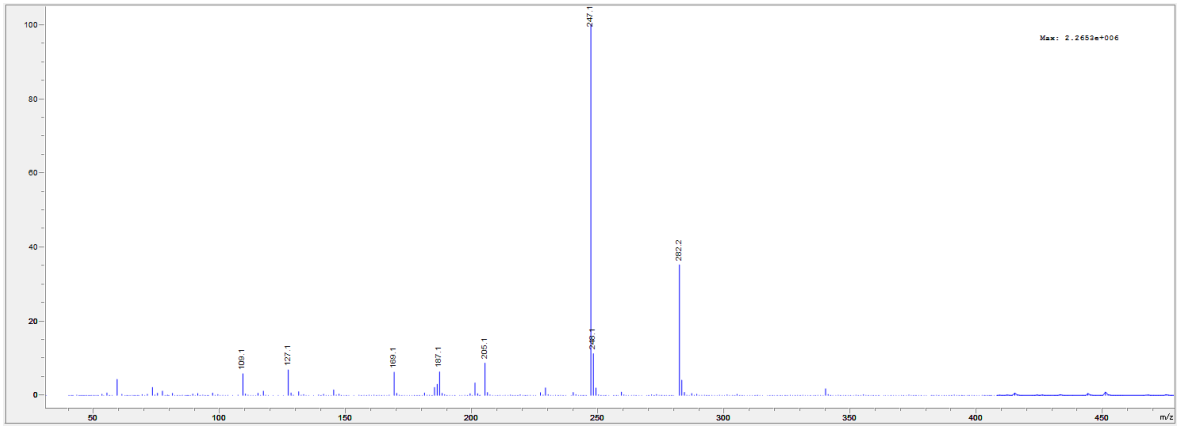



**Figure S3.** Mass spectrum of DAF

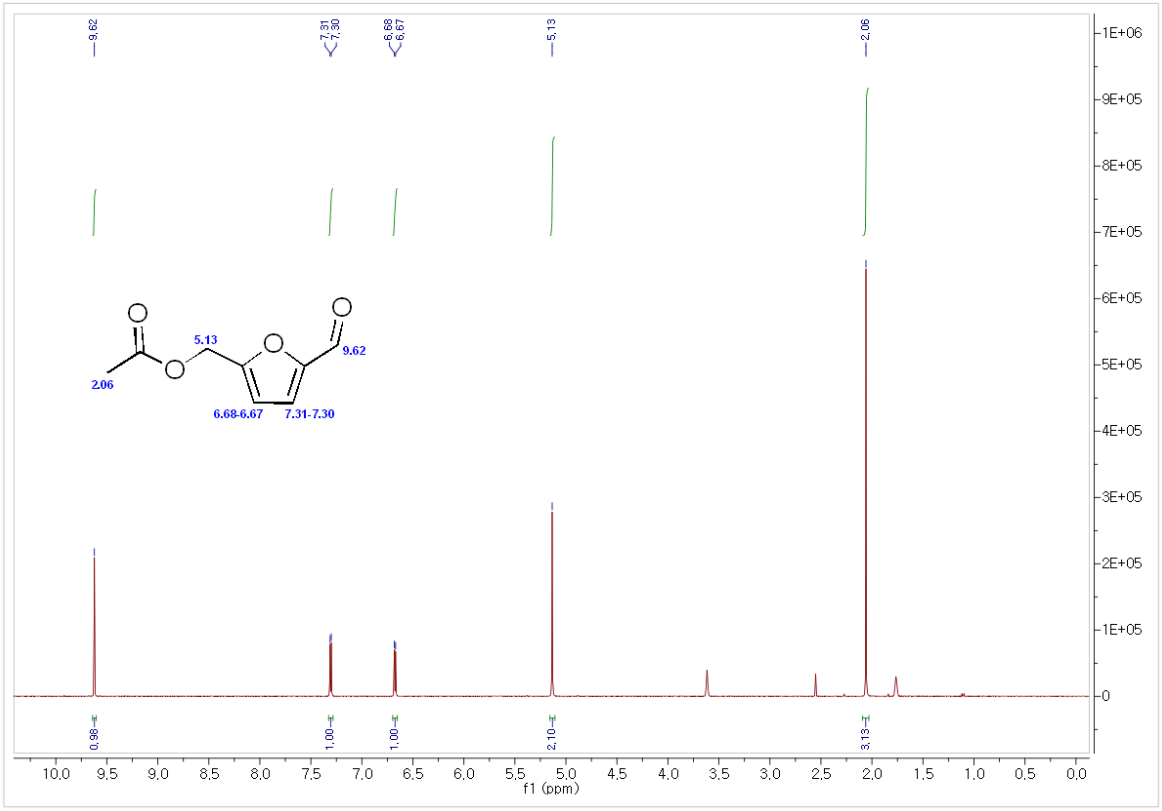



**Figure S4.** $^{1}$H NMR analysis of AMF

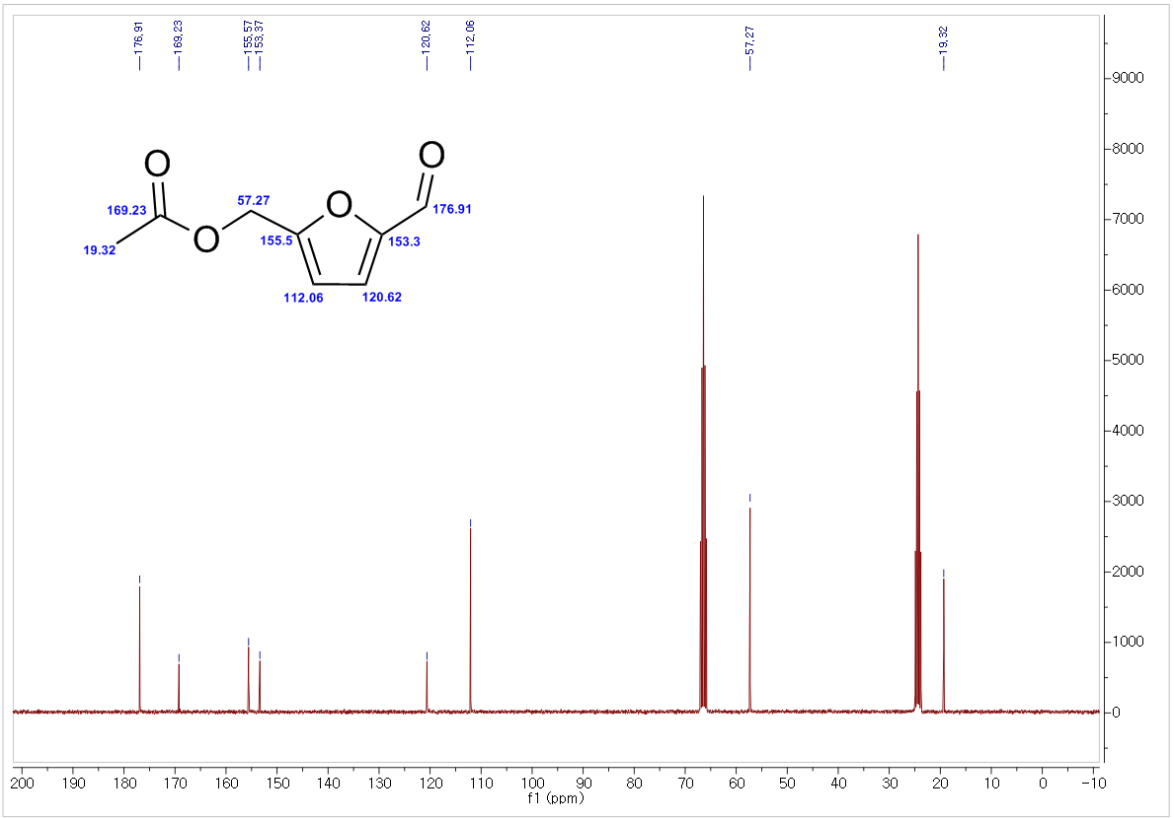



**Figure S5.** $^{13}$C NMR analysis of AMF

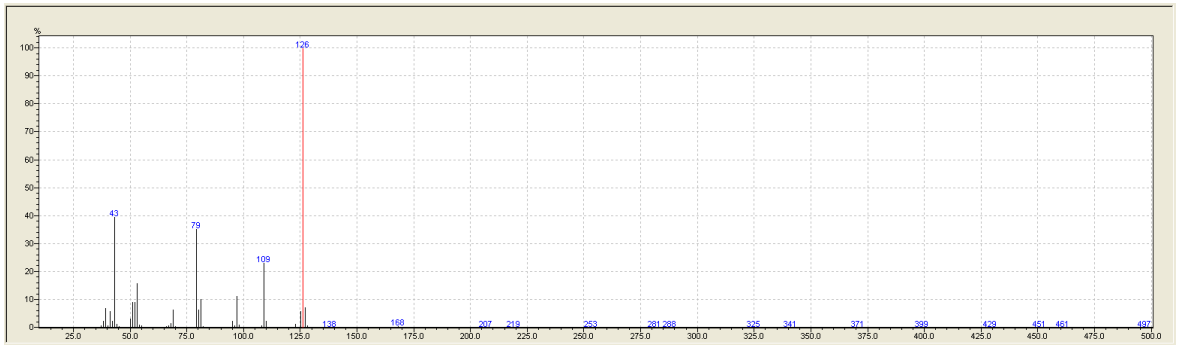



**Figure S6.** Mass spectrum of AMF

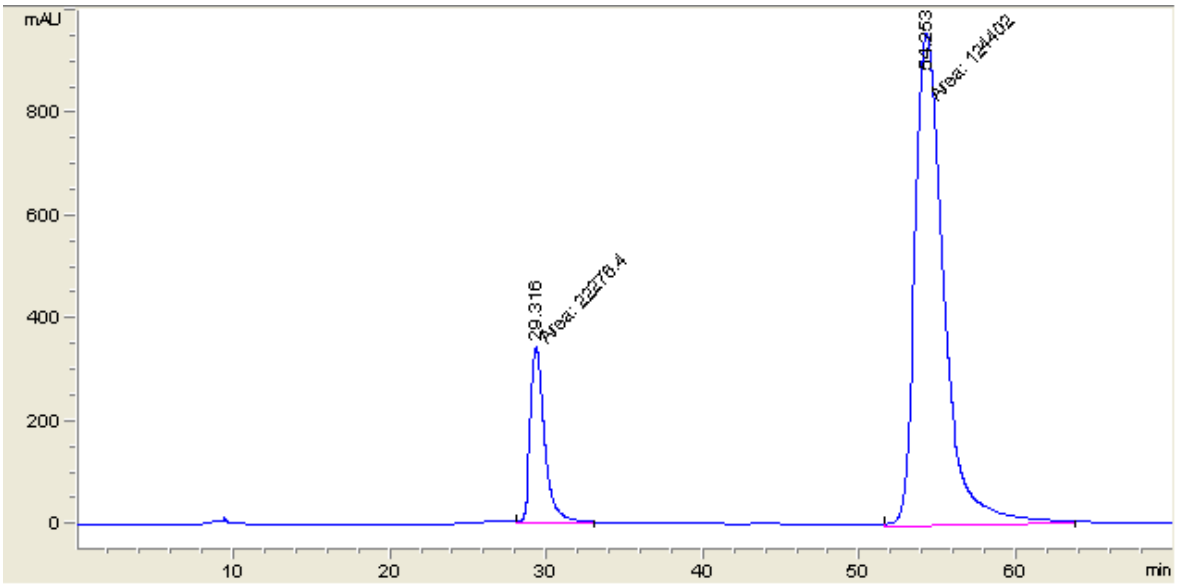



**Figure S7.** HPLC analysis of AMF and HMF

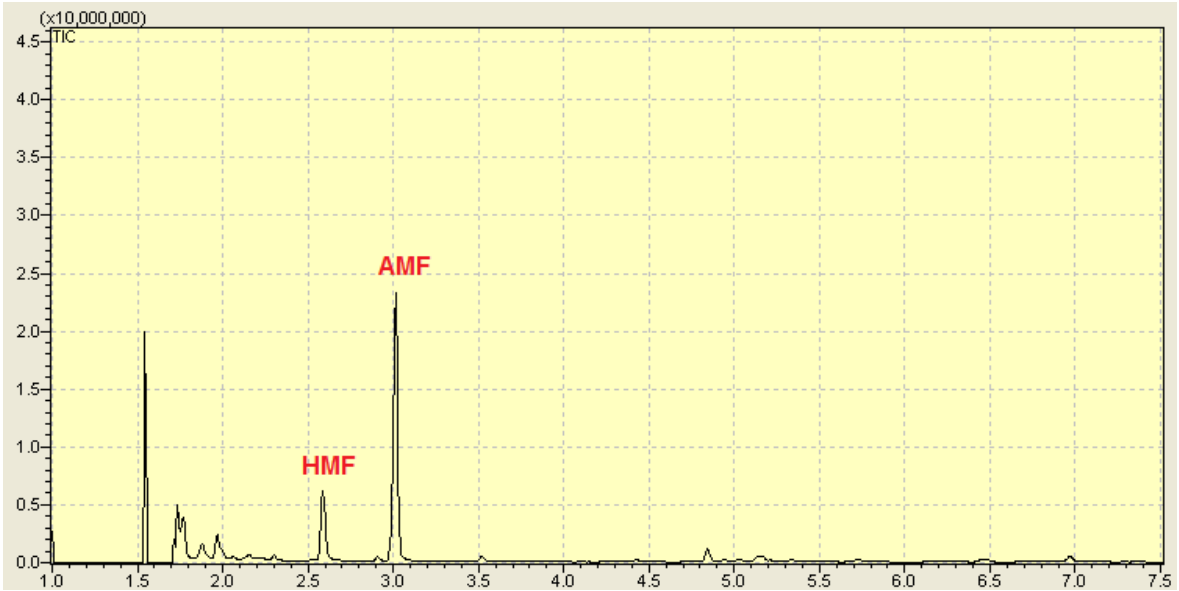
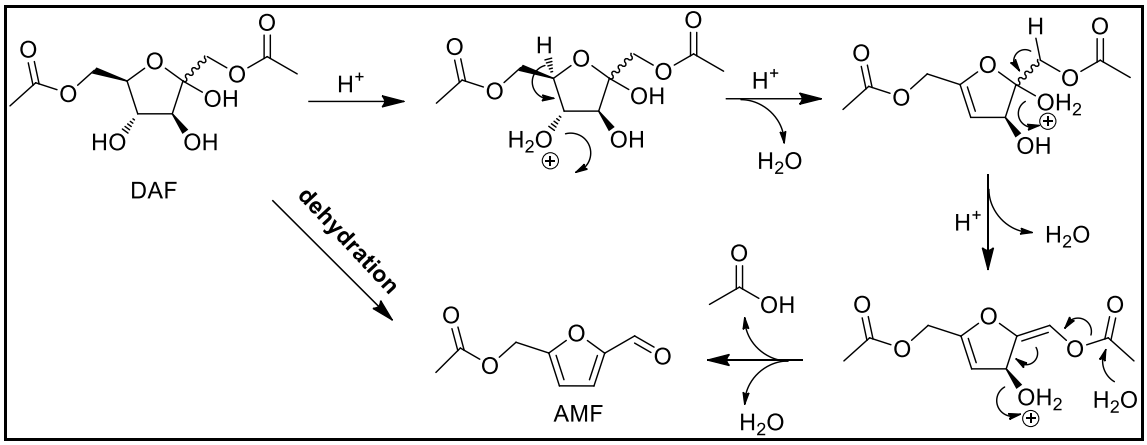
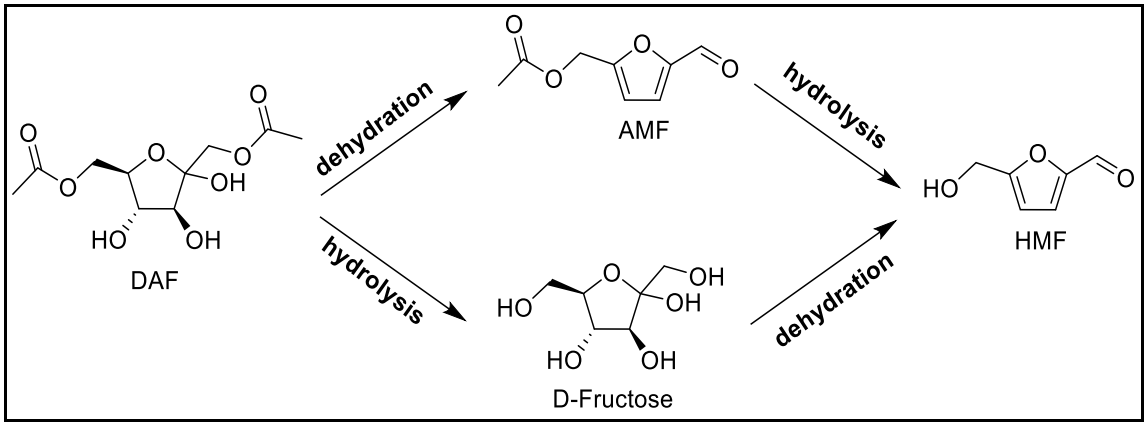



**Figure S8.** GC-MS analysis of AMF and HMF




**Scheme S1.** Plausible mechanism for the dehydration of DAF to AMF under acidic conditions




**Scheme S2.** Suggested pathway for the formation of AMF and HMF in the dehydration of DAF