

Supporting Information for

Multiple Brønsted acidic sites of nitrogen-rich dicyandiamide immobilized on silica gel as a heterogeneous catalyst for efficient conversion of fructose into 5-hydroxymethylfurfural

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Section 1: Proposed mechanism

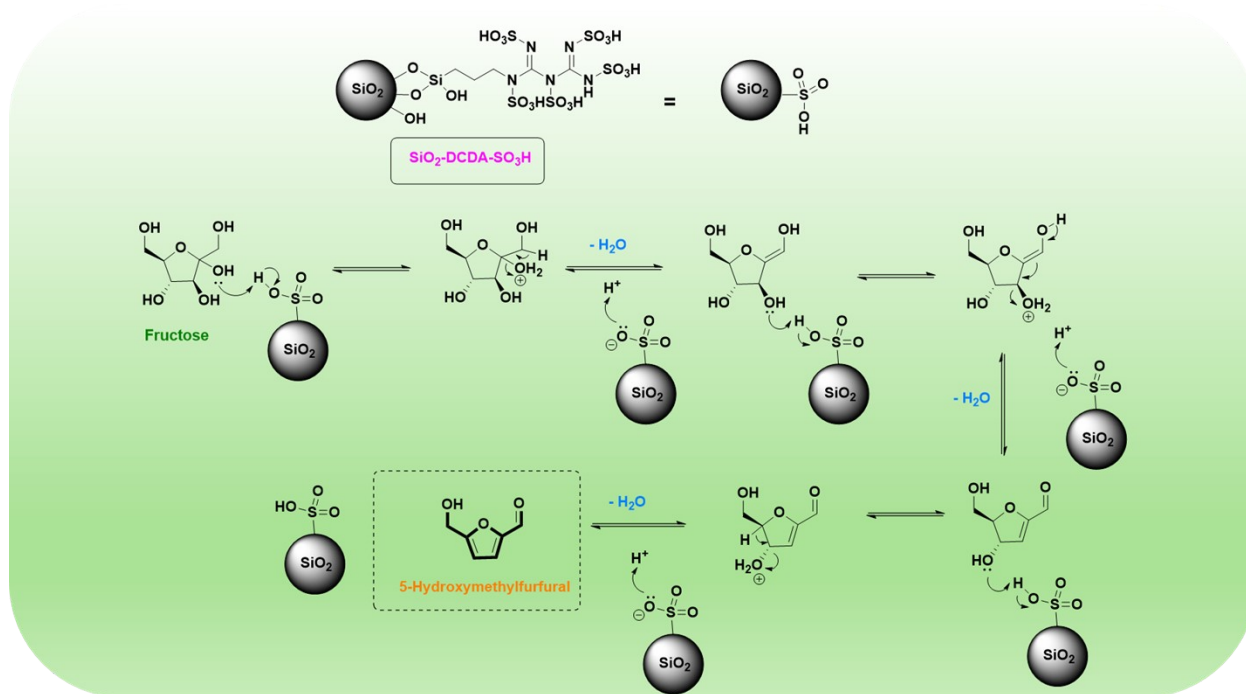
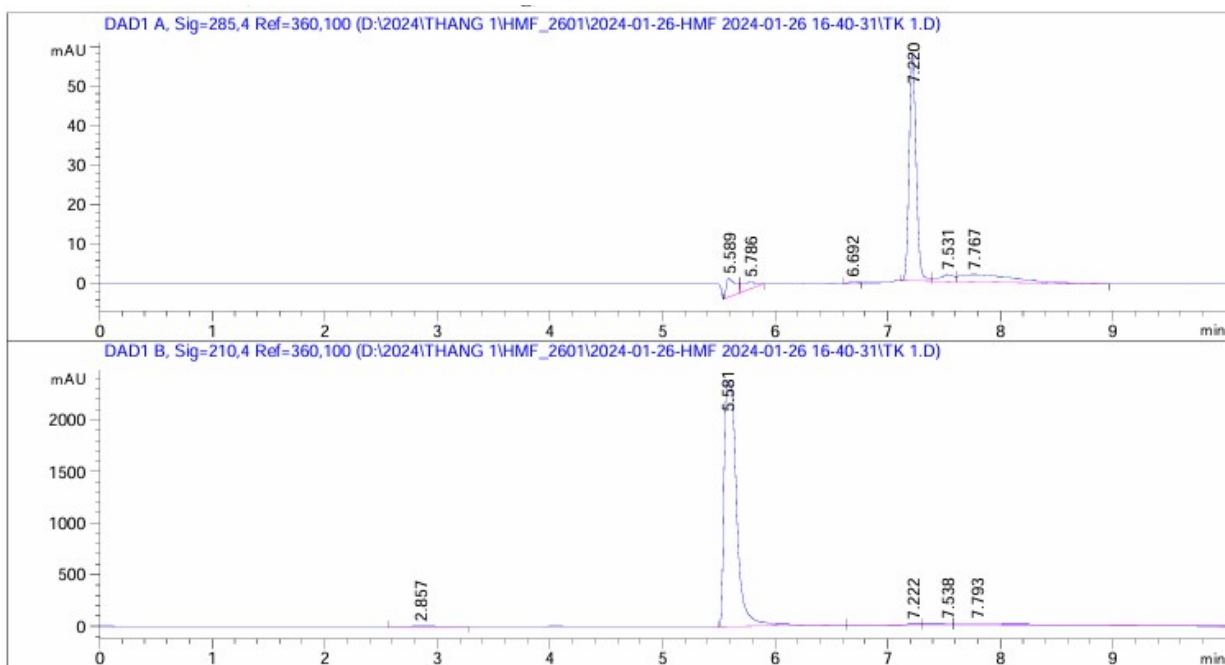


Figure S1. Reaction route for the dehydration of fructose to HMF over $\text{SiO}_2\text{-DCDA-SO}_3\text{H}$.

Section 2: HPLC chromatography



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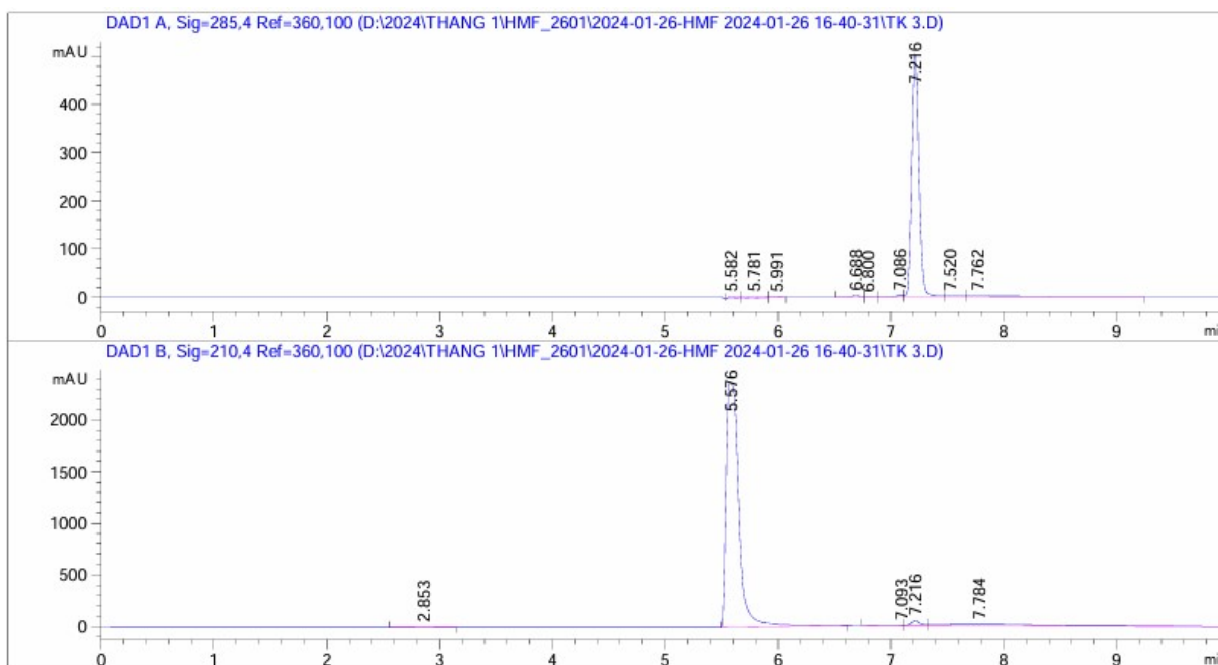
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RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.220	BV +	245.71069	3.12644e-3	7.68199e-1		HMF
7.767	VB +	61.69586	8.41798e-2	5.19354		DFF
8.200	-	-	-	-		Furfural

Totals : 5.96174

Figure S2.1. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 100 °C, 10 min.



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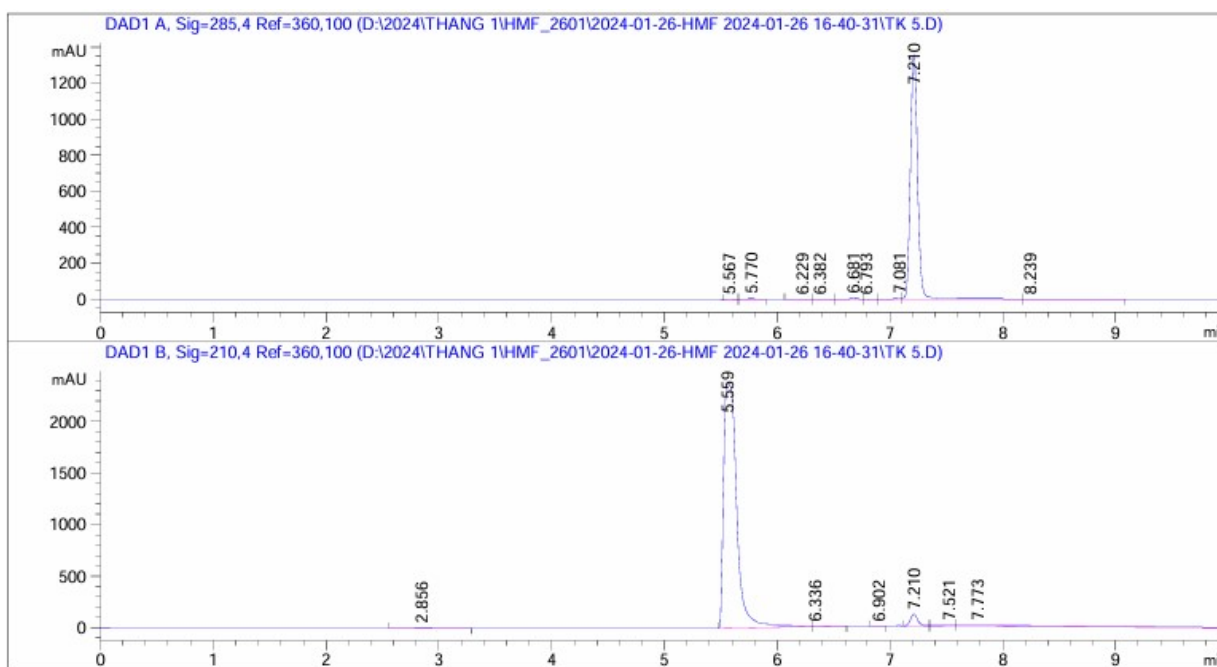
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.216	VV +	2198.37524	9.65677e-3	21.22921		HMF
7.762	VB +	102.08332	5.61930e-2	5.73637		DFF
8.200		-	-	-		Furfural

Totals : 26.96558

Figure S2.2. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 100 °C, 30 min.



External Standard Report

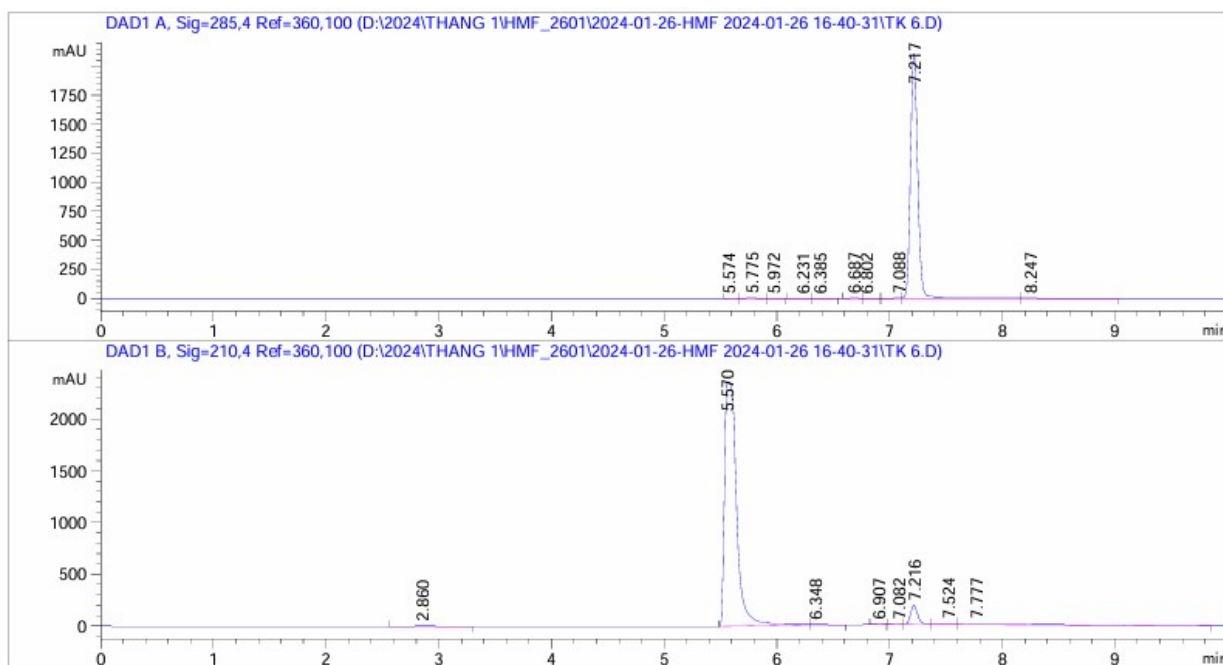
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.210	VV +	6076.75830	1.01812e-2	61.86888		HMF
7.600		-	-	-		DFF
8.239	VB +	26.36559	0.00000	0.00000		Furfural

Totals : 61.86888

Figure S2.3. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 100 °C, 60 min.



External Standard Report

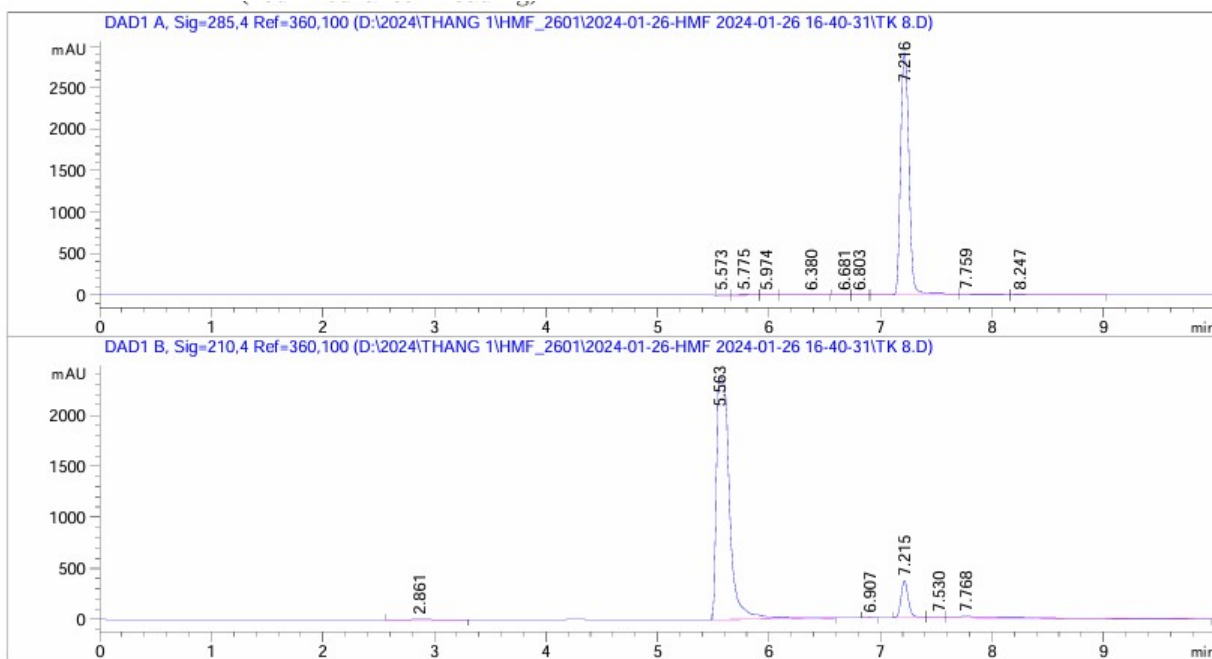
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.217	VV +	9541.88867	1.02892e-2	98.17827		HMF
7.600		-	-	-		DFF
8.247	VB +	34.67983	0.00000	0.00000		Furfural

Totals : 98.17827

Figure S2.4. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 100 °C, 120 min.



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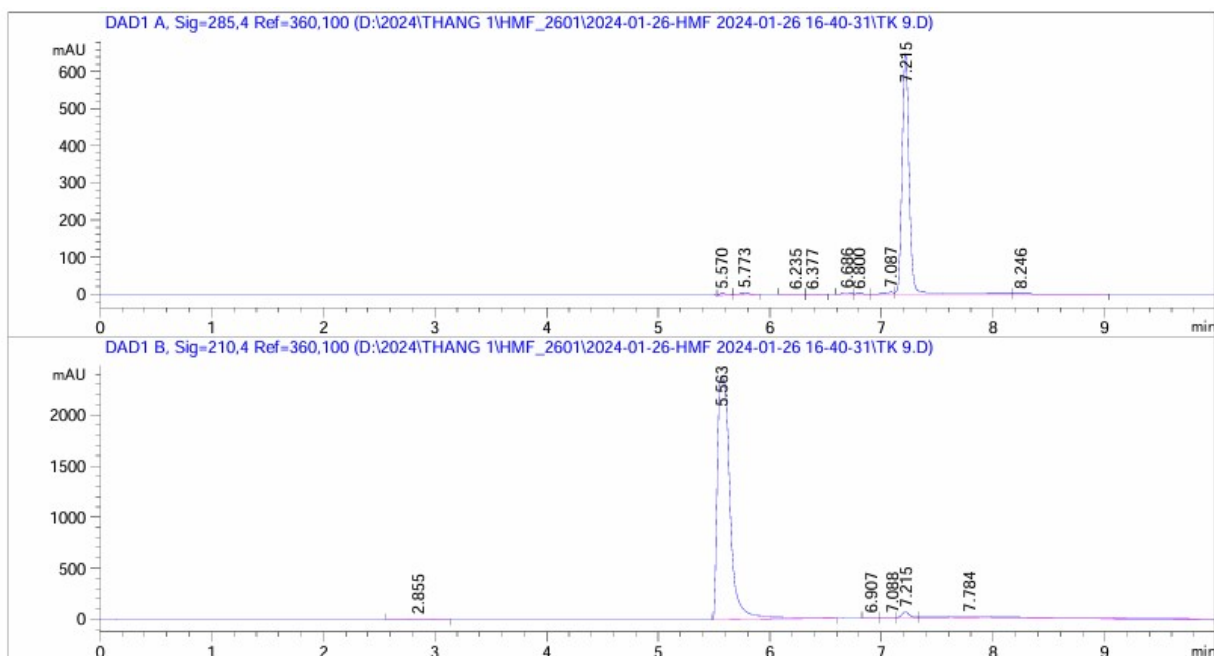
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

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7.216	BV +	1.50242e4	1.03583e-2	155.62513		HMF
7.759	VV +	166.46213	3.96586e-2	6.60165		DFF
8.247	VB +	57.89862	0.00000	0.00000		Furfural

Totals : 162.22678

Figure S2.5. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 100 °C, 300 min.



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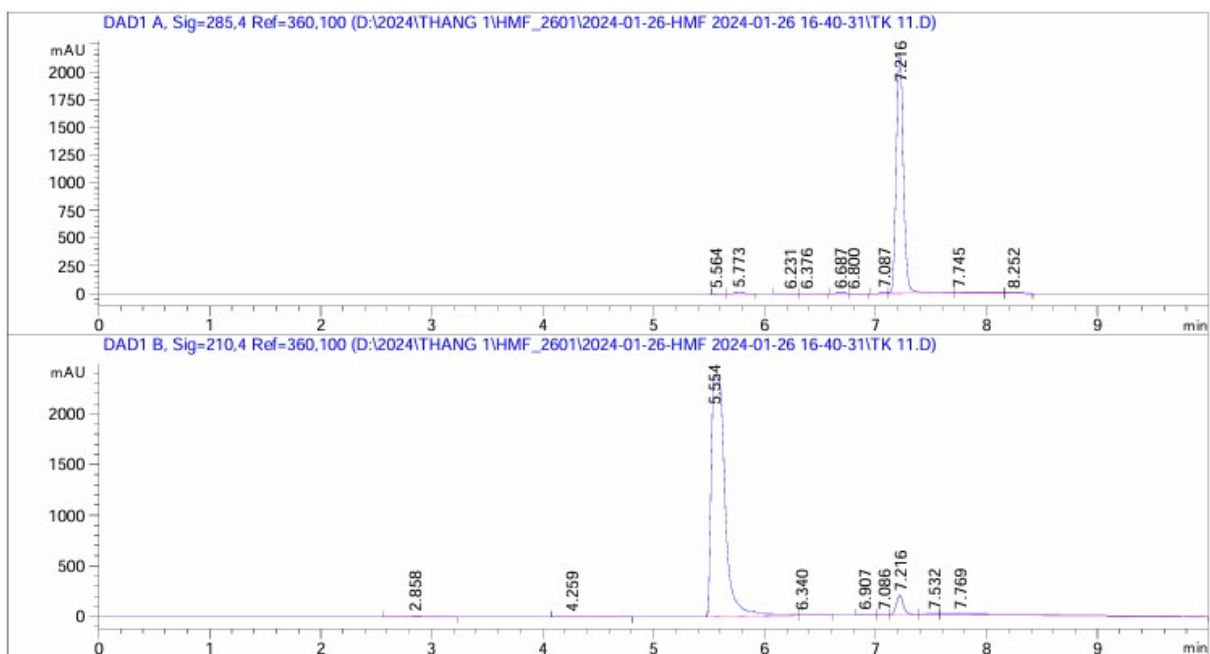
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.215	VV +	2925.10693	9.86093e-3	28.84427		HMF
7.600		-	-	-		DFF
8.246	VB +	18.36296	0.00000	0.00000		Furfural

Totals : 28.84427

Figure S2.6. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 120 °C, 10 min.



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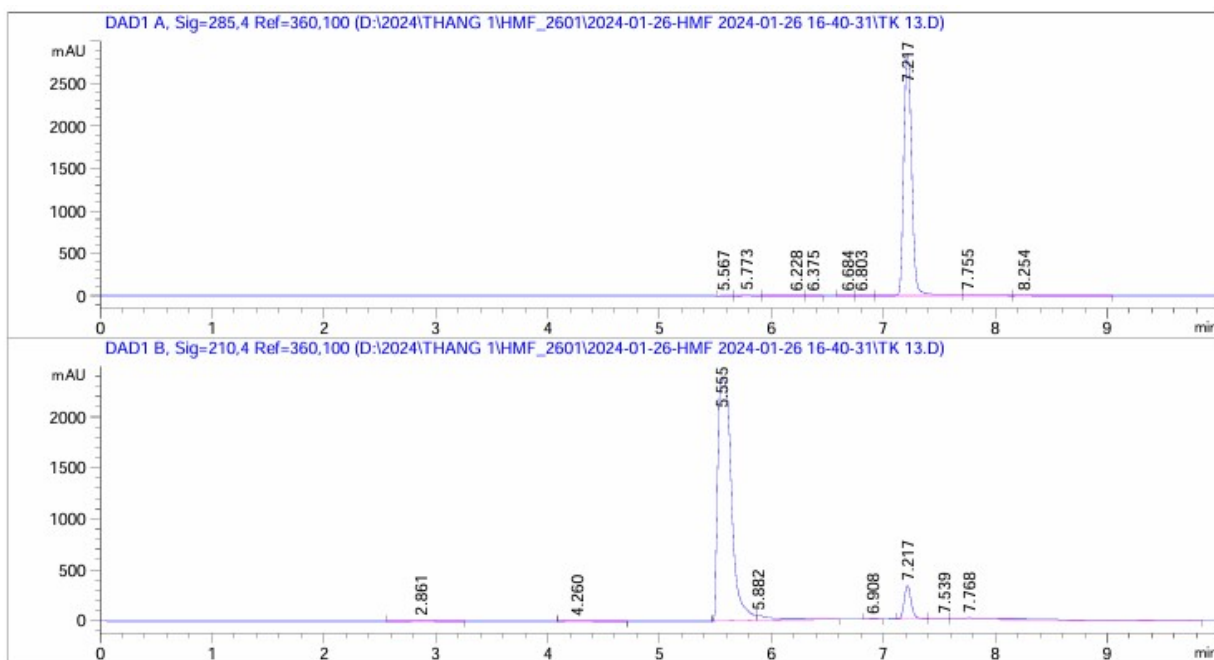
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.216	VV +	9737.74316	1.02930e-2	100.23054		HMF
7.745	VB +	55.86256	9.15666e-2	5.11514		DFF
8.252	BB +	10.88599	0.00000	0.00000		Furfural

Totals : 105.34568

Figure S2.7. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 120 °C, 30 min.



External Standard Report

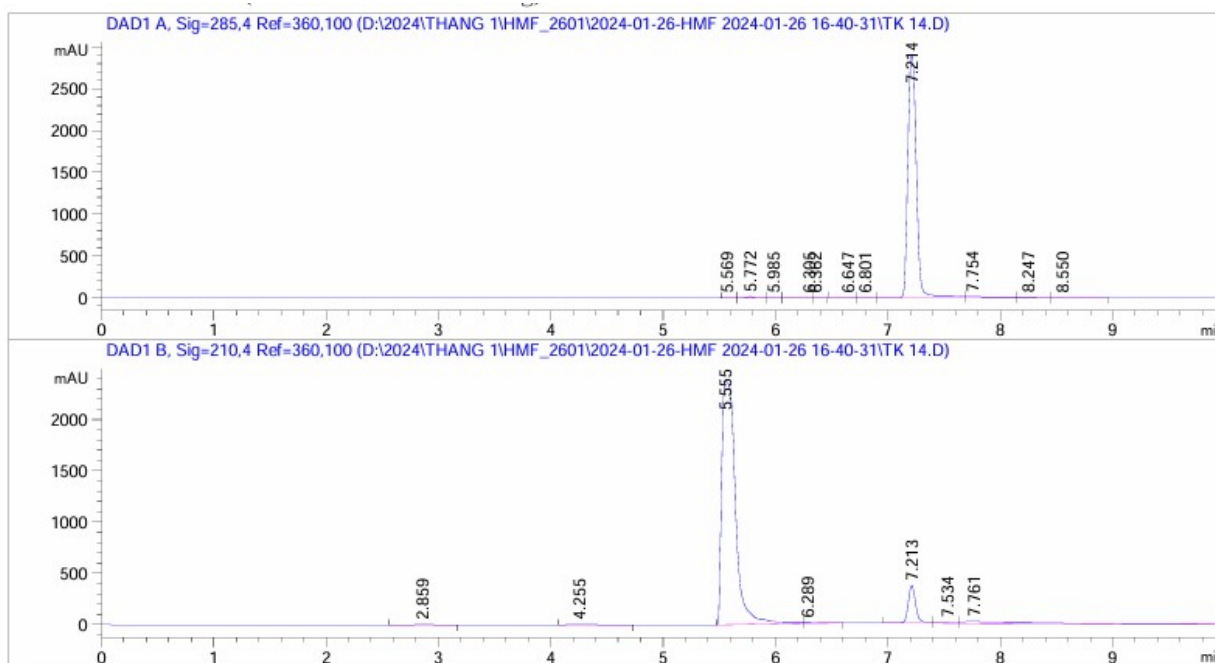
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.217	BV +	1.43570e4	1.03527e-2	148.63300		HMF
7.755	VV +	150.95862	4.23512e-2	6.39328		DFF
8.254	VB +	68.21301	0.00000	0.00000		Furfural

Totals : 155.02628

Figure S2.8. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 120 °C, 60 min.



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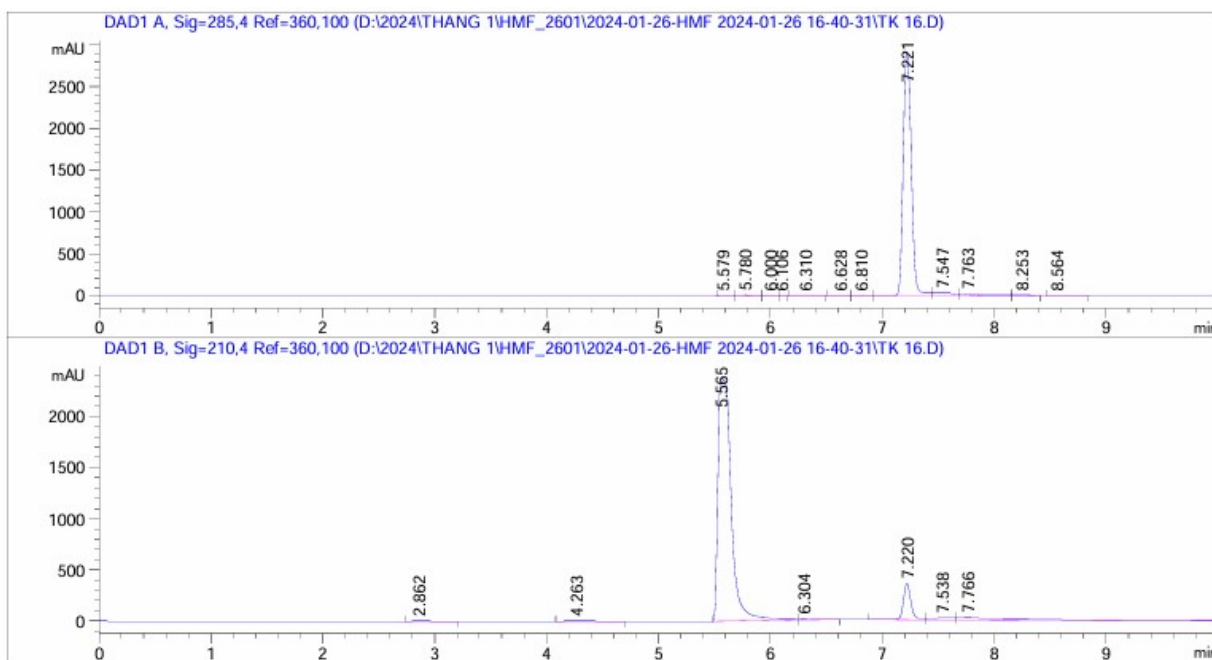
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.214	BV +	1.51195e4	1.03590e-2	156.62353		HMF
7.754	VV +	183.87300	3.71760e-2	6.83566		DFP
8.247	VB +	48.12315	0.00000	0.00000		Furfural

Totals : 163.45920

Figure S2.9. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 120 °C, 120 min.



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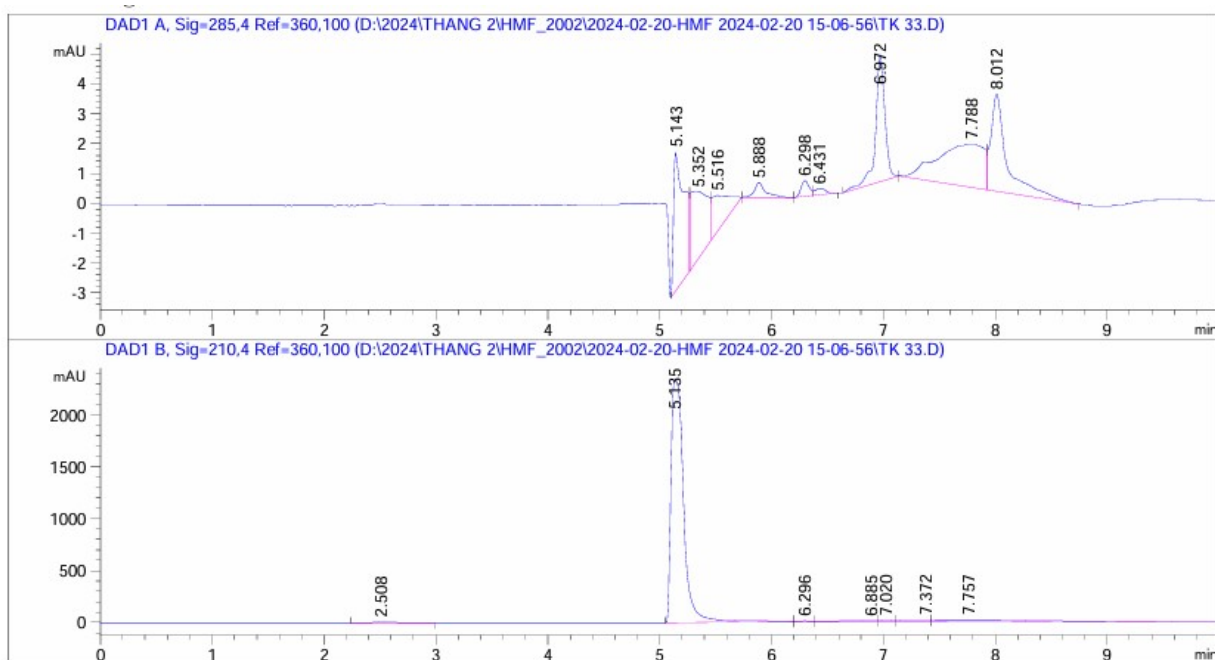
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.221	BV +	1.46053e4	1.03548e-2	151.23578		HMF
7.547	VV +	366.88983	2.53359e-2	9.29550		DFF
8.253	BB +	25.70772	0.00000	0.00000		Furfural

Totals : 160.53128

Figure S2.10. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 120 °C, 300 min.



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RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.972	BB +	24.73978	0.00000	0.00000		HMF
7.200		-	-	-		DFF
7.788	BV +	40.80038	0.00000	0.00000		Furfural

Totals : 0.00000

Figure S2.11. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 140 °C, 10 min.

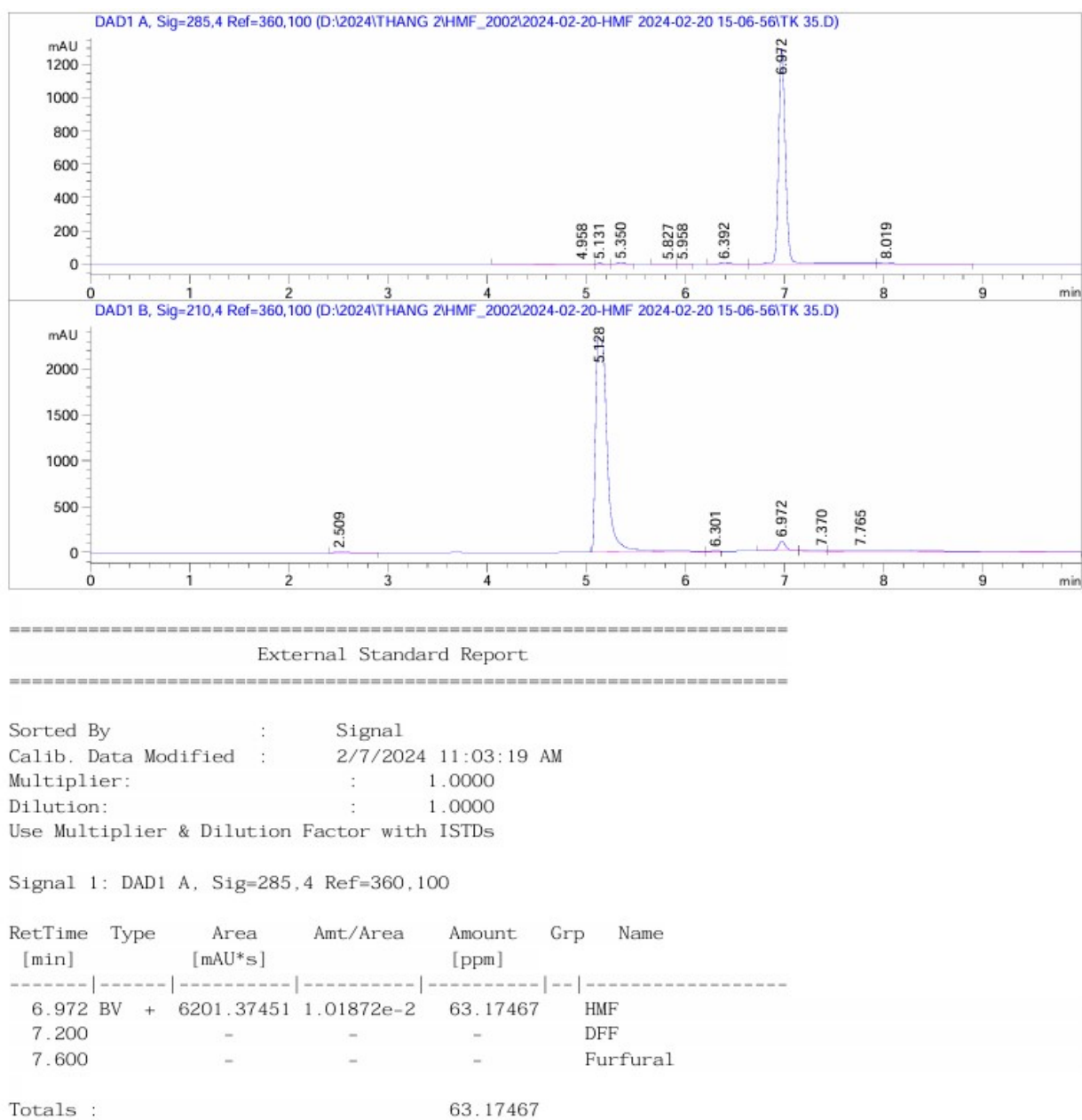
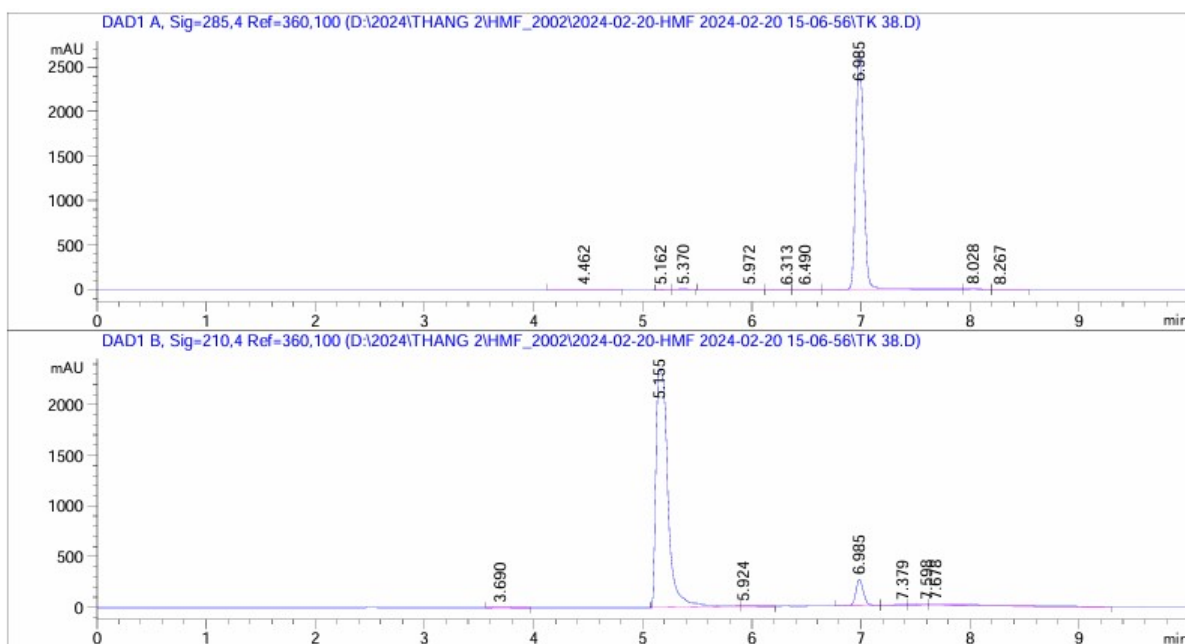


Figure S2.12. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 140 °C, 30 min.



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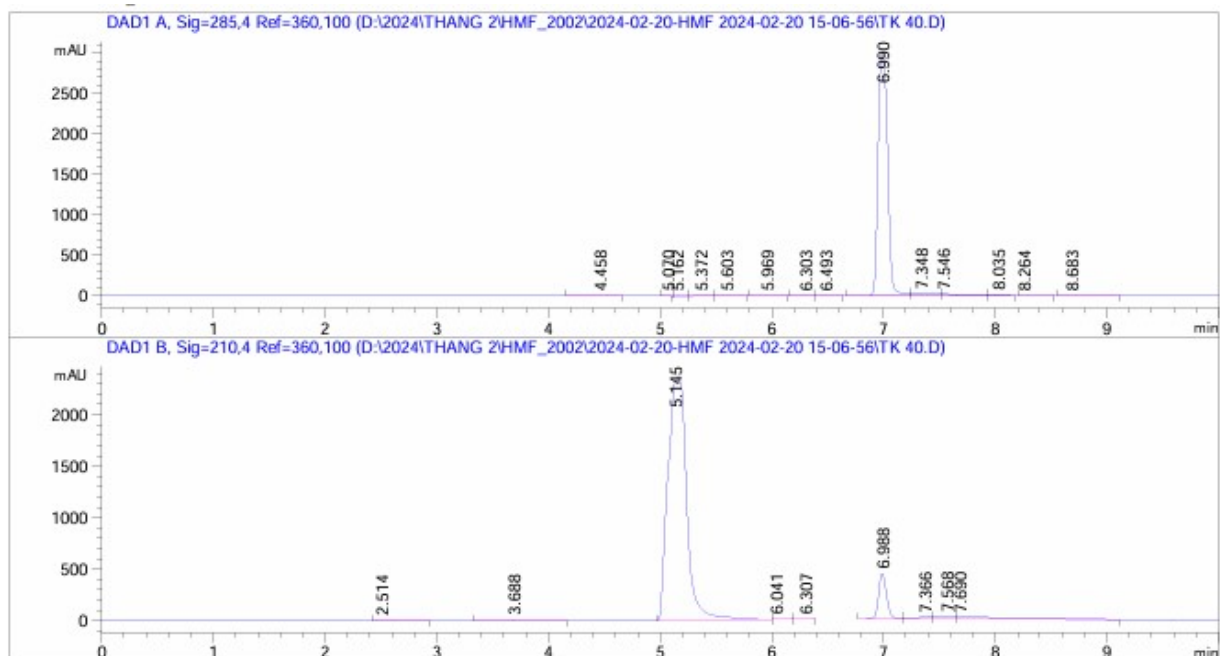
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.985	BV +	1.35264e4	1.03450e-2	139.92972		HMF
7.200		-	-	-		DFF
7.600		-	-	-		Furfural

Totals : 139.92972

Figure S2.13. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 140 °C, 120 min.



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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.990	BV +	1.75307e4	1.03755e-2	181.88901		HMF
7.348	VV +	345.85123	2.60596e-2	9.01273		DFP
7.546	VB +	128.94870	0.00000	0.00000		Furfural

Totals : 190.90174

Figure S2.14. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 140 °C, 300 min.

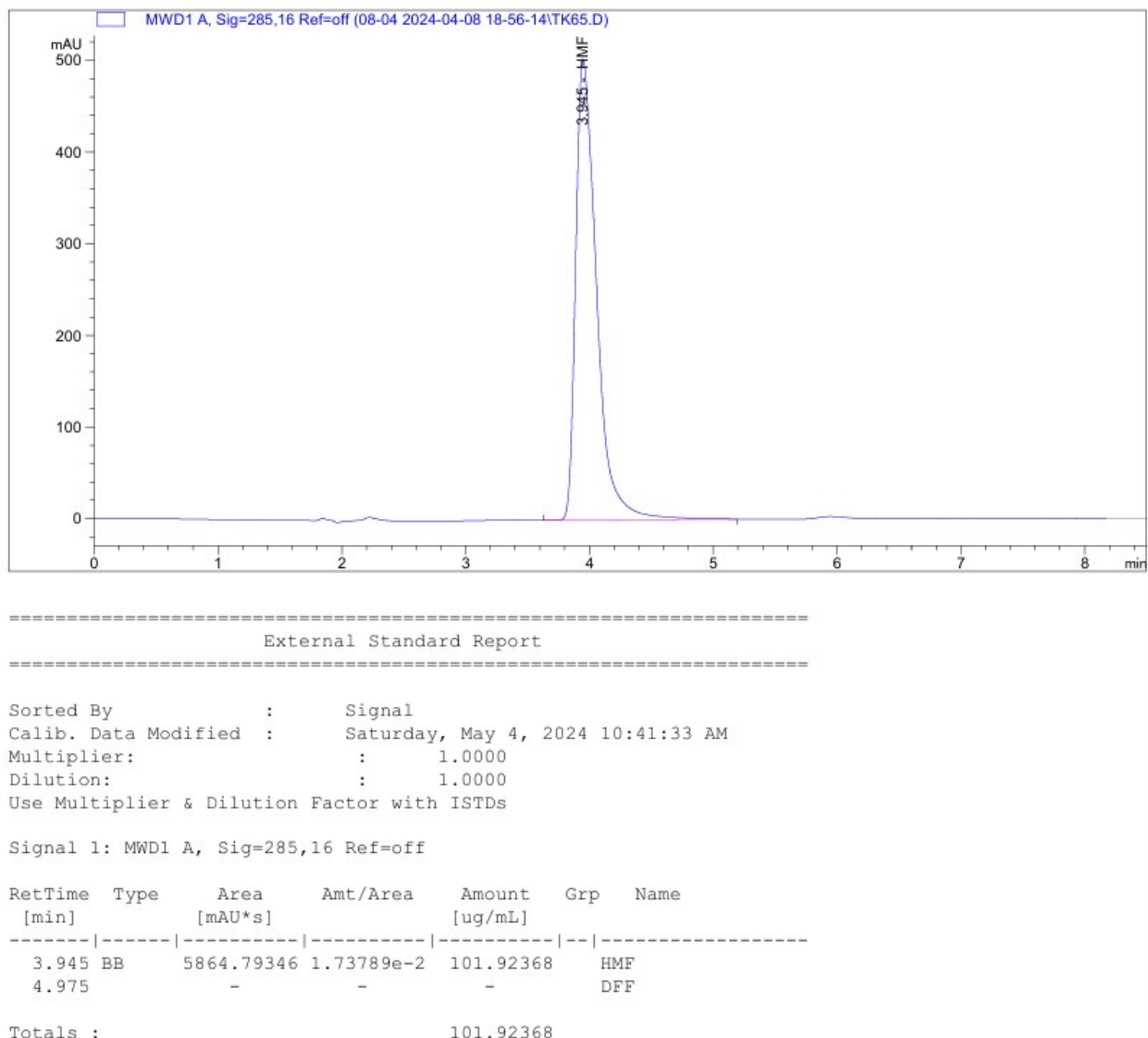


Figure S2.15. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 10 min.

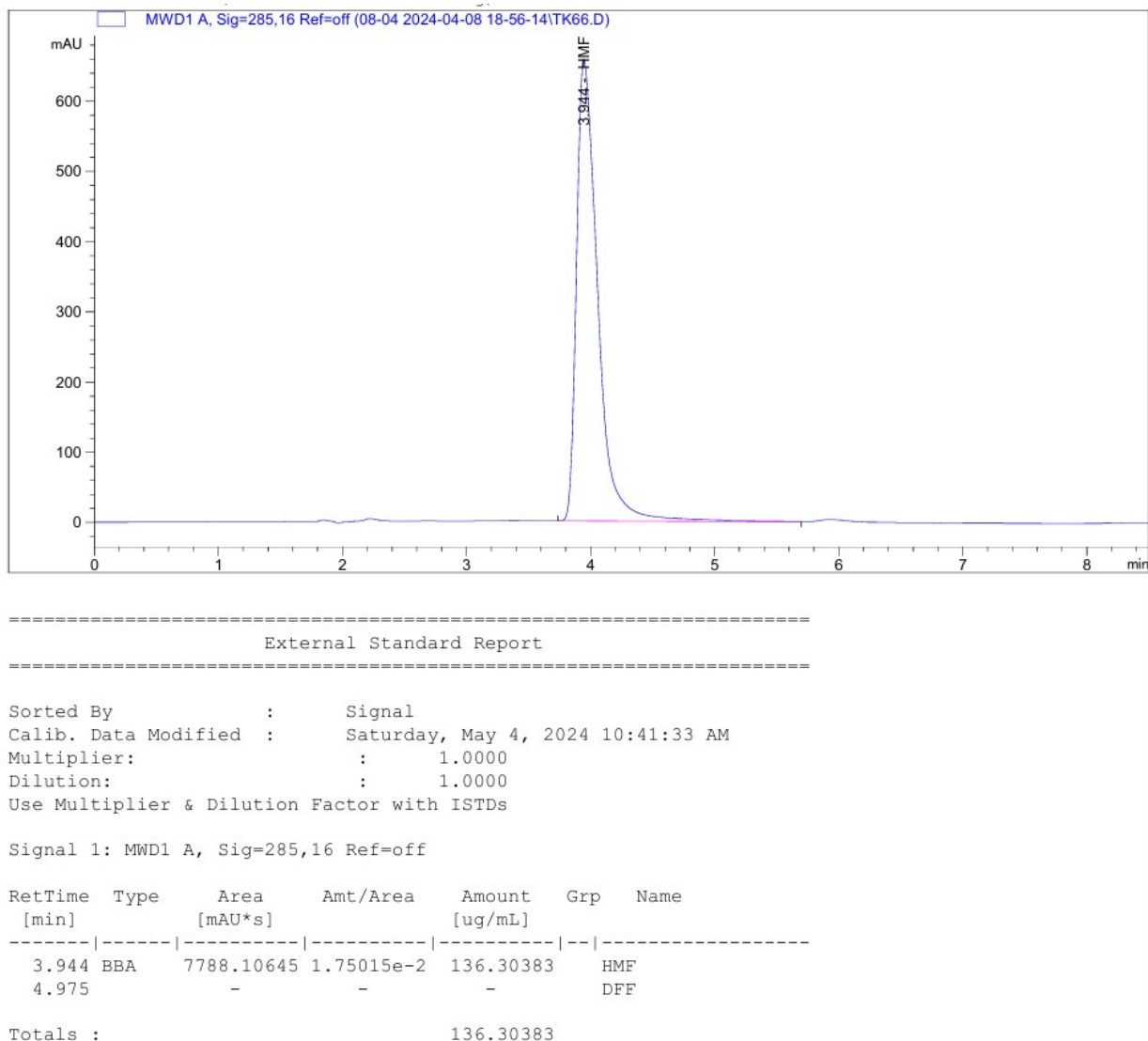
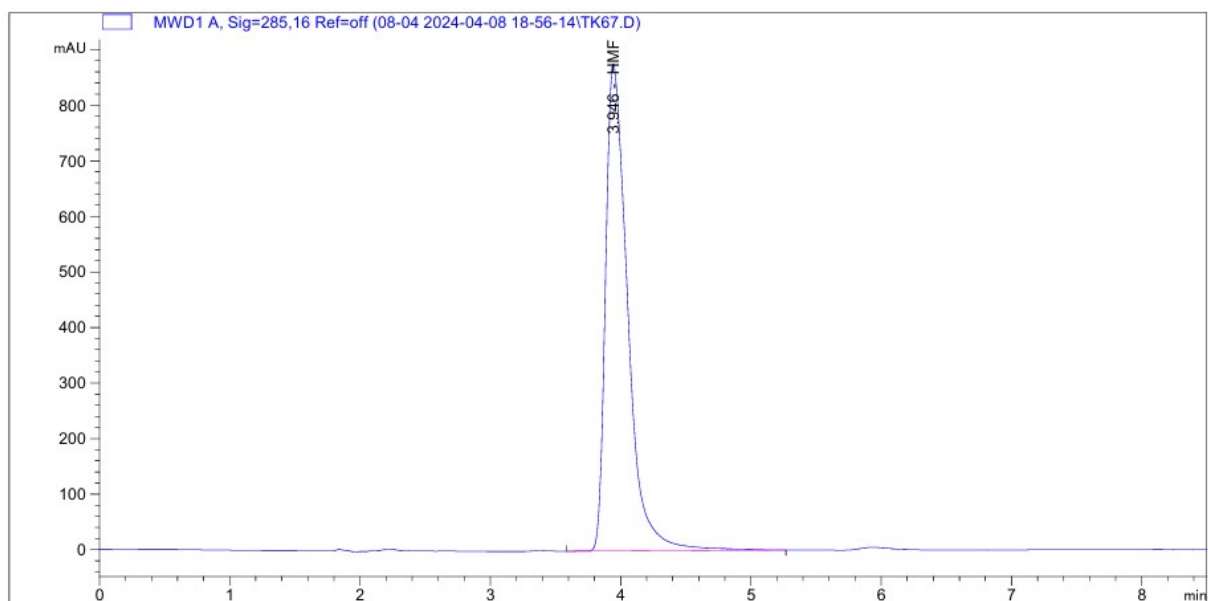


Figure S2.16. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 20 min.



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3.946	BB	1.03341e4	1.75937e-2	181.81417		HMF
4.875		-	-	-		DFF
Totals :				181.81417		

Figure S2.17. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 30 min.

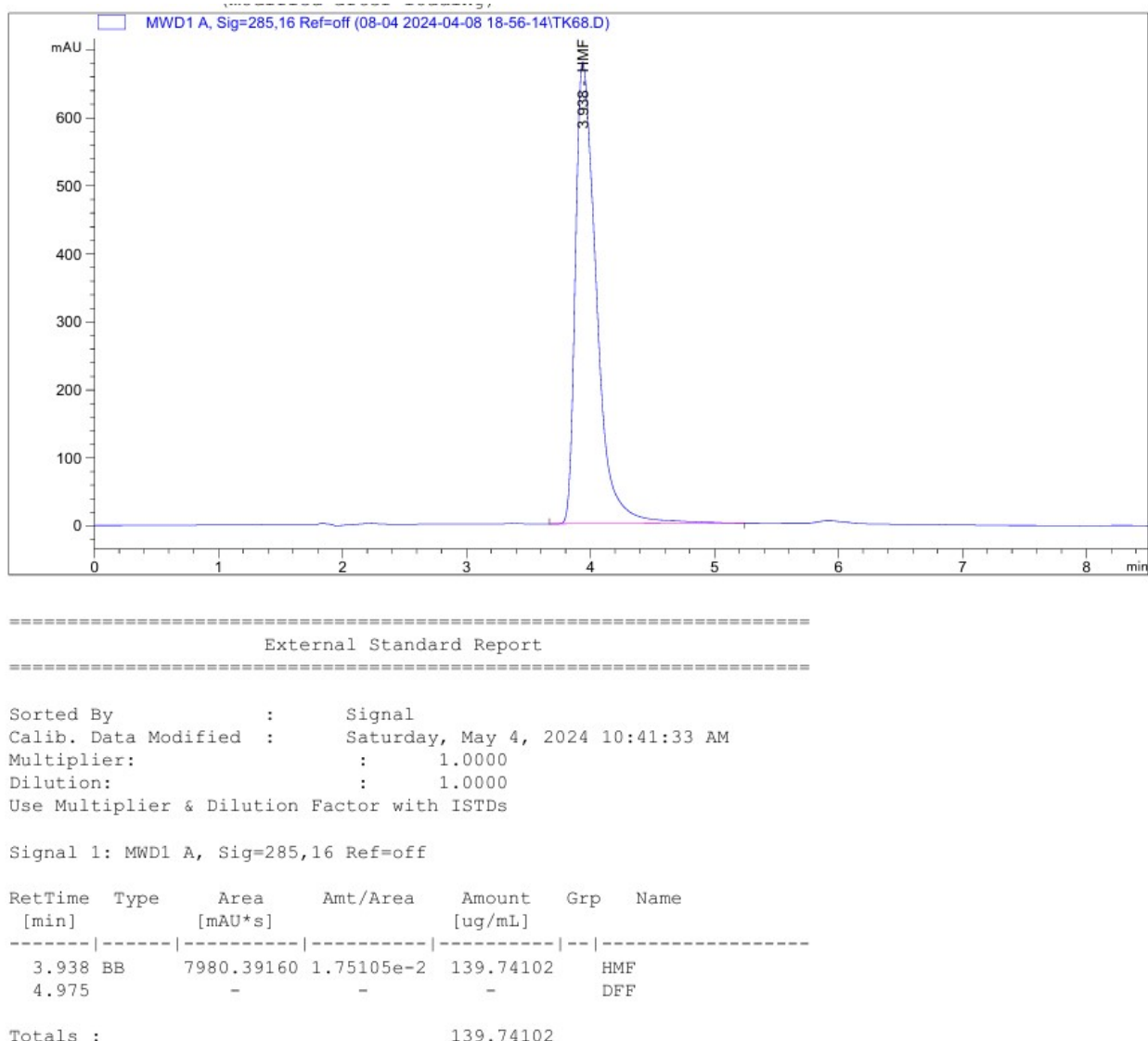


Figure S2.18. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 40 min.

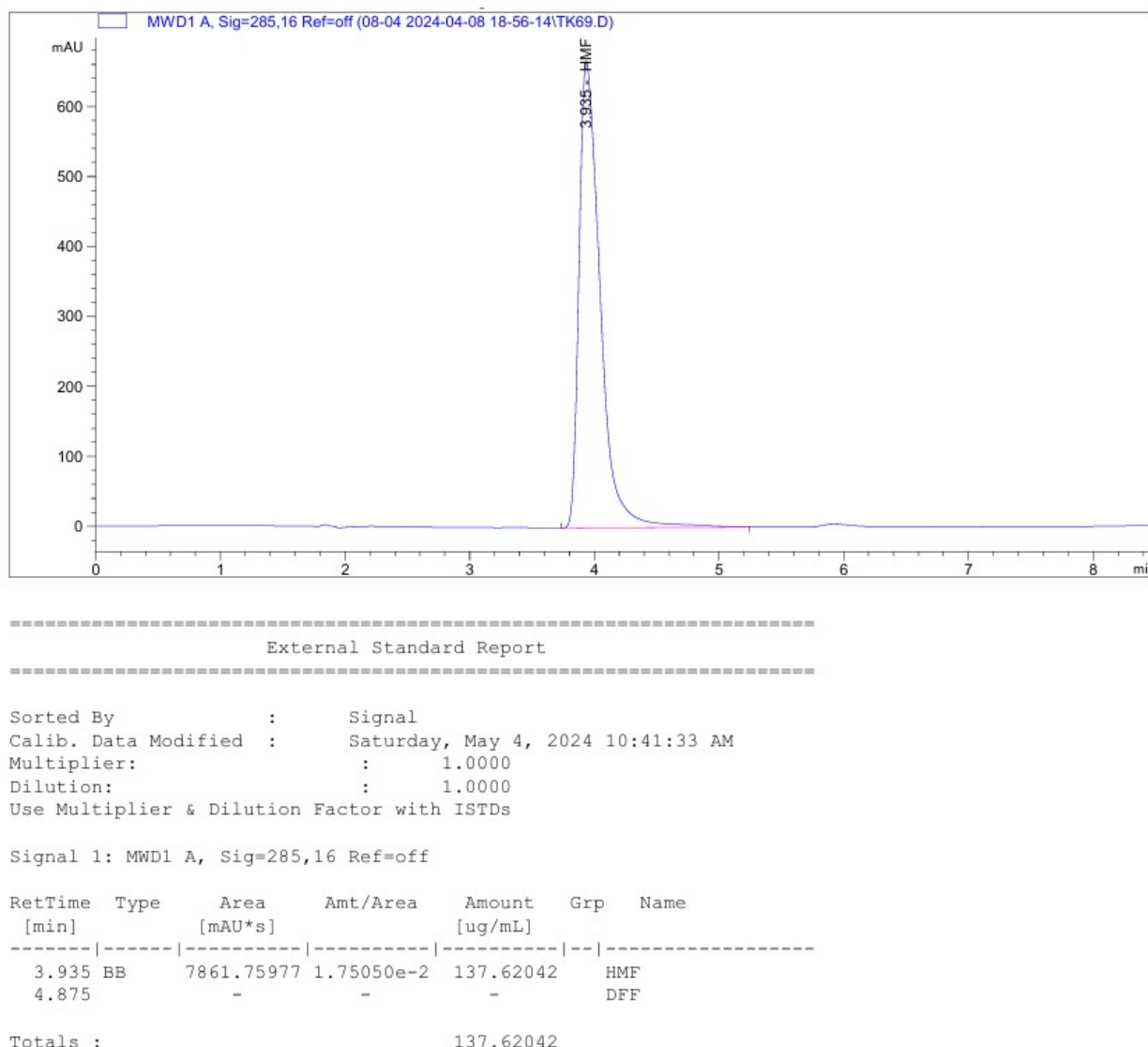
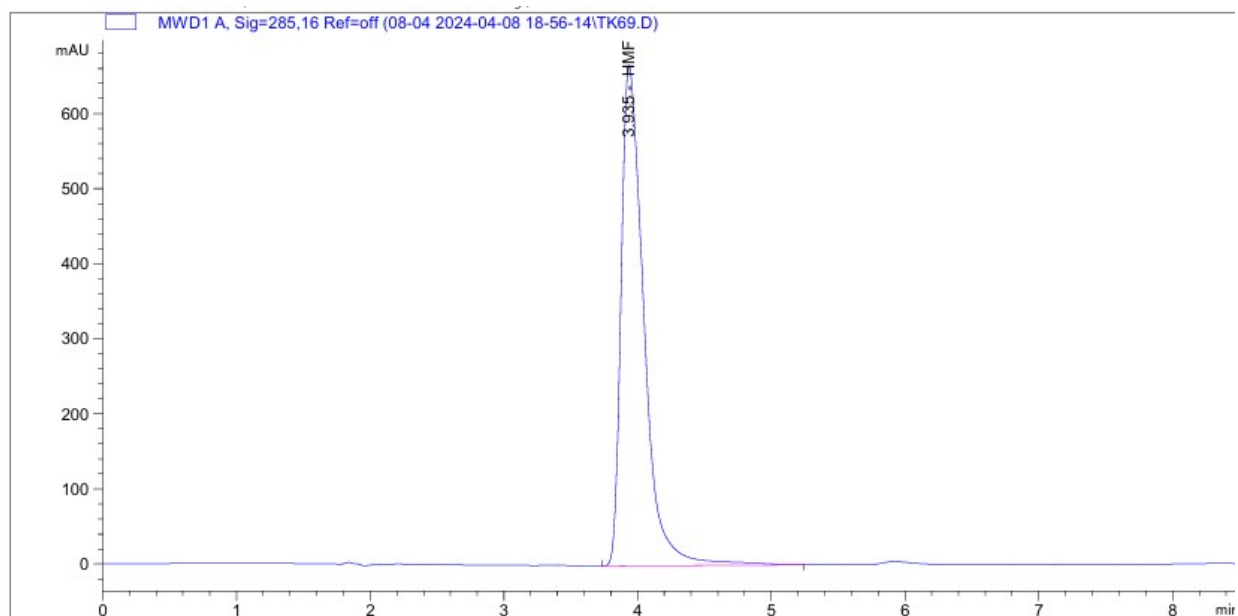


Figure S2.19. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 50 min.



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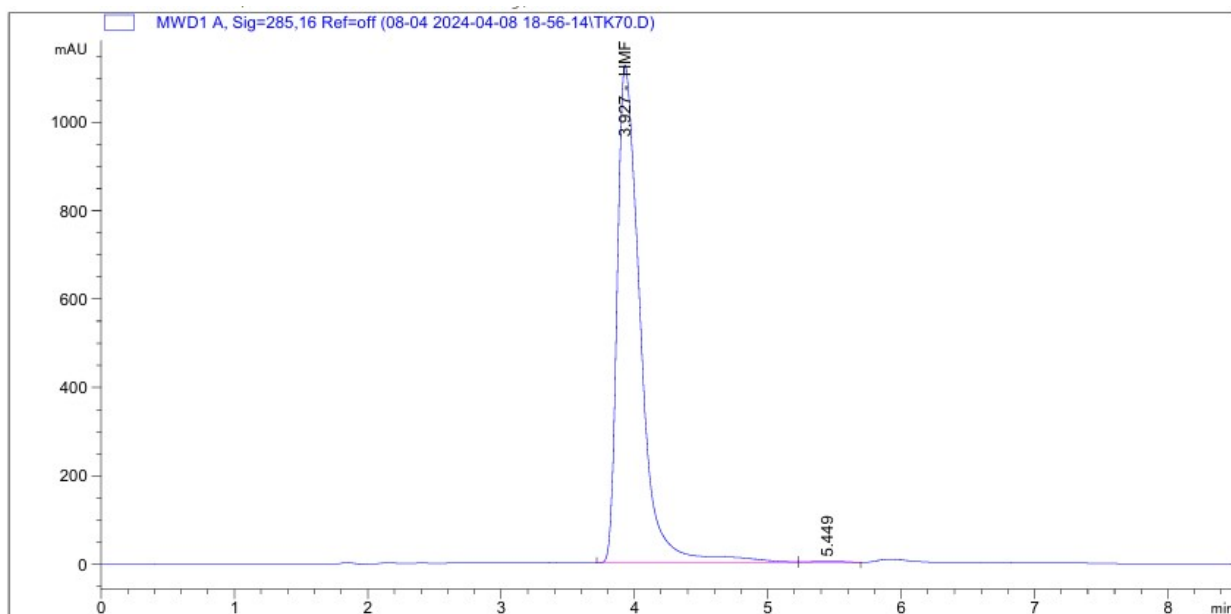
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RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ug/mL]	Grp	Name
3.935	BB	7861.75977	1.75050e-2	137.62042		HMF
4.875		-	-	-		DFF

Totals : 137.62042

Figure S2.20. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 60 min.



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[ min]                [mAU*s]                [ug/mL]
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3.927 BV    1.35589e4  1.76607e-2  239.45982  HMF
4.975      -          -          -          DFF

Totals :                               239.45982
  
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Figure S2.21. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.

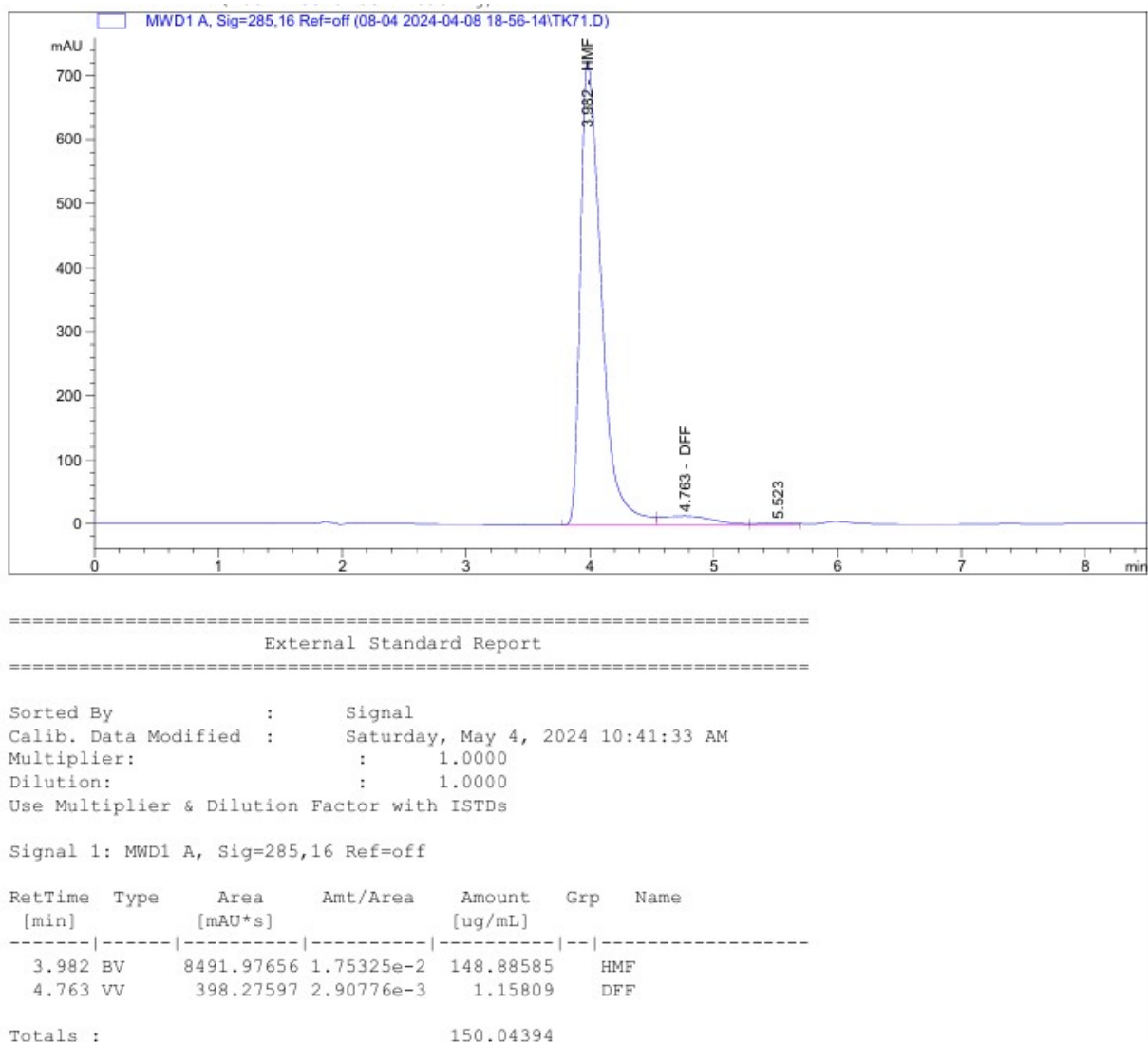
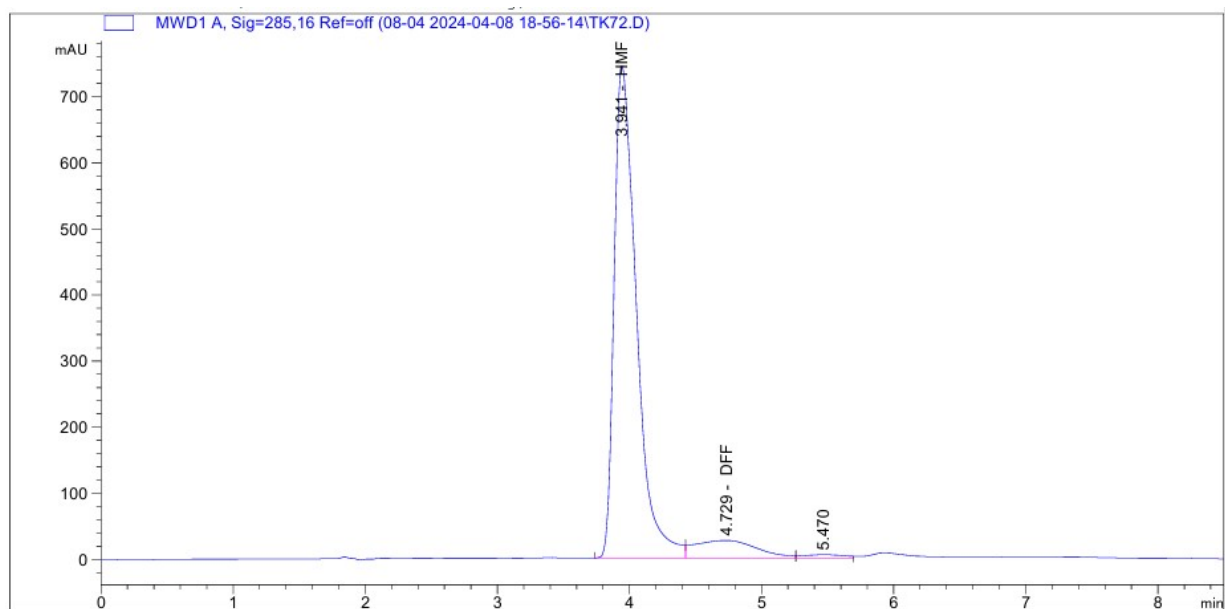


Figure S2.22. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 180 min.



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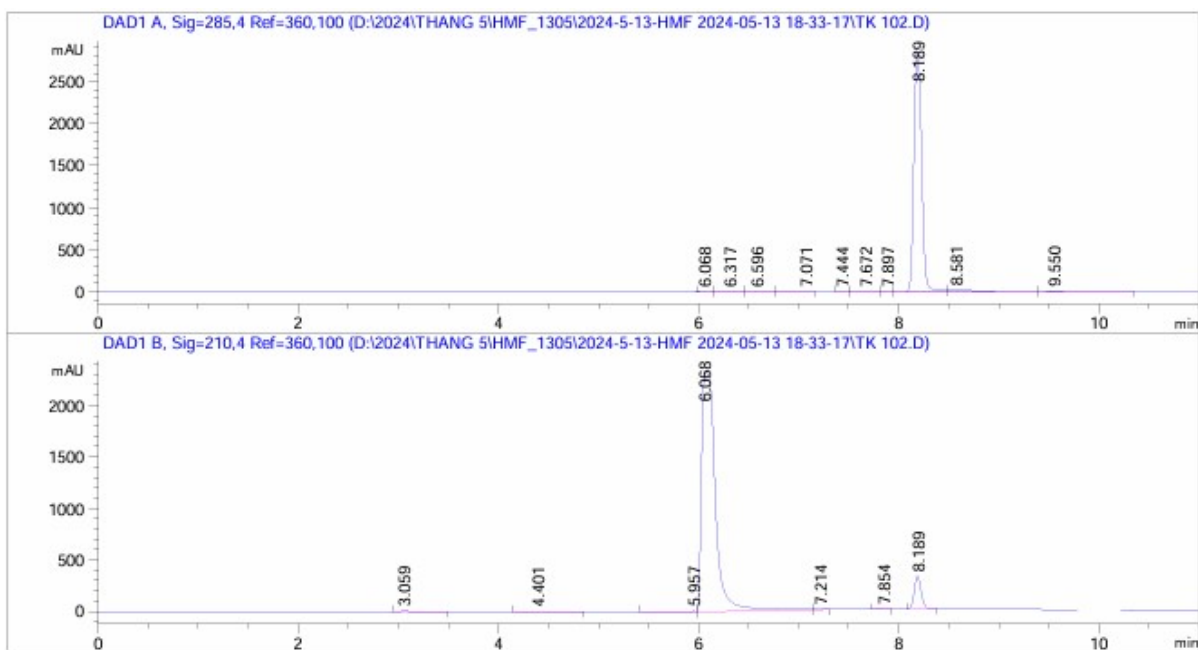
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Signal 1: MWD1 A, Sig=285,16 Ref=off

RetTime  Type      Area      Amt/Area    Amount    Grp   Name
[min]    [mAU*s]   [ug/mL]
-----|-----|-----|-----|-----|-----|-----
3.941    BV      8698.89258  1.75407e-2  152.58458  HMF
4.729    VV      849.67969  1.08331e-2   9.20463   DFF

Totals :                               161.78920
  
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Figure S2.23. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 300 min.



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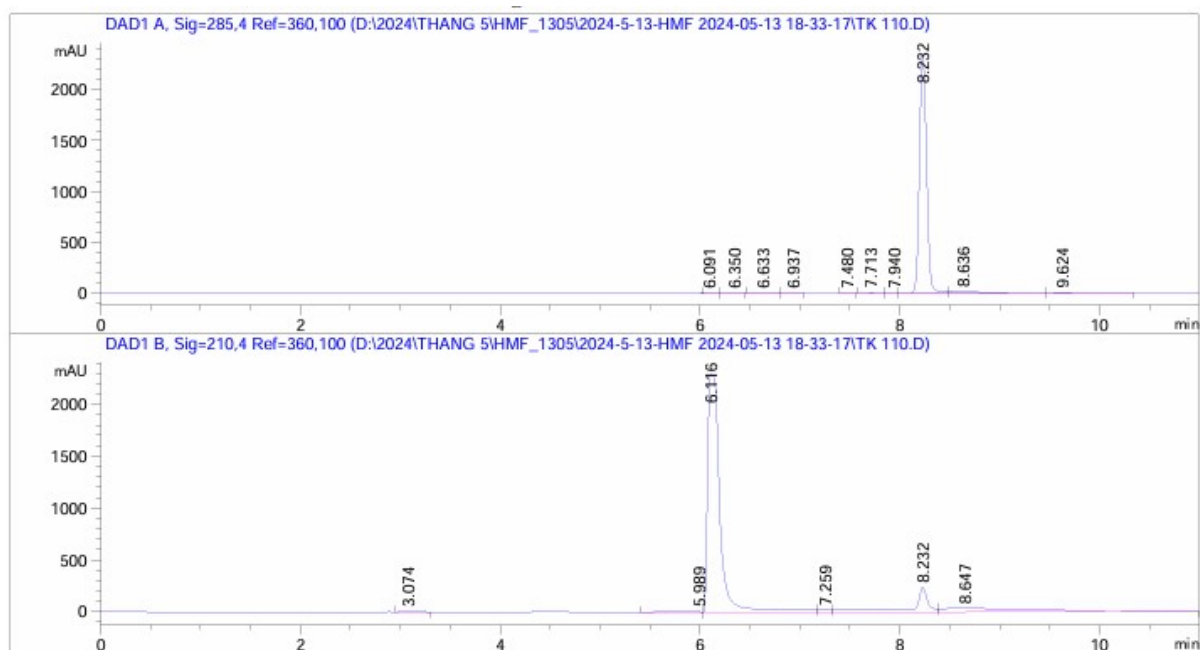
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
8.189	VV +	1.52549e4	7.84312e-3	119.64590		HMF
8.581	VV +	338.04294	9.30174e-3	3.14439		DFF
9.000	-	-	-	-		Furfural

Totals : 122.79029

Figure S2.24. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (5 mg), DMSO (3 mL), 160 °C, 120 min.



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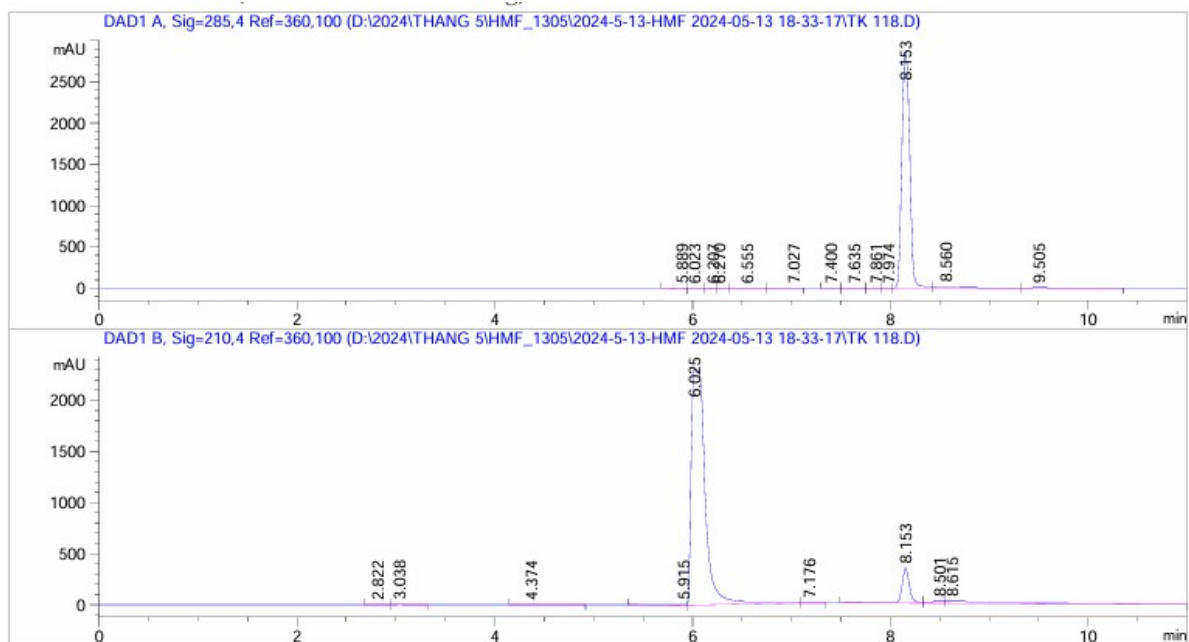
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RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
8.232	VV +	1.15386e4	7.71956e-3	89.07334		HMF
8.636	VV +	319.67722	9.32189e-3	2.97999		DFF
9.000	-	-	-	-		Furfural

Totals : 92.05334

Figure S2.25. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (10 mg), DMSO (3 mL), 160 °C, 120 min.



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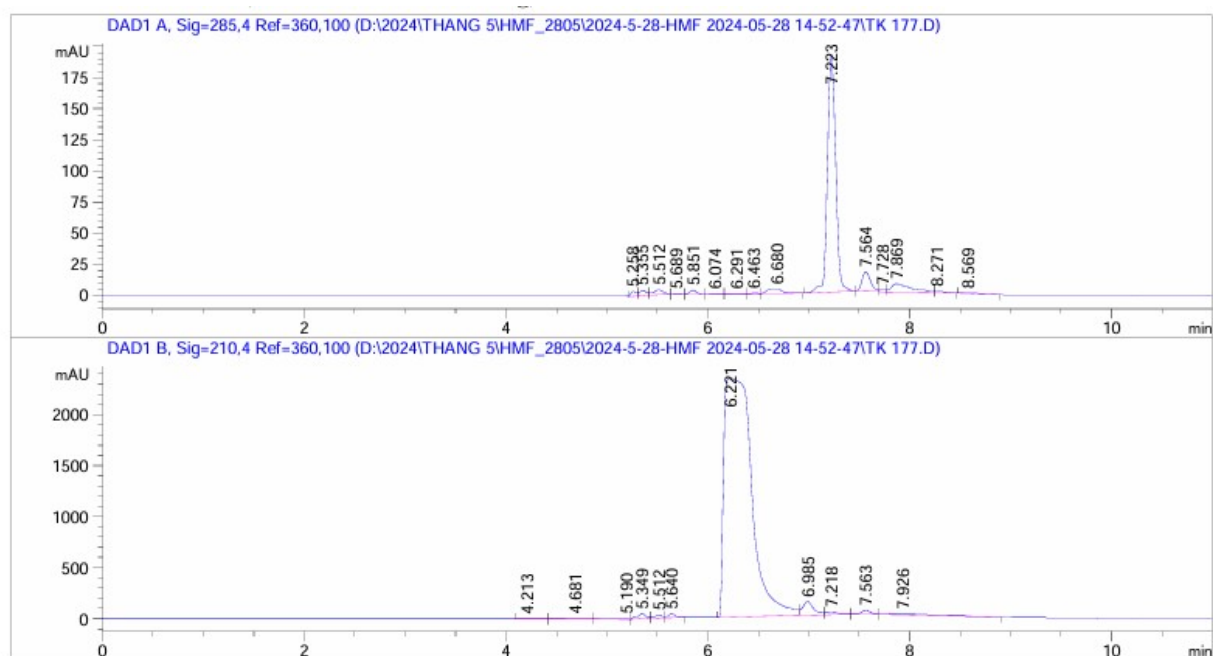
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
8.153	VV +	1.56888e4	7.85373e-3	123.21595		HMF
8.560	VV +	440.20276	9.22035e-3	4.05882		DFF
9.000	-	-	-	-		Furfural

Totals : 127.27477

Figure S2.26. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (50 mg), DMSO (3 mL), 160 °C, 120 min.



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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.223	BB +	1084.99182	7.80282e-3	8.46599		HMF
7.564	BV +	93.09402	6.71650e-3	6.25266e-1		DFF
7.869	VV +	95.44495	0.00000	0.00000		Furfural

Totals : 9.09126

Figure S2.27. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMF (3 mL), 160 °C, 120 min.



External Standard Report

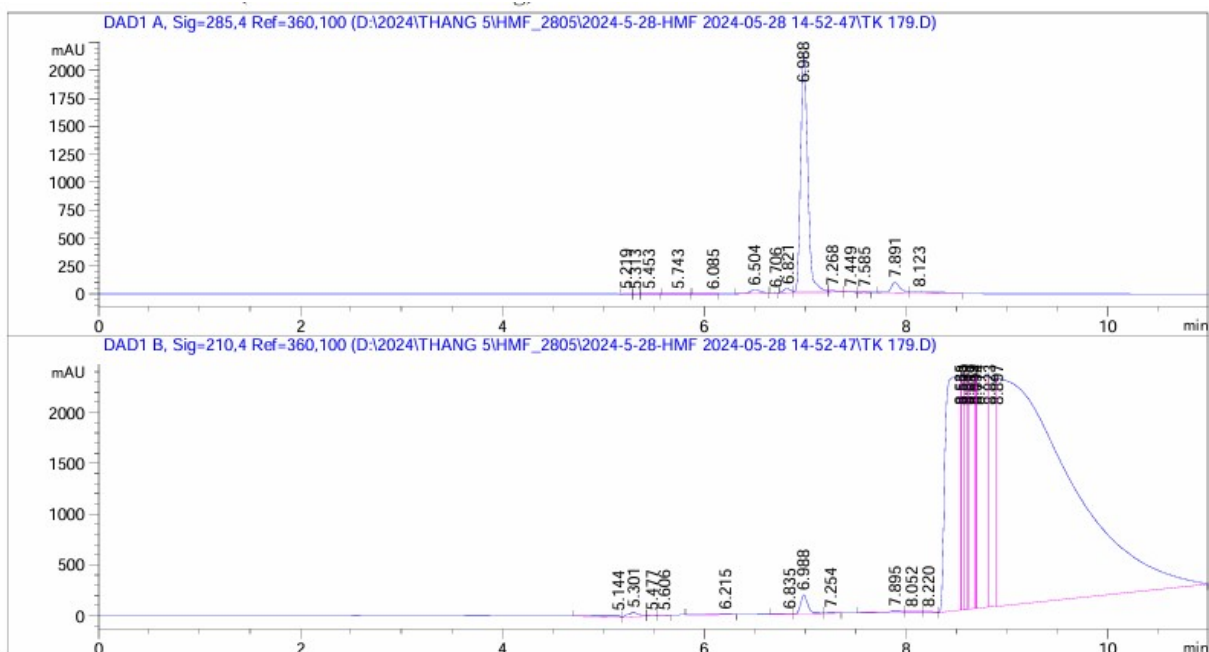
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.228	VV +	1998.65173	7.85391e-3	15.69724		HMF
7.567	VV +	63.23390	5.84704e-3	3.69731e-1		DFF
7.903	VV +	74.16126	0.00000	0.00000		Furfural

Totals : 16.06697

Figure S2.28. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), Sulfolane (3 mL), 160 °C, 120 min.



External Standard Report

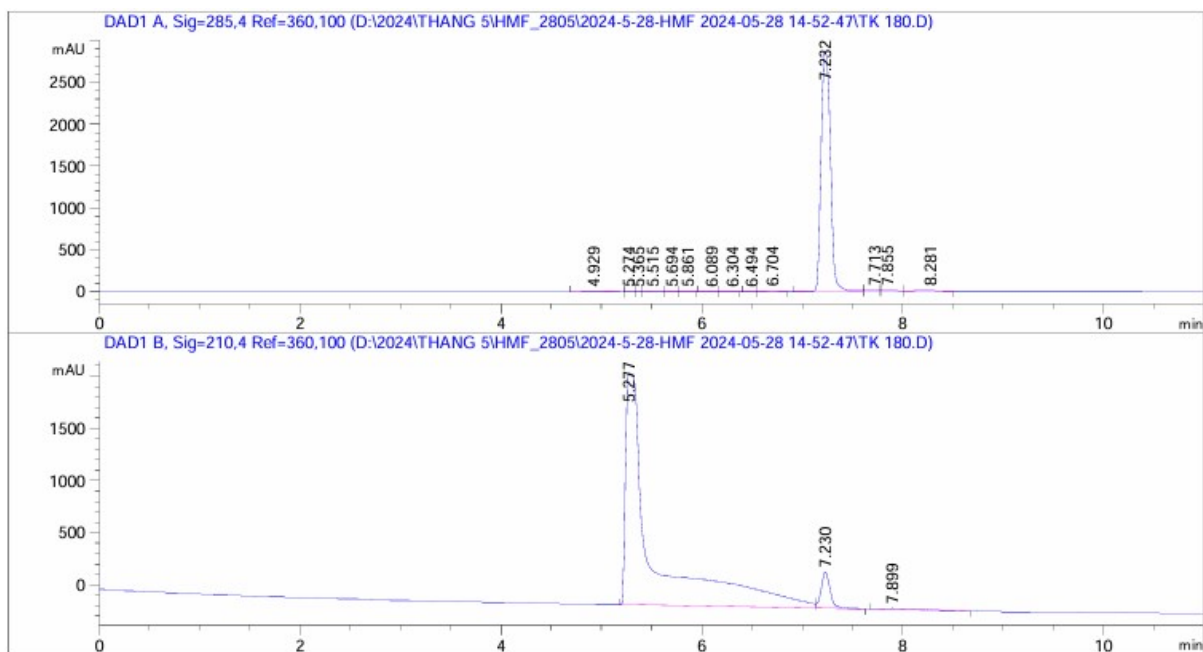
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.988	VV +	1.04341e4	7.90297e-3	82.46041		HMF
7.449	BB +	22.23825	8.49949e-4	1.89014e-2		DFF
7.891	BV +	555.68762	4.40534e-4	2.44799e-1		Furfural

Totals : 82.72411

Figure S2.29. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), Nitrobenzene (3 mL), 160 °C, 120 min.



External Standard Report

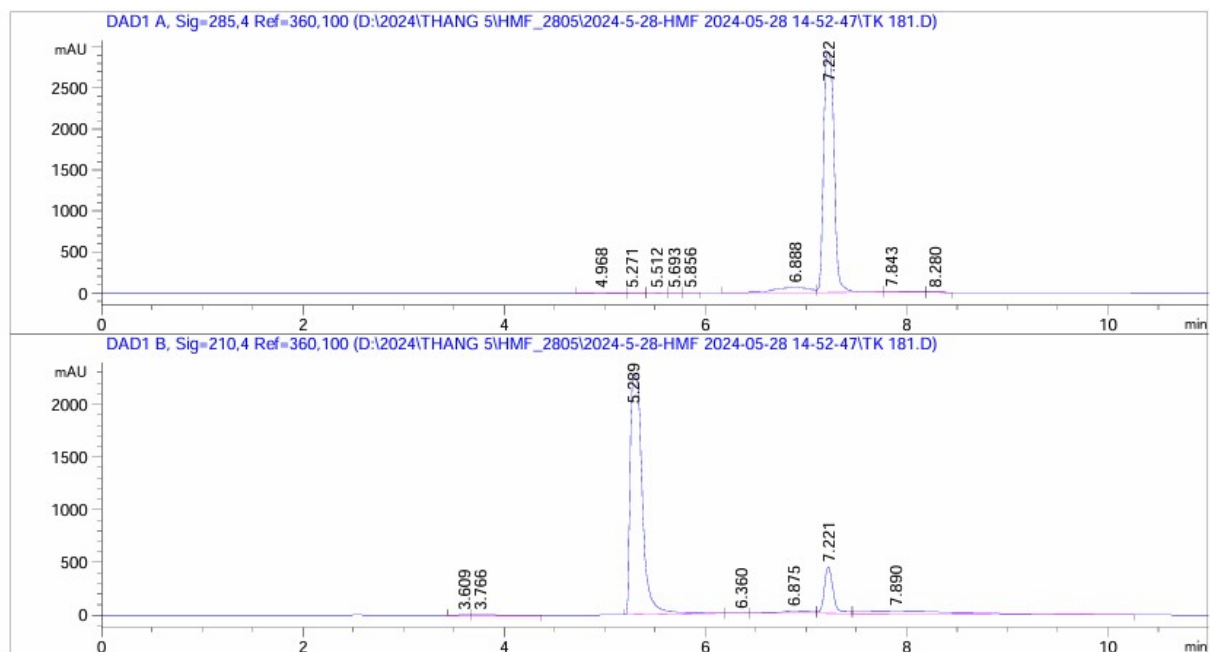
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.232	BV +	1.83230e4	7.90797e-3	144.89746		HMF
7.713	VV +	68.71357	6.06321e-3	4.16625e-1		DFF
7.855	VB +	61.83992	0.00000	0.00000		Furfural

Totals : 145.31408

Figure S2.30. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO: H₂O (1:2) (3 mL), 160 °C, 120 min.



External Standard Report

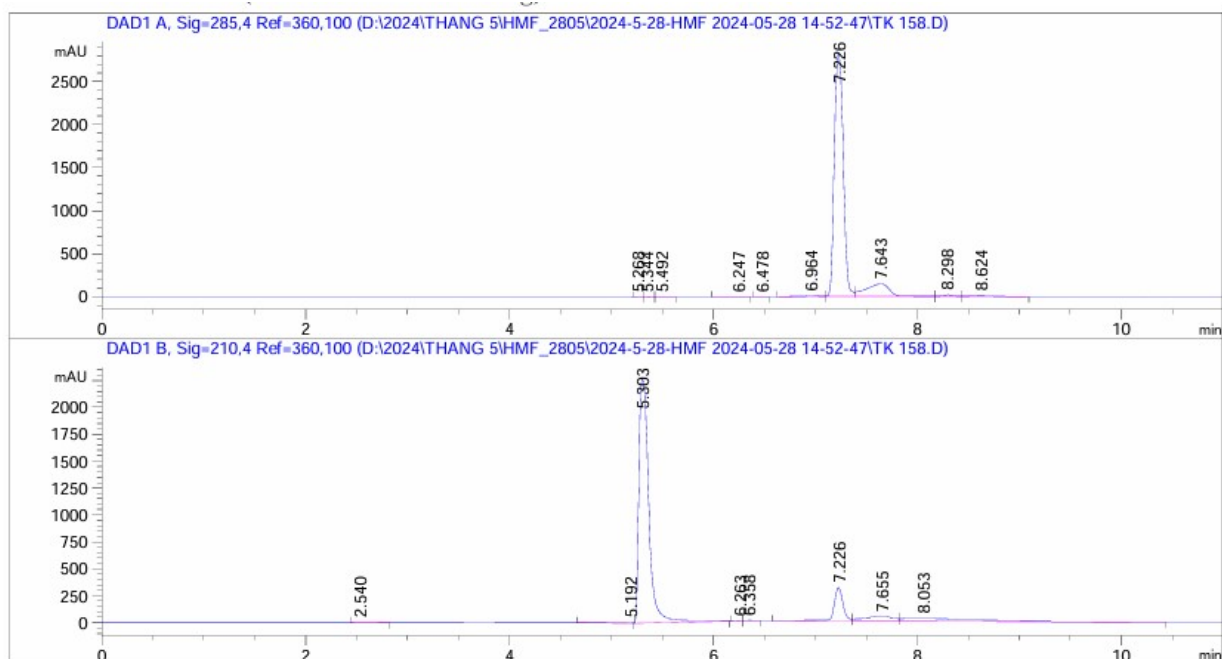
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.222	VV +	2.10463e4	7.90883e-3	166.45172		HMF
7.600		-	-	-		DFF
7.843	VB +	119.27074	0.00000	0.00000		Furfural

Totals : 166.45172

Figure S2.31. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO: H₂O (1:1) (3 mL), 160 °C, 120 min.



External Standard Report

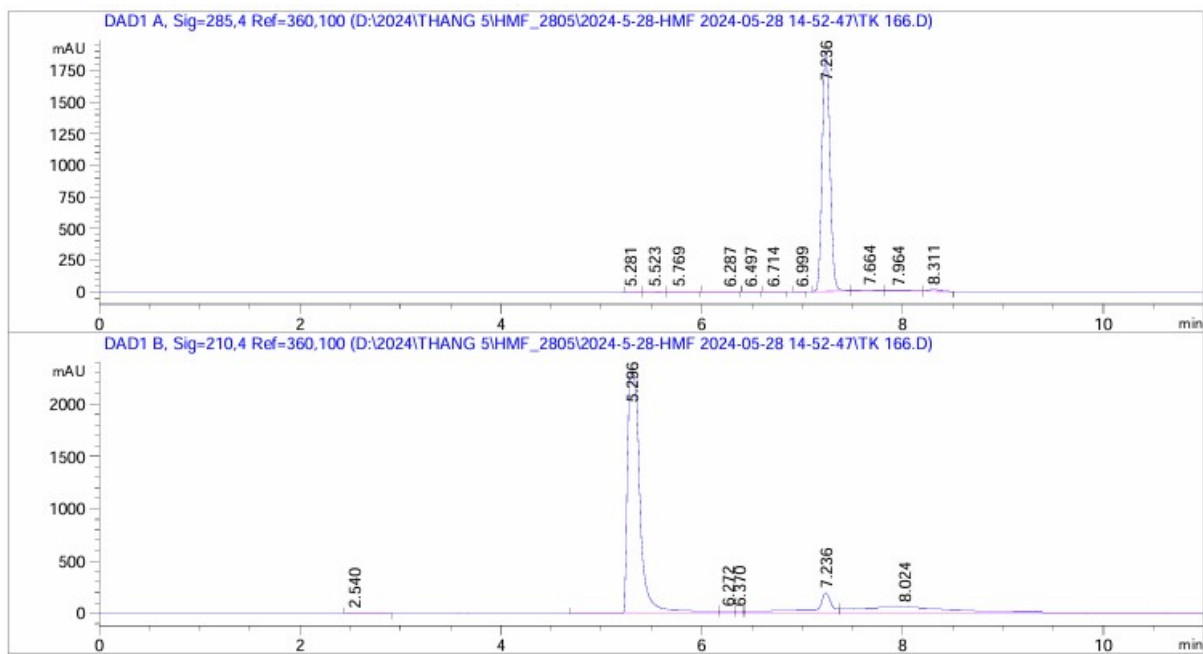
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.226	BV +	1.69557e4	7.90744e-3	134.07641		HMF
7.643	VV +	2310.07544	8.48353e-3	19.59760		DFF
8.000	-	-	-	-		Furfural

Totals : 153.67401

Figure S2.32. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (1 mL), 160 °C, 120 min.



External Standard Report

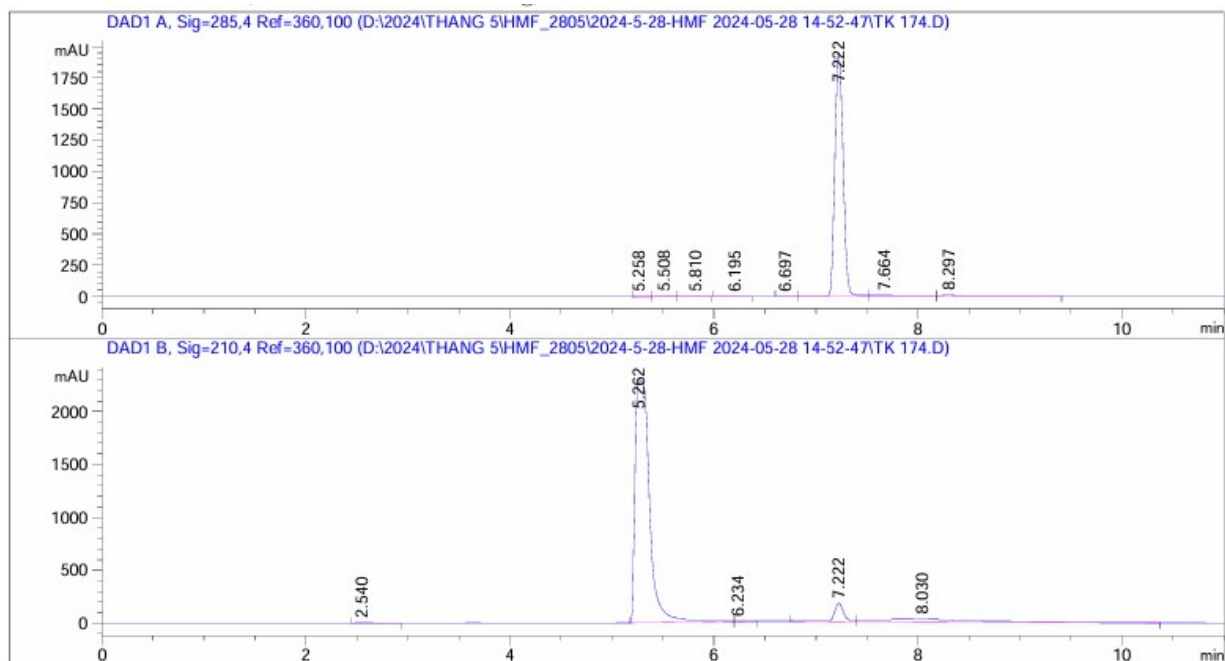
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.236	BV +	1.02946e4	7.90281e-3	81.35615		HMF
7.664	VV +	125.50610	7.19200e-3	9.02640e-1		DFF
7.964	VB +	51.29406	0.00000	0.00000		Furfural

Totals : 82.25879

Figure S2.33. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (5 mL), 160 °C, 120 min.



External Standard Report

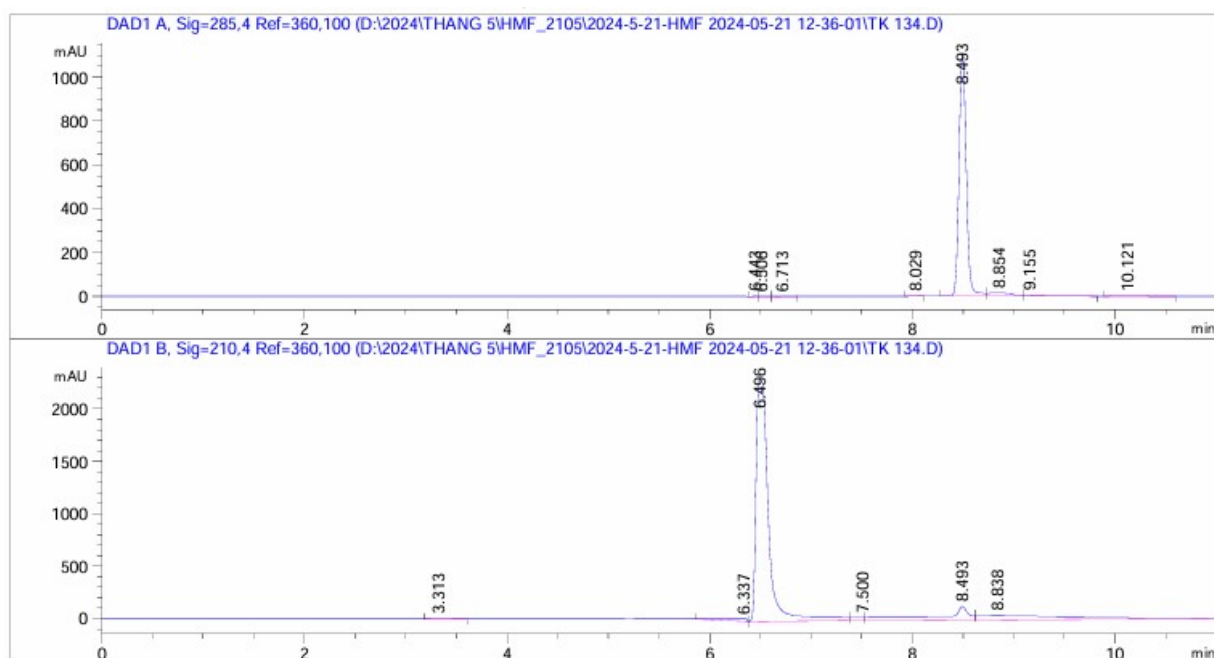
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.222	BV +	1.08635e4	7.90343e-3	85.85887		HMF
7.664	VV +	233.66505	7.82417e-3	1.82824		DFP
8.000	-	-	-	-		Furfural

Totals : 87.68710

Figure S2.34. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (7 mL), 160 °C, 120 min.



External Standard Report

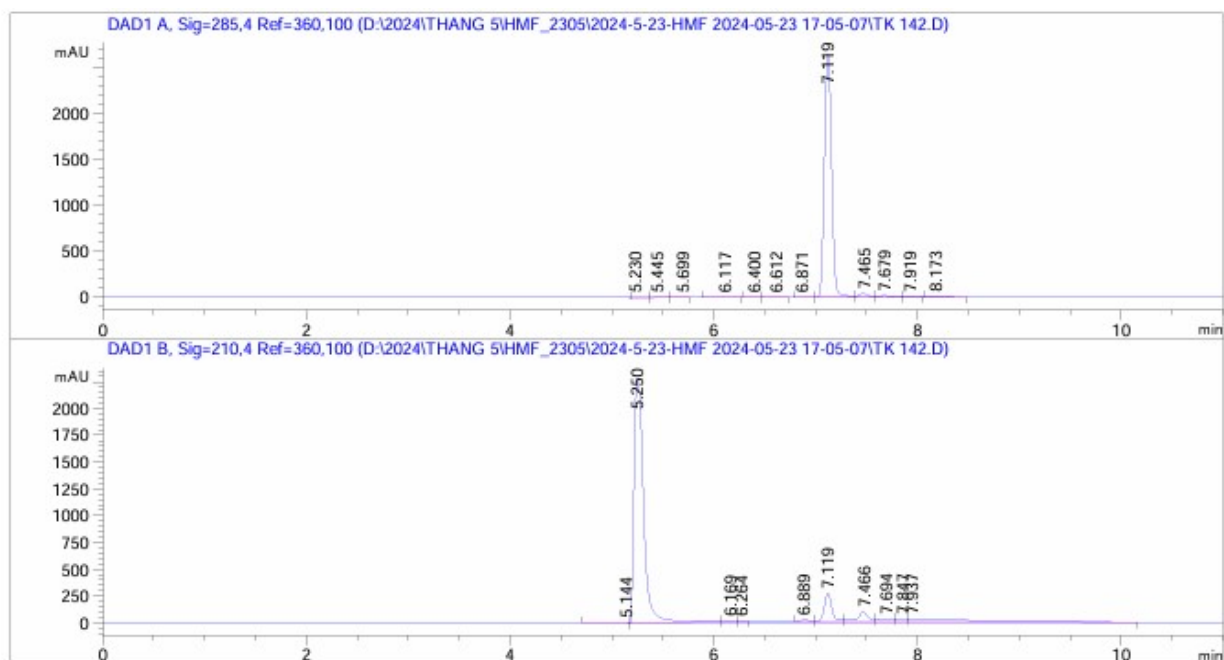
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
8.493	BV +	5454.85938	7.89236e-3	43.05172		HMF
8.854	VV +	245.83554	7.86049e-3	1.93239		DFF
9.155	VB +	60.67457	0.00000	0.00000		Furfural

Totals : 44.98410

Figure S2.35: HPLC chromatography of HMF. Reaction condition: fructose (0.5 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.



External Standard Report

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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.119	BV +	1.27647e4	1.03370e-2	131.94827		HMF
7.465	VV +	202.11078	3.50342e-2	7.08079		DFF
8.173	BB +	51.35548	0.00000	0.00000		Furfural

Totals : 139.02906

Figure S2.36: HPLC chromatography of HMF. Reaction condition: fructose (2 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.

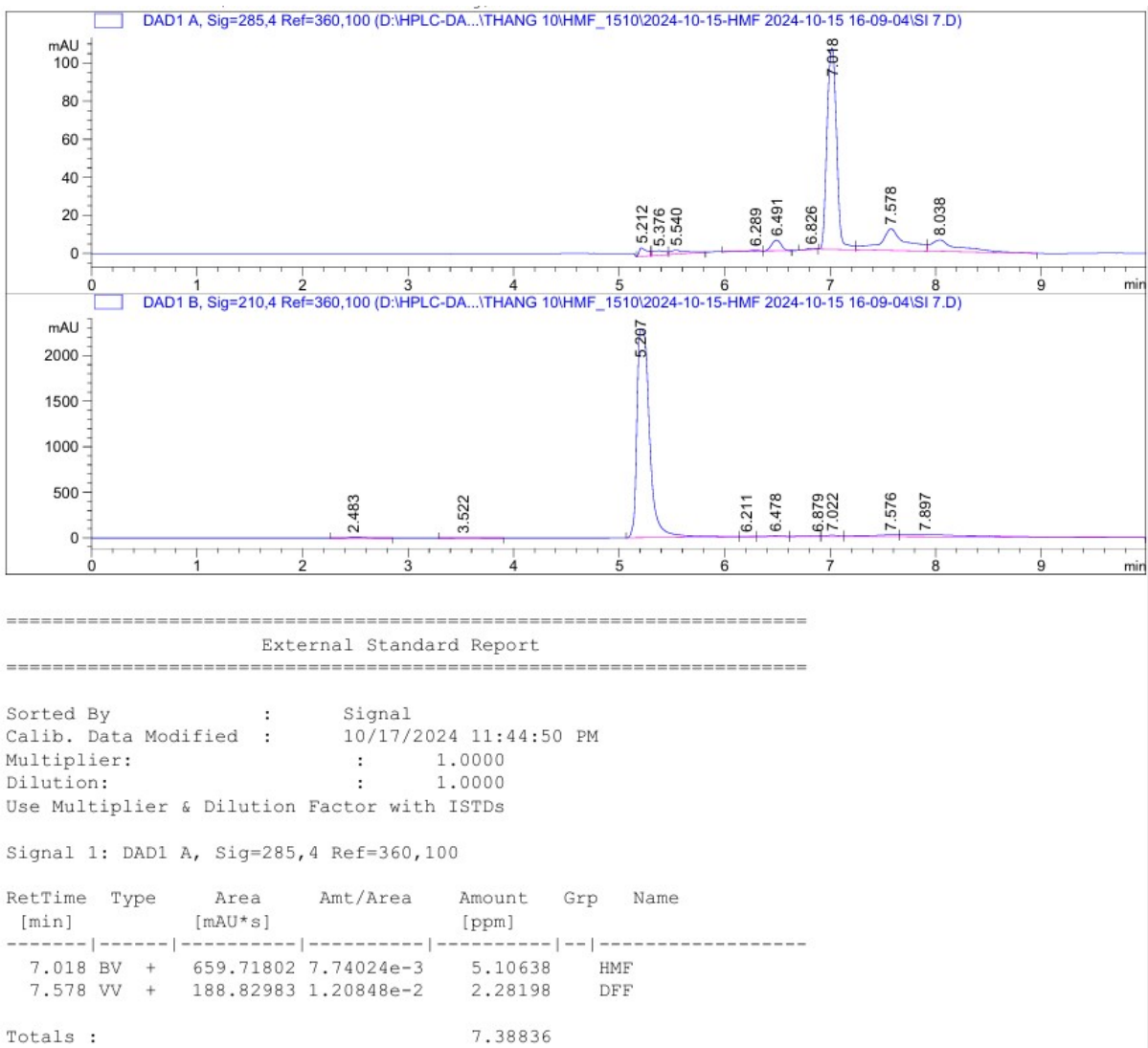


Figure S2.37. HPLC chromatography of HMF. Reaction condition: glucose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.

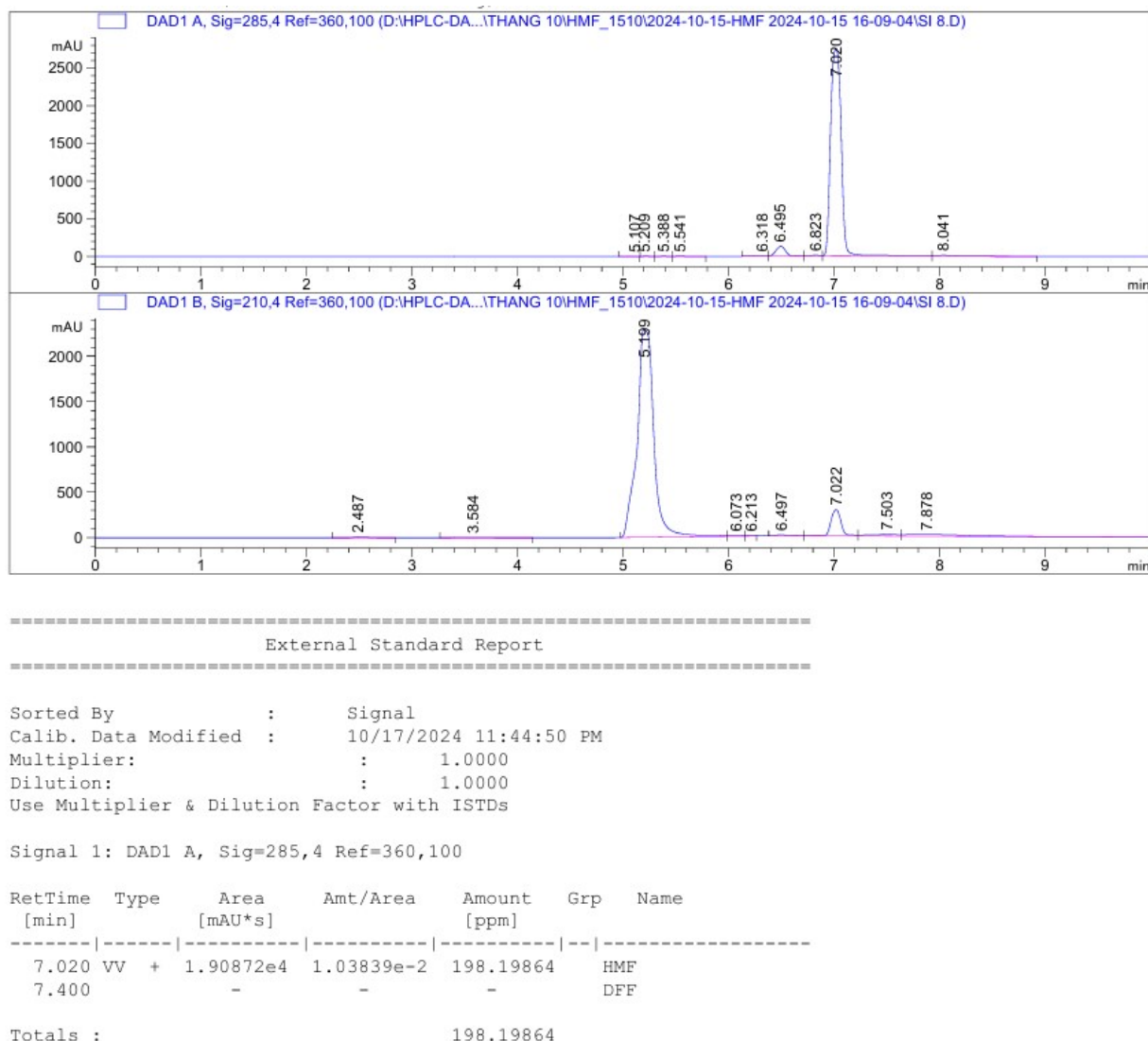
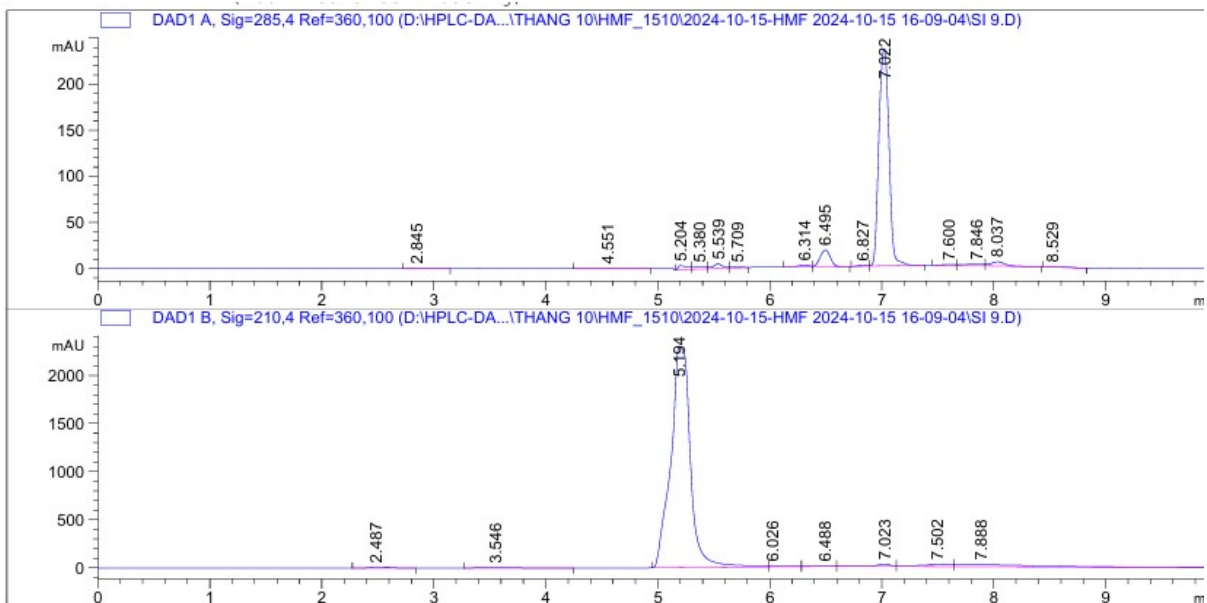
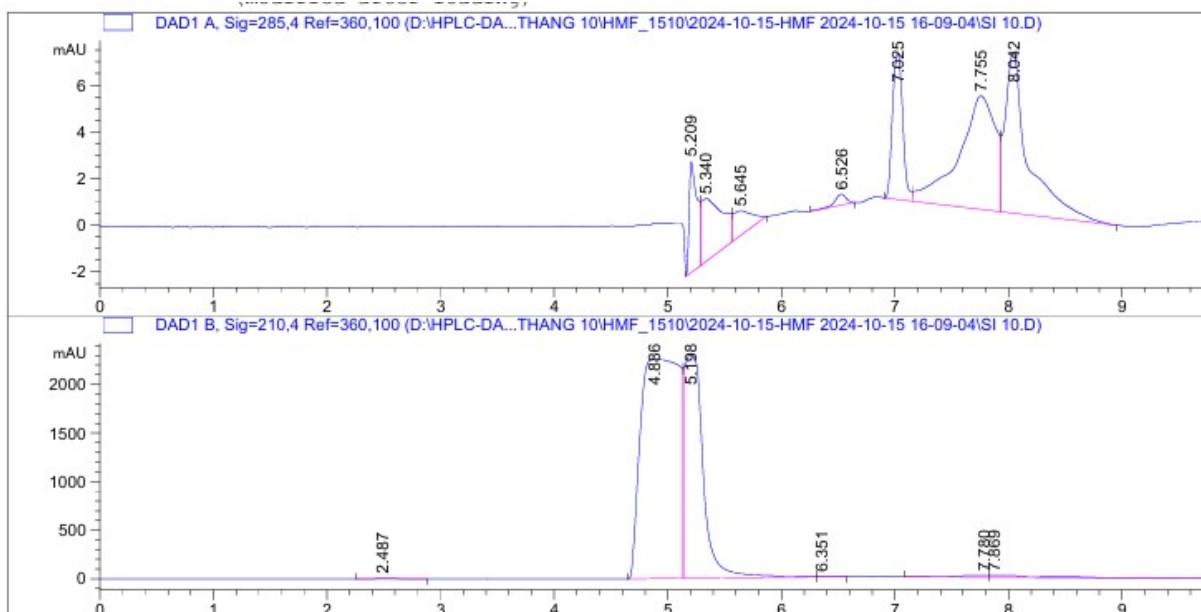


Figure S2.38. HPLC chromatography of HMF. Reaction condition: sucrose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.



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RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
7.022	VB +	1457.48975	9.23906e-3	13.46584	HMF	
7.400	-	-	-	-	DFF	
Totals :				13.46584		

Figure S2.39. HPLC chromatography of HMF. Reaction condition: maltose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.



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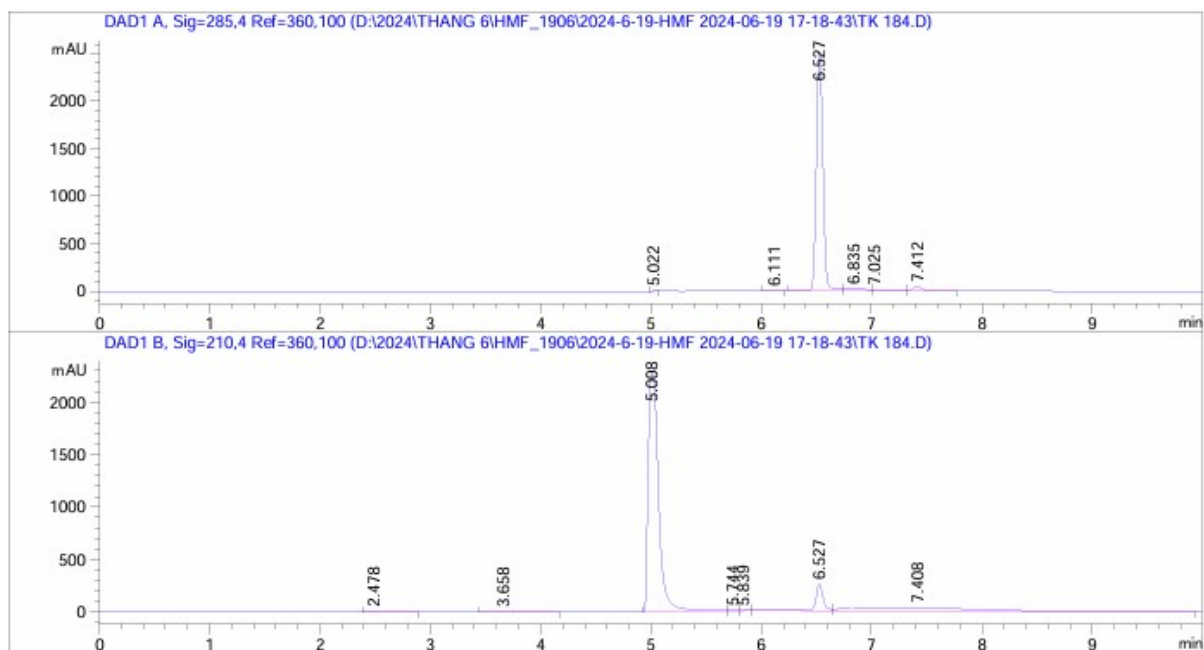
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime  Type      Area      Amt/Area      Amount      Grp      Name
[ min]    ----- [mAU*s] ----- [ppm] -----
-----|-----|-----|-----|-----|-----|-----
7.025 BV + 38.95666 0.00000 0.00000 HMF
7.400 - - - - - - - - - - - - - - - - - - - - - - - - - - -
Totals :                               0.00000
  
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Figure S2.40. HPLC chromatography of HMF. Reaction condition: cellulose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min.



External Standard Report

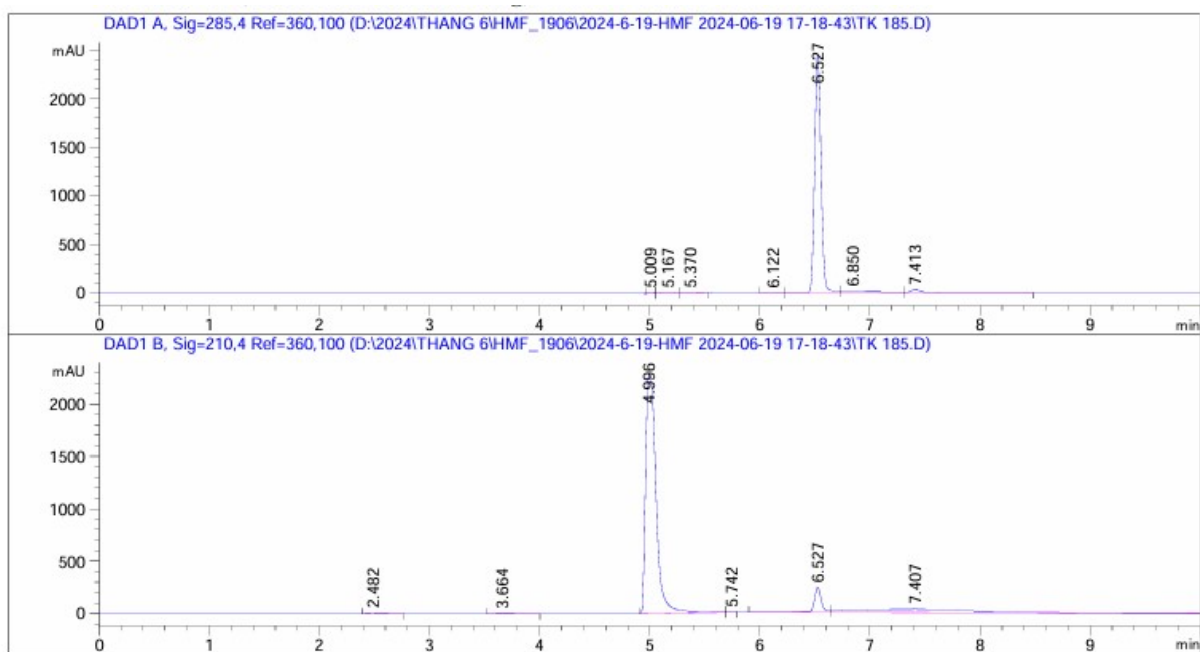
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.527	BV +	1.02424e4	1.03021e-2	105.51811		HMF
6.835	VV +	213.72728	1.21080e-2	2.58780		DFF
7.025	VB +	50.13300	0.00000	0.00000		Furfural

Totals : 108.10591

Figure S2.41. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min. Reusability (fresh).



External Standard Report

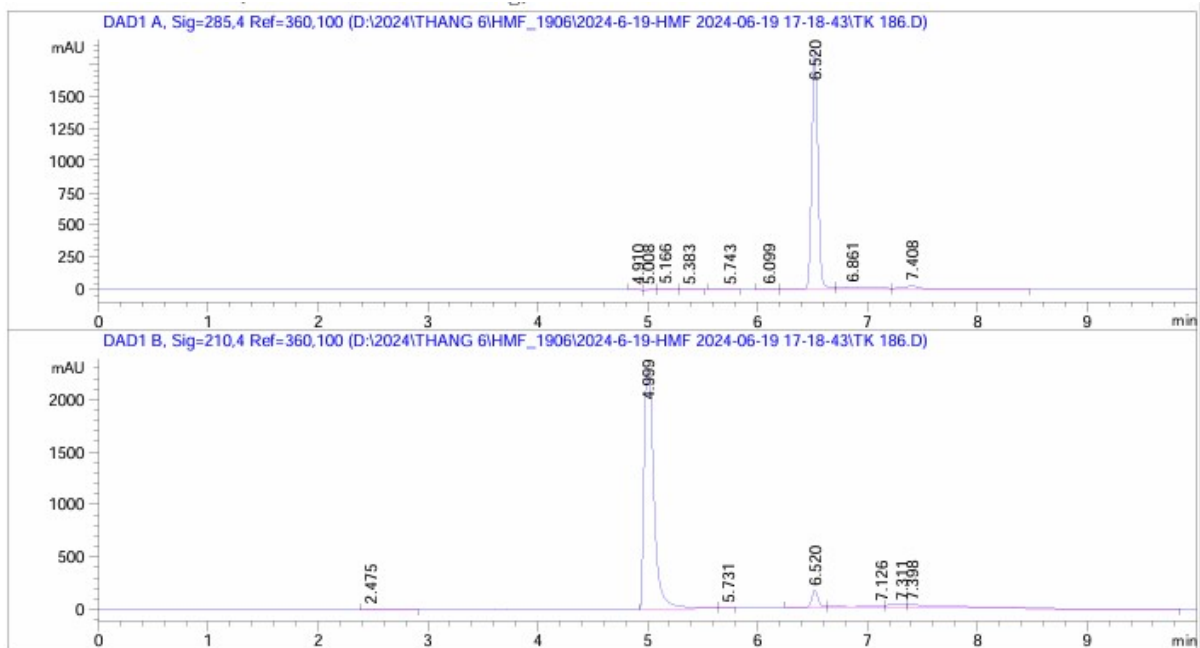
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Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.527	BV +	9952.35938	1.02970e-2	102.47939		HMF
6.850	VV +	426.04001	1.21954e-2	5.19572		DFF
7.100		-	-	-		Furfural

Totals : 107.67511

Figure S2.42. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min. Reusability (run 1).



External Standard Report

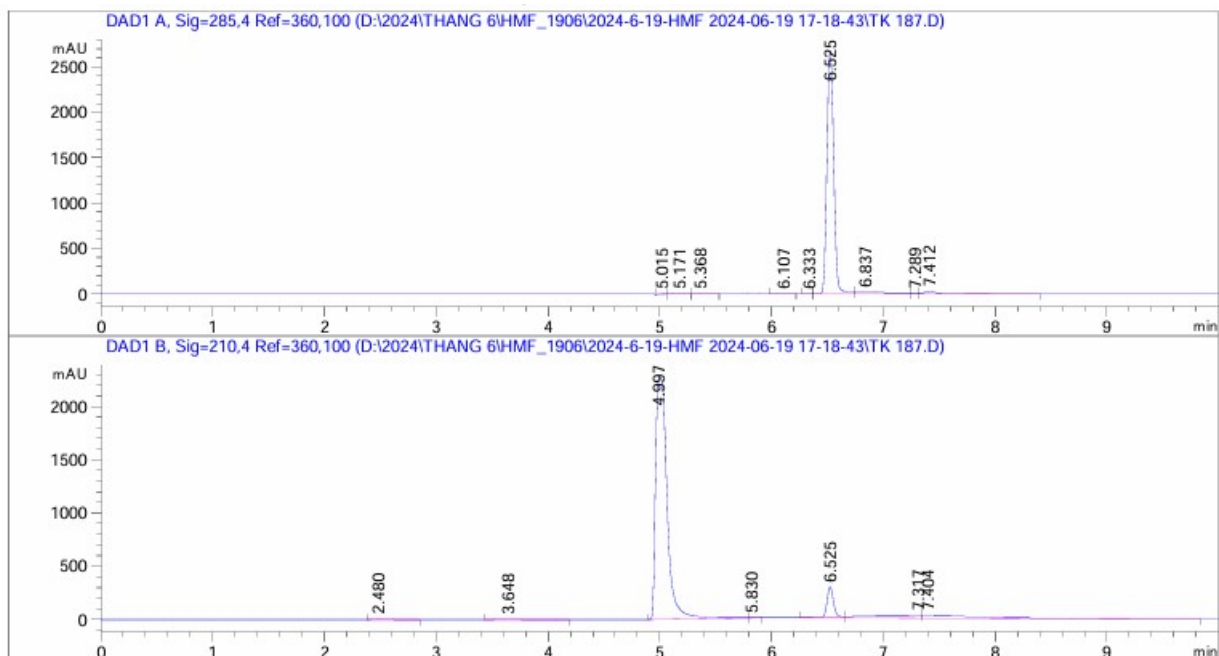
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.520	BV +	7214.55176	1.02281e-2	73.79126		HMF
6.861	VV +	371.35870	1.21824e-2	4.52405		DFF
7.100		-	-	-		Furfural

Totals : 78.31530

Figure S2.43. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min. Reusability (run 2).



External Standard Report

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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=285,4 Ref=360,100

RetTime [min]	Type	Area [mAU*s]	Amt/Area	Amount [ppm]	Grp	Name
6.525	BV +	1.12595e4	1.03181e-2	116.17670		HMF
6.837	VV +	360.23935	1.21793e-2	4.38747		DFF
7.100		-	-	-		Furfural

Totals : 120.56416

Figure S2.44. HPLC chromatography of HMF. Reaction condition: fructose (1 mmol), SiO₂-DCDA-SO₃H (20 mg), DMSO (3 mL), 160 °C, 120 min. Reusability (run 3).