Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supplementary material

Eco-friendly hydrogenation of aromatic aldehyde compounds by tandem dehydrogenation of dimethylamine-borane in the presence of reduced graphene oxide furnished platinum nanocatalyst

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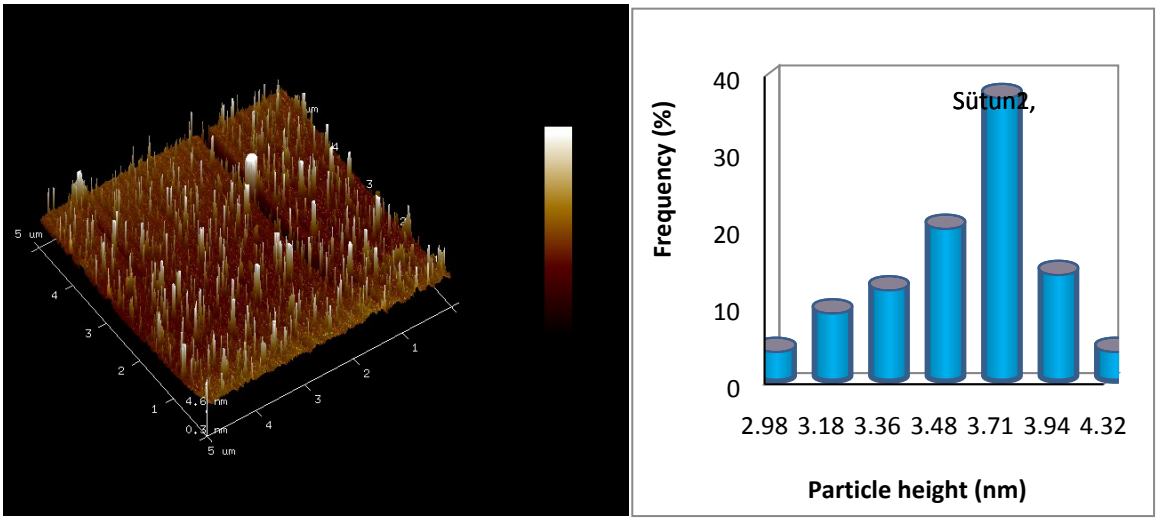


Figure S1 AFM image of highly monodisperse Pt(0)/TPA@rGO NPs (a). Histogram of height of particles obtained from AFM data (b).

Materials

$PtCl_4$ (99%) was obtained from Alfa, tetrahydrofuran (THF; 99.5%), methanol (≥99.5%), ethanol (99.9%), 2-propanol and $HClO_4$ (60%) were purchased from Merck, superhydride, dimetilaminoborane (DMAB) and all aldehyde compounds were bought from Aldrich and used as received. Water was purified using a Millipore water purification system (18 MΩ) analytical grade. All glassware and Teflon-coated magnetic stir bars were cleaned with aqua regia, followed by washing with distilled water before drying.

Characterization methods

TEM images of Pt /TPA@rGO NPs have been obtained by a JEOL 200 kV TEM instrument. Sample preparation was carried out through the suspension of ~0.5 mg catalyst in 3 ml of ethanol in an ultrasonic bath and then a drop of this solution was put on to a carbon covered 400-mesh copper grid. More than 300 particles were analyzed to get a particle size distrubition. Finally, evaporation of the solvent was done at room temperature

X-ray diffraction (XRD) was performed using a Panalytical Empyrean diffractometer with Ultima + theta-theta high resolution goniometer, the X-ray generator (Cu Kα radiation, λ = 1.54056Å) with an operation conditions at 45 kV and 40 mA.

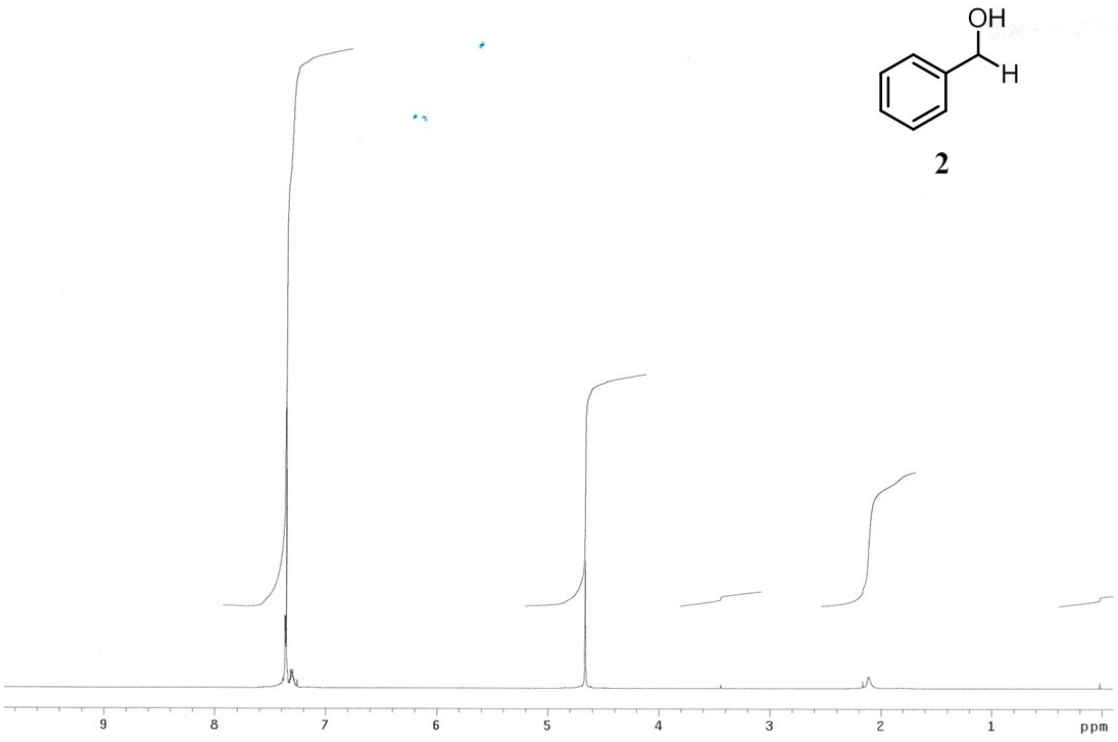
A Specs spectrometer was used for X-ray photoelectron spectroscopy (XPS) measurements using Kα lines of Mg (1253.6 eV, 10 mA) as an X-ray source. All lines were referenced to the C 1s line at 284.6 eV. Peak fittings were done using a Gaussian function.

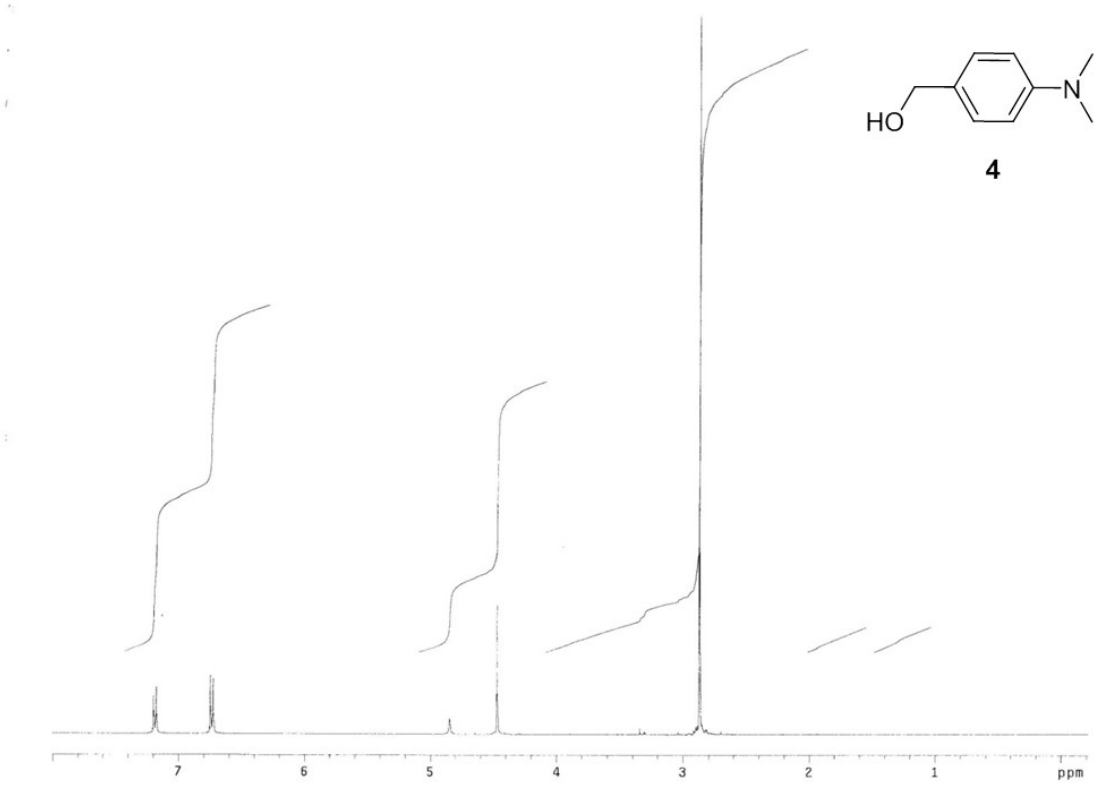
The amount of platinum in monodisperse Pt (0)/TPA@rGO NPs was determined by a Leeman Lab inductively coupled plasma spectroscopy (ICP).

By using a Park Systems AFM XE-100E, the surface topographies of Pt (0)/TPA@rGO NPs were analyzed. We used 0.01-0.025 ohm-cm antimony doped silicon AFM probes (Ultrasharp TESP) having cantilever spring constants of 20−80 N/m and resonance frequencies of 328 - 379 kHz. The manufacturer estimates that the tip radius of curvature is about 2 nm. For the measurements, first, we prepare a sample for AFM by diluting the product solutions by 300-fold or more with DI water and place 2.5 μL of the final solution directly onto the freshly cleaved mica disk (supporting material) and then a solvent was dried in a vacuum at room temperature for at least 12 h.

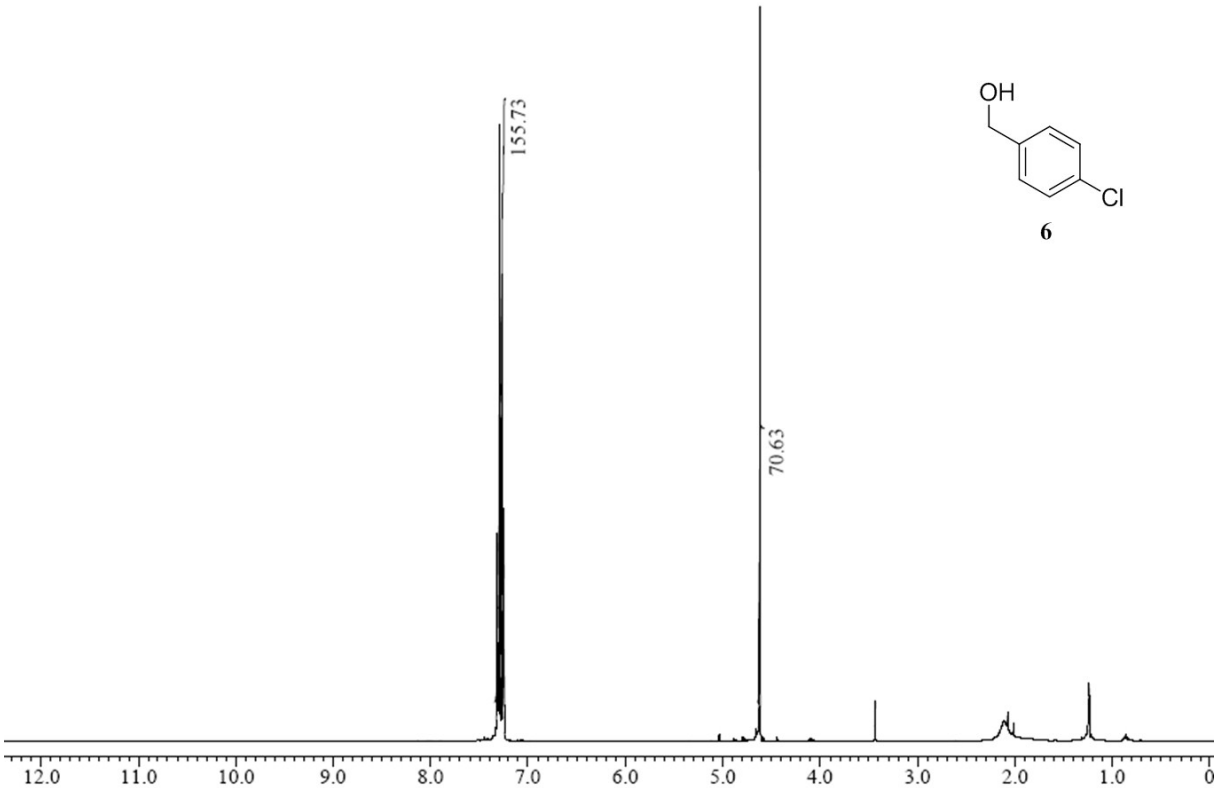
^{1}H NMR spectra were recorded on a Bruker Avance DPX 400 MHz spectrometer.

^{1}H-NMR Spectra for The Alcohol Products




HO
N
7
6
5
4
3
2
1
ppm

4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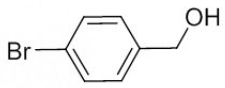
70.63
OH
Cl
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0

6



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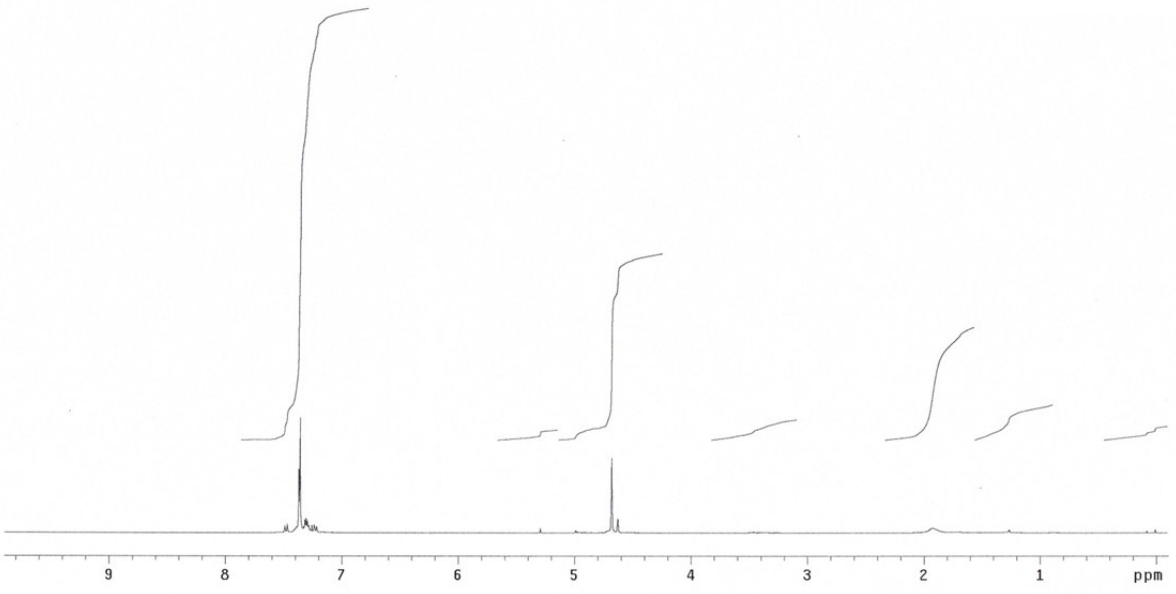
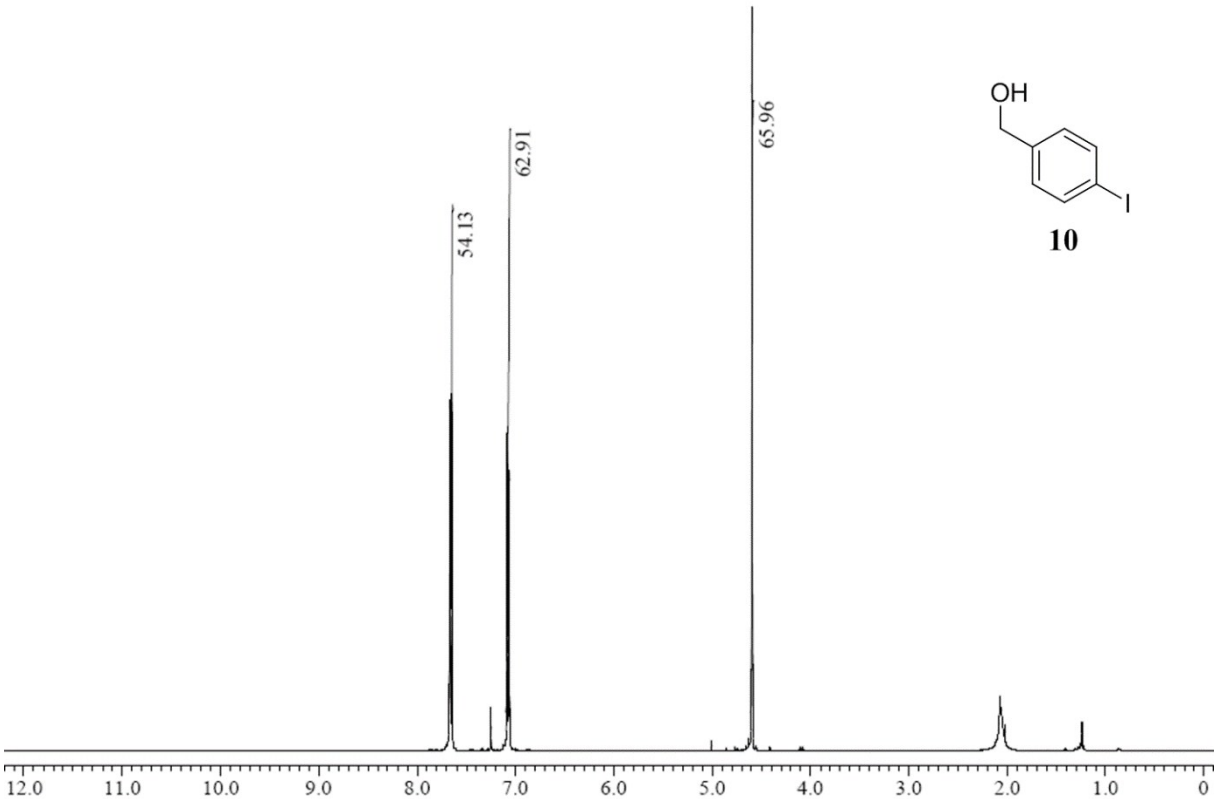
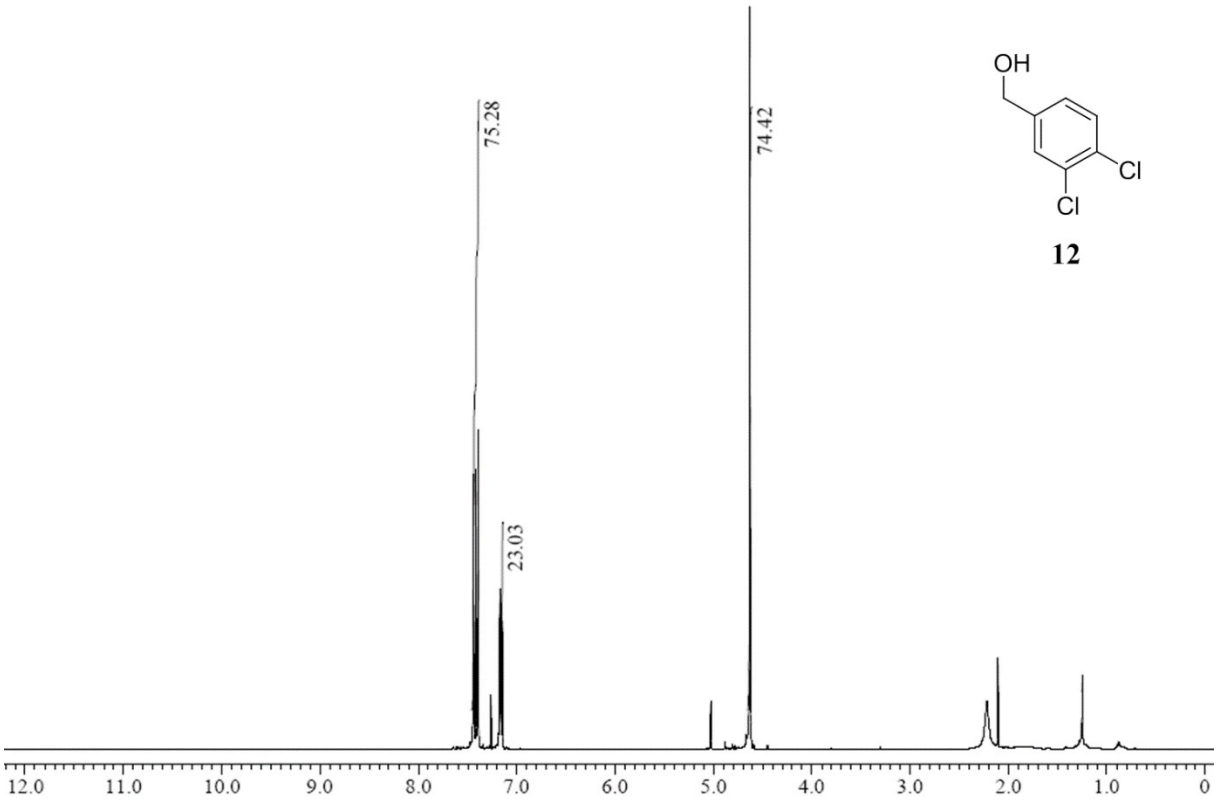



54.13
62.91
65.96
OH
I
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0

10


75.28
23.03
74.42
OH
Cl
Cl
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10.0
9.0
8.0
7.0
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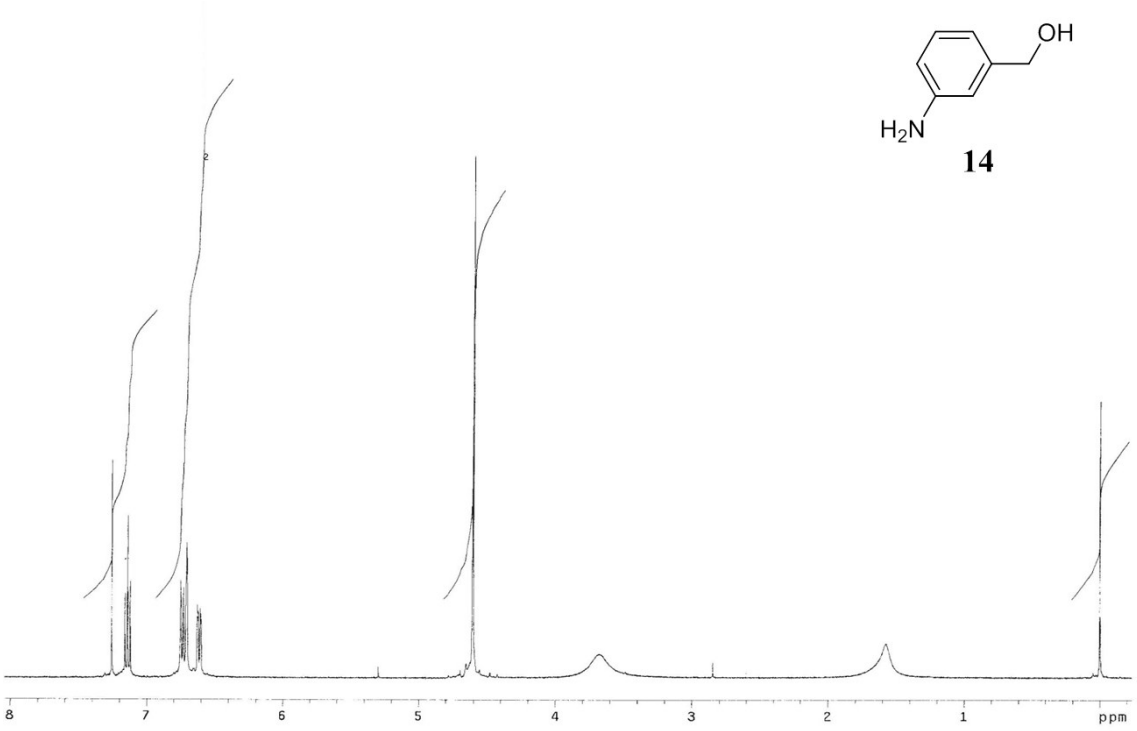
5.0
4.0
3.0
2.0
1.0
0

12



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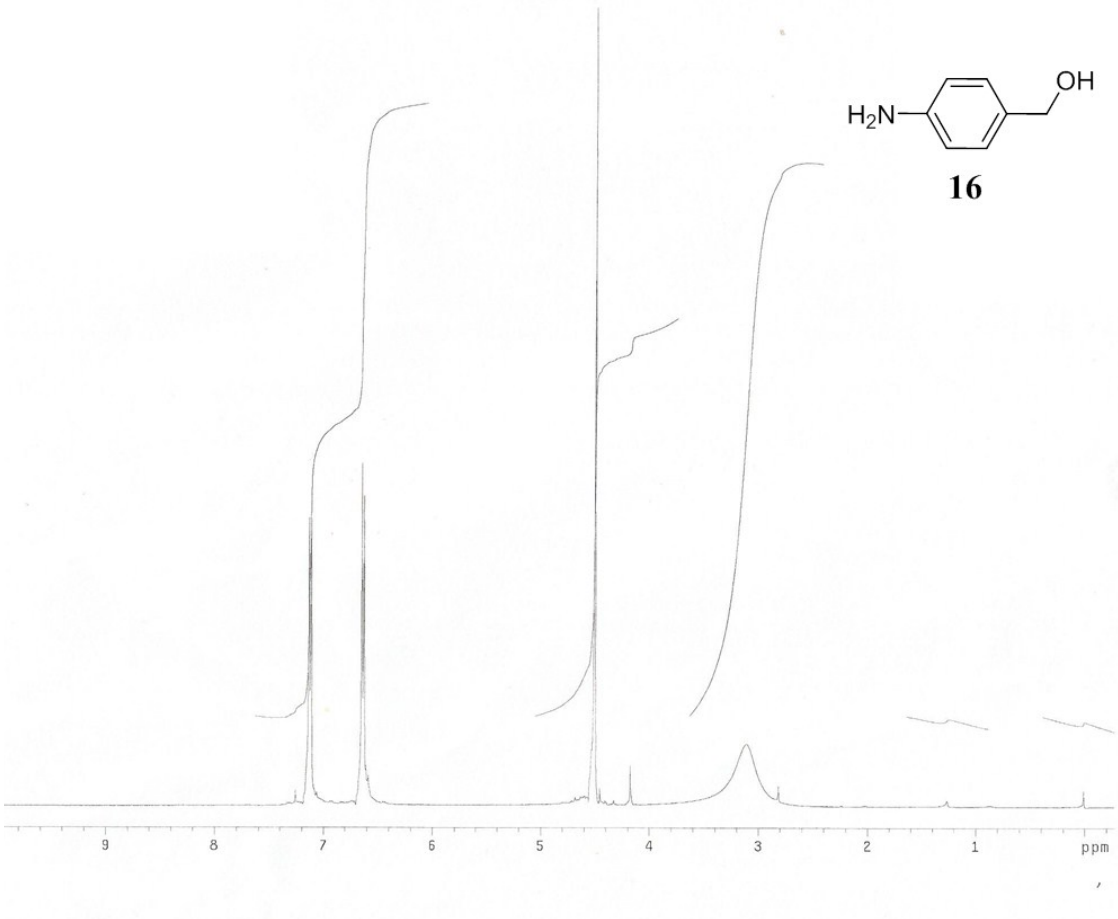

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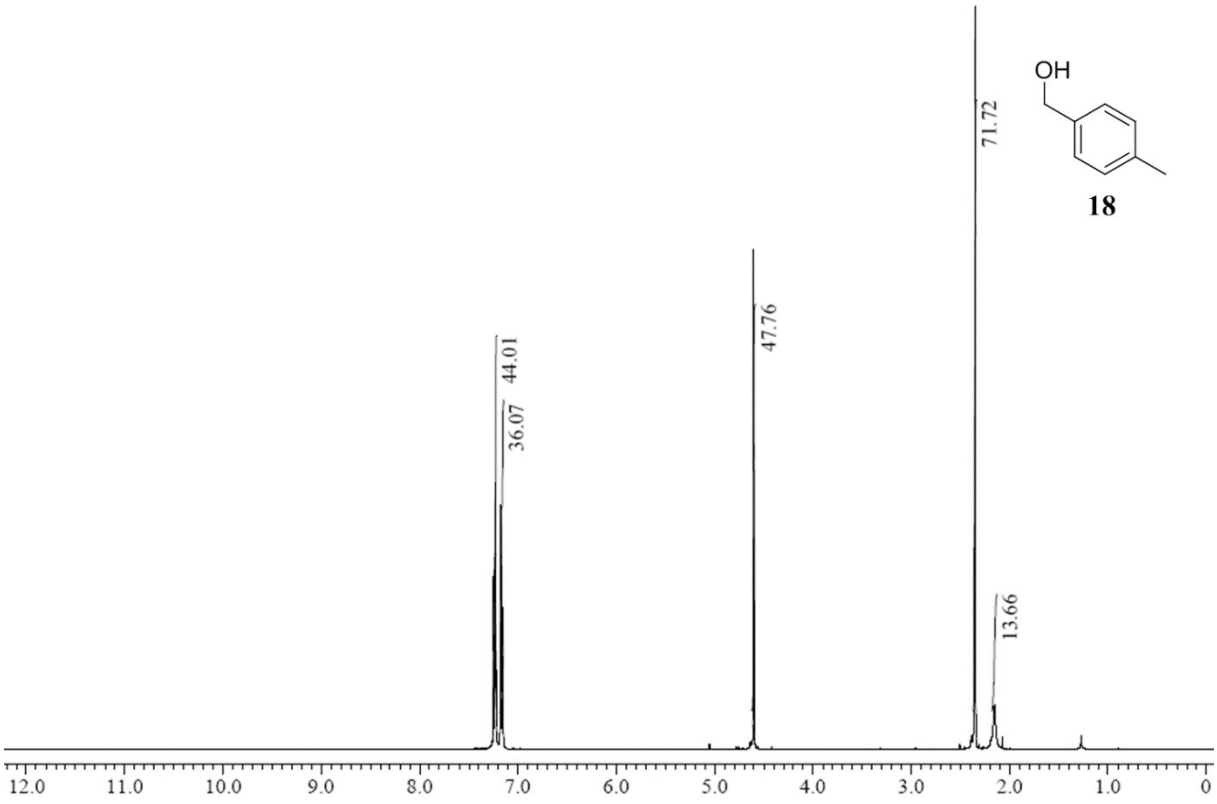
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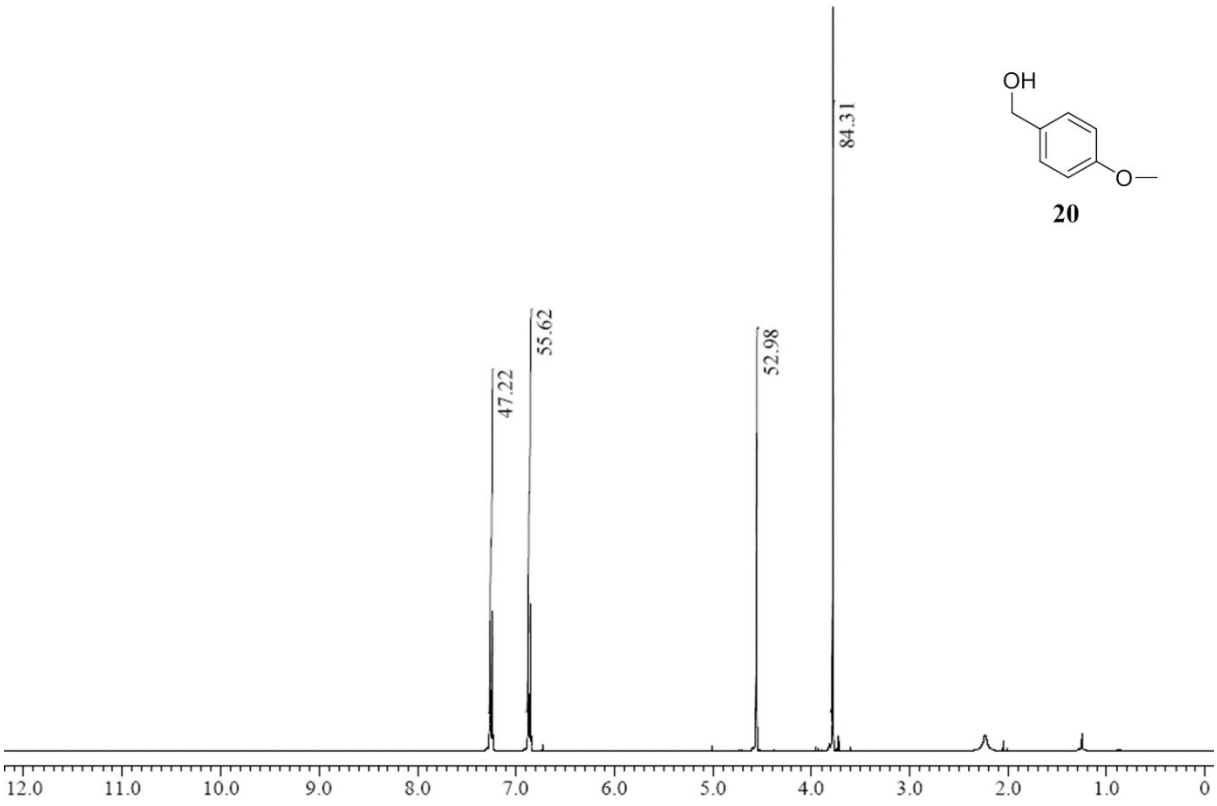
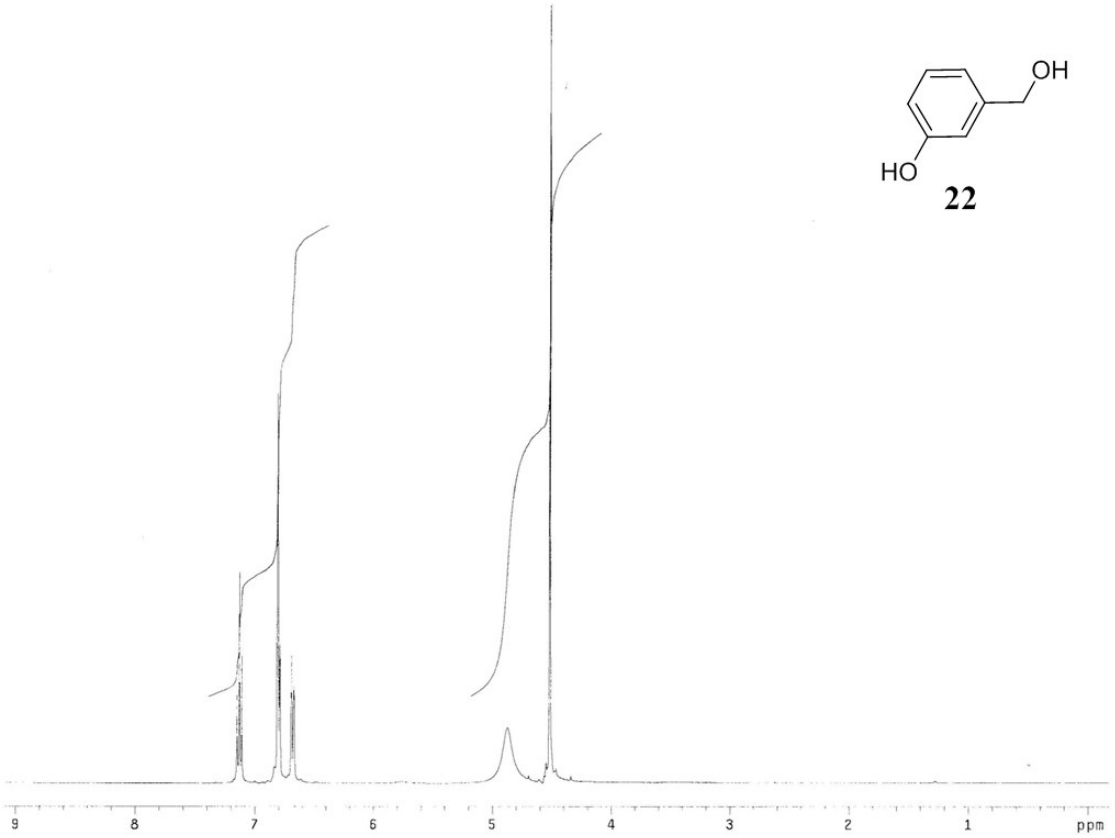
71.72
47.76
44.01
36.07
13.66
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0

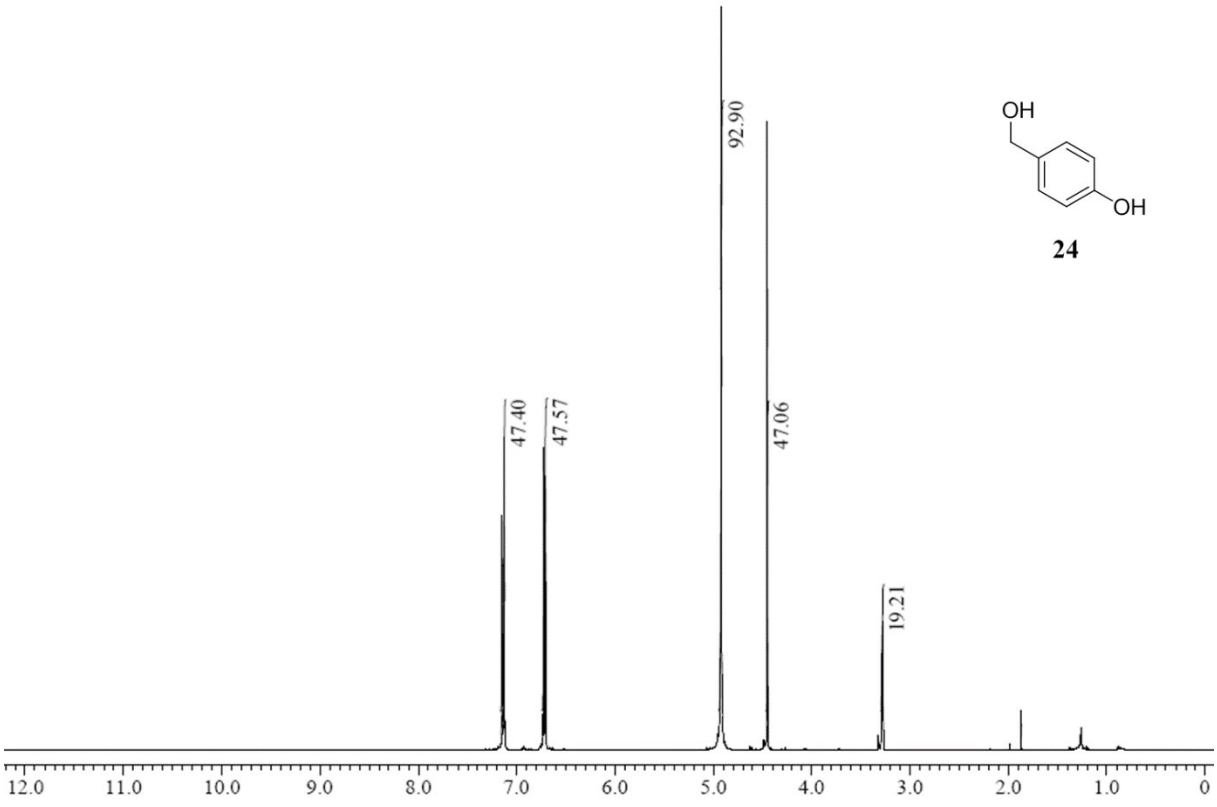
18


OH
O—
84.31
55.62
52.98
47.22
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0

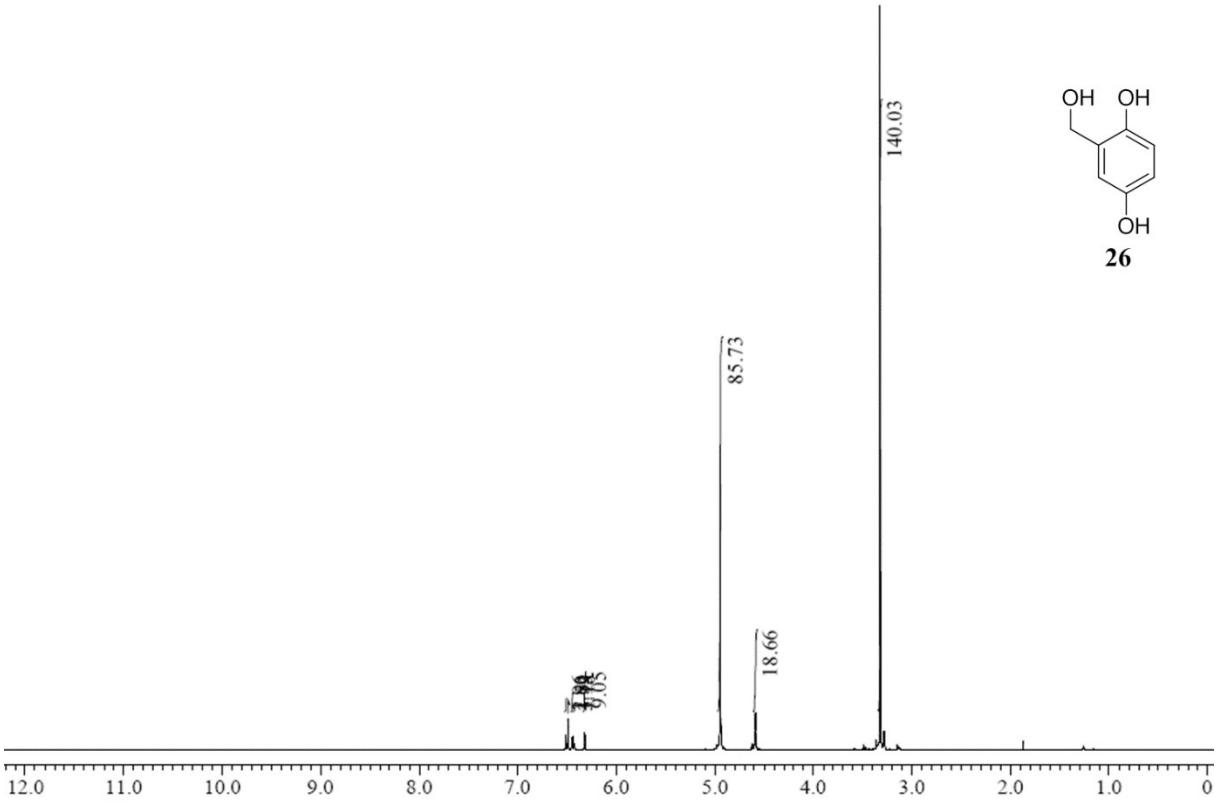
20


OH
HO
9
8
7
6
5
4
3
2
1
ppm

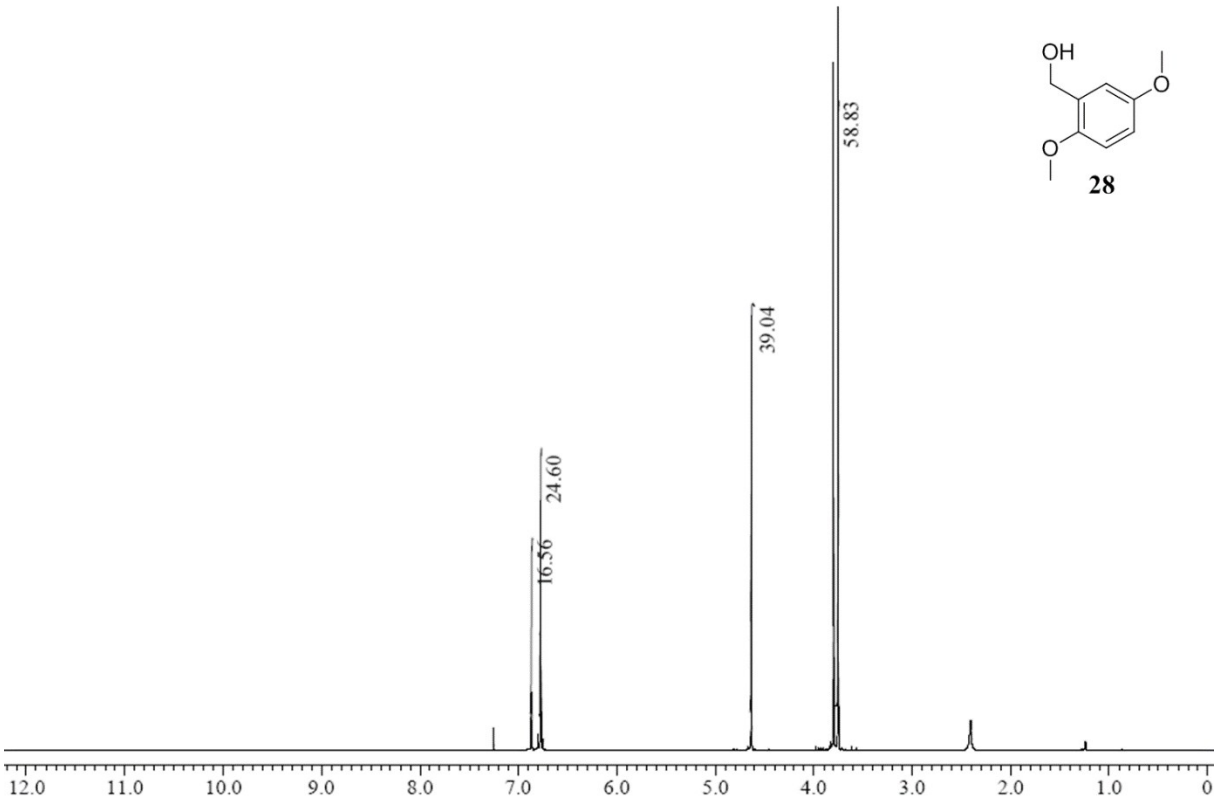
22


OH
OH
92.90
47.40
47.57
47.06
19.21
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0

24


140.03
85.73
18.66
OH
OH
OH
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0

26


58.83
39.04
24.60
16.56
OH
O
O
12.0
11.0
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9.0
8.0
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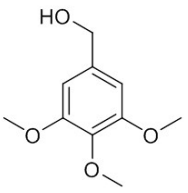
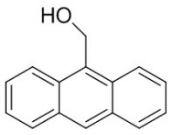
6.0
5.0
4.0
3.0
2.0
1.0
0

28


HO
O
O
O

30

8
7
6
5
4
3
2
1
ppm


HO

32

46.96
27.93
62.36
32.89
61.72
18.90
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0