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Supplementary Information

for

Synthesis of pyrazole derivatives in the presence of dioxomolybdenum complex supported on silica-coated magnetite nanoparticles as an efficient and easily recyclable catalyst

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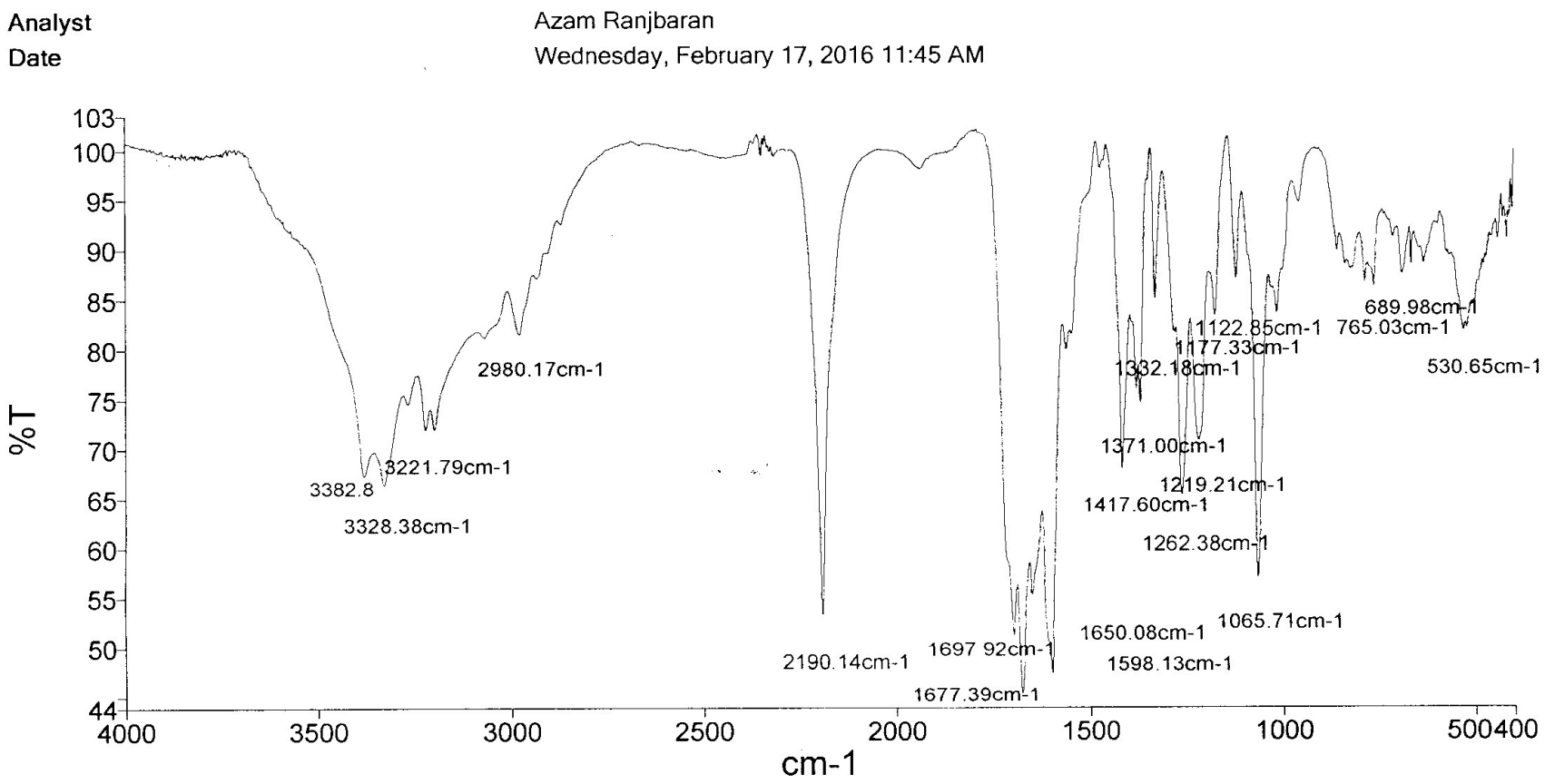


Fig S1.*The IR of 5-amino-3-(perfluorophenyl)-1-phenyl-1H-pyrazole-4-carbonitrile (Table 3, entry 5)*

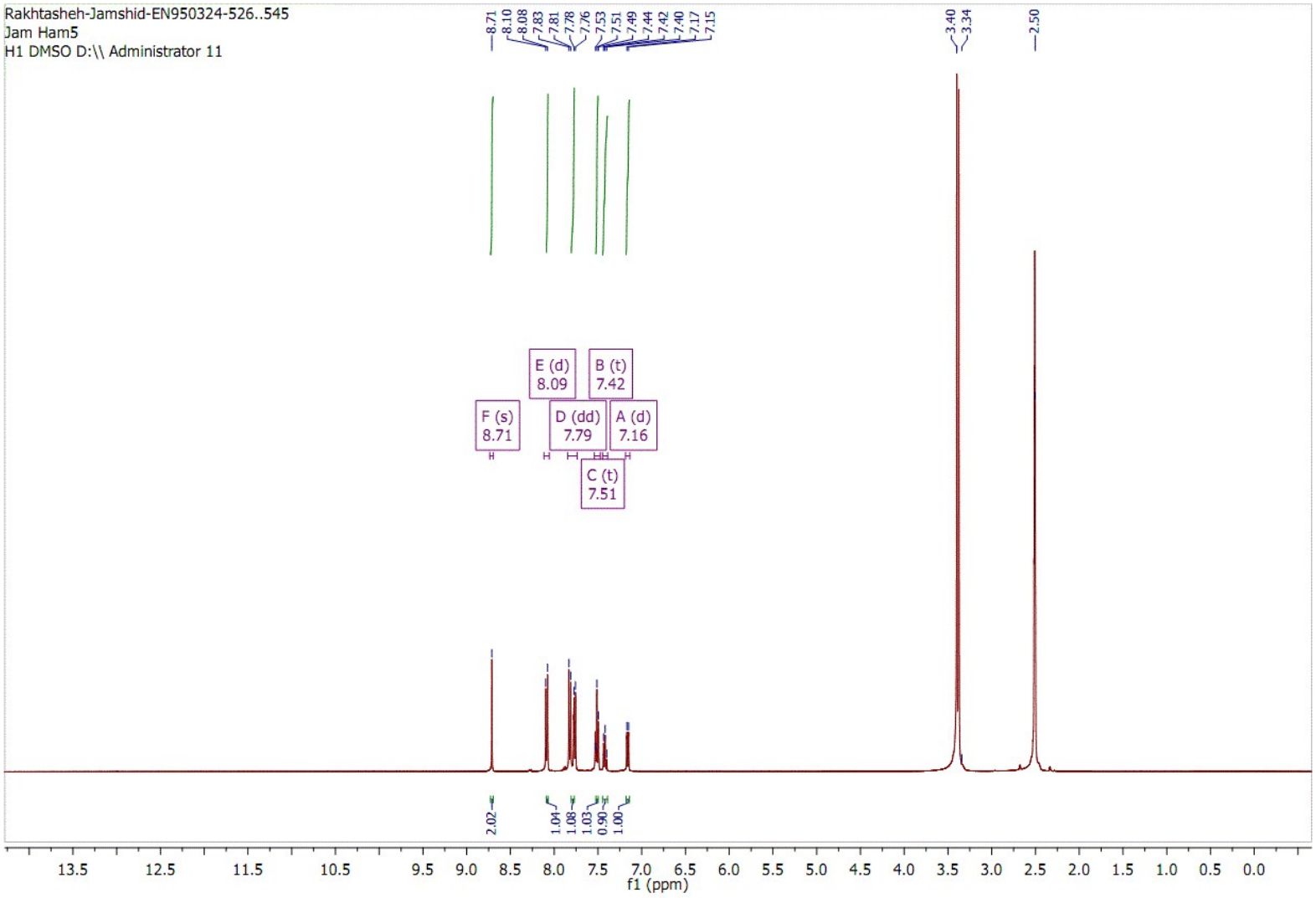


Fig S2.*The [1]H NMR of 5-amino-3-(perfluorophenyl)-1-phenyl-1H-pyrazole-4-carbonitrile (Table 3, entry 5)*

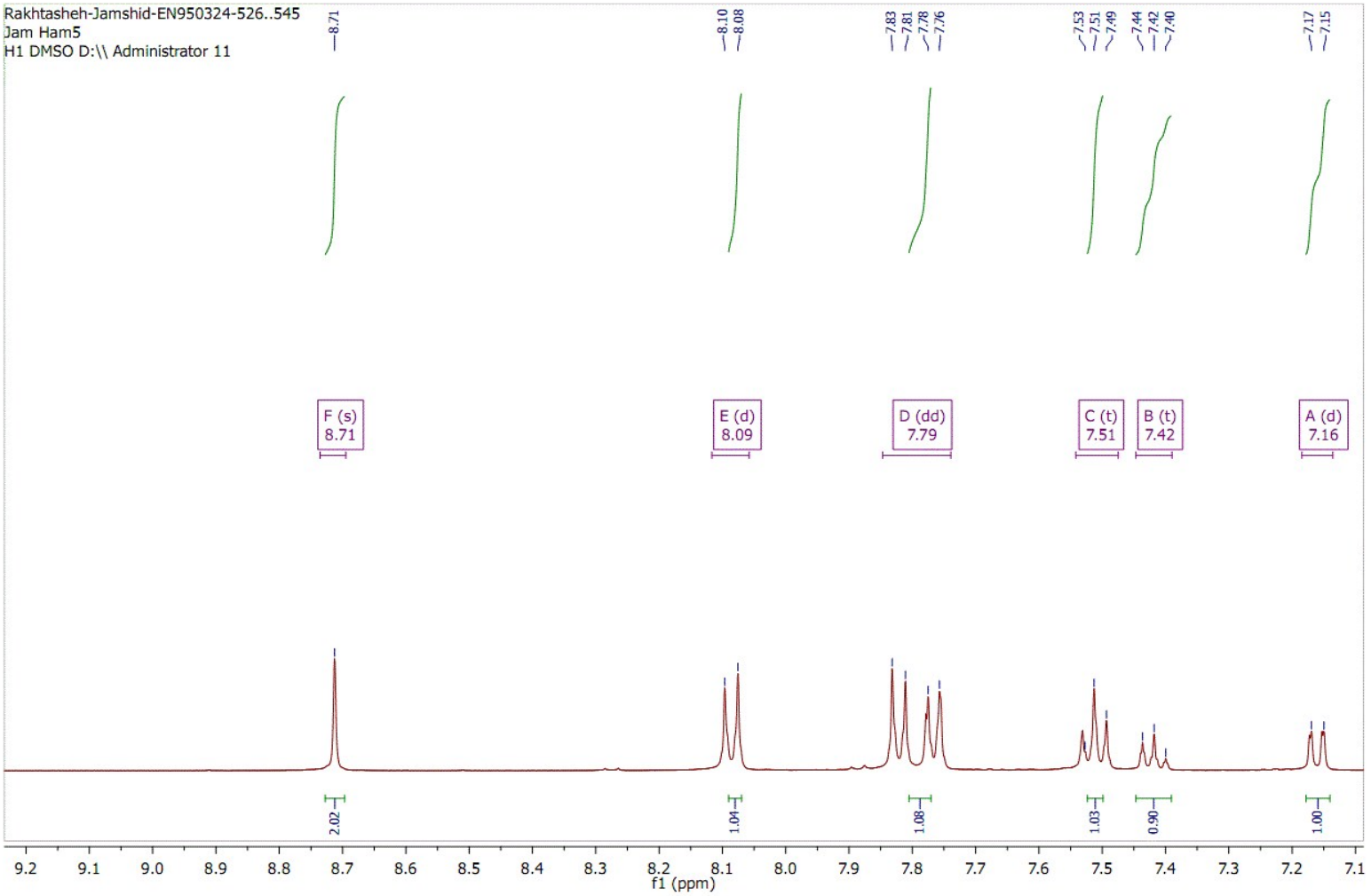


Fig S3.*The expanded [1]H NMR of 5-amino-3-(perfluorophenyl)-1-phenyl-1H-pyrazole-4-carbonitrile (Table 3, entry 5)*

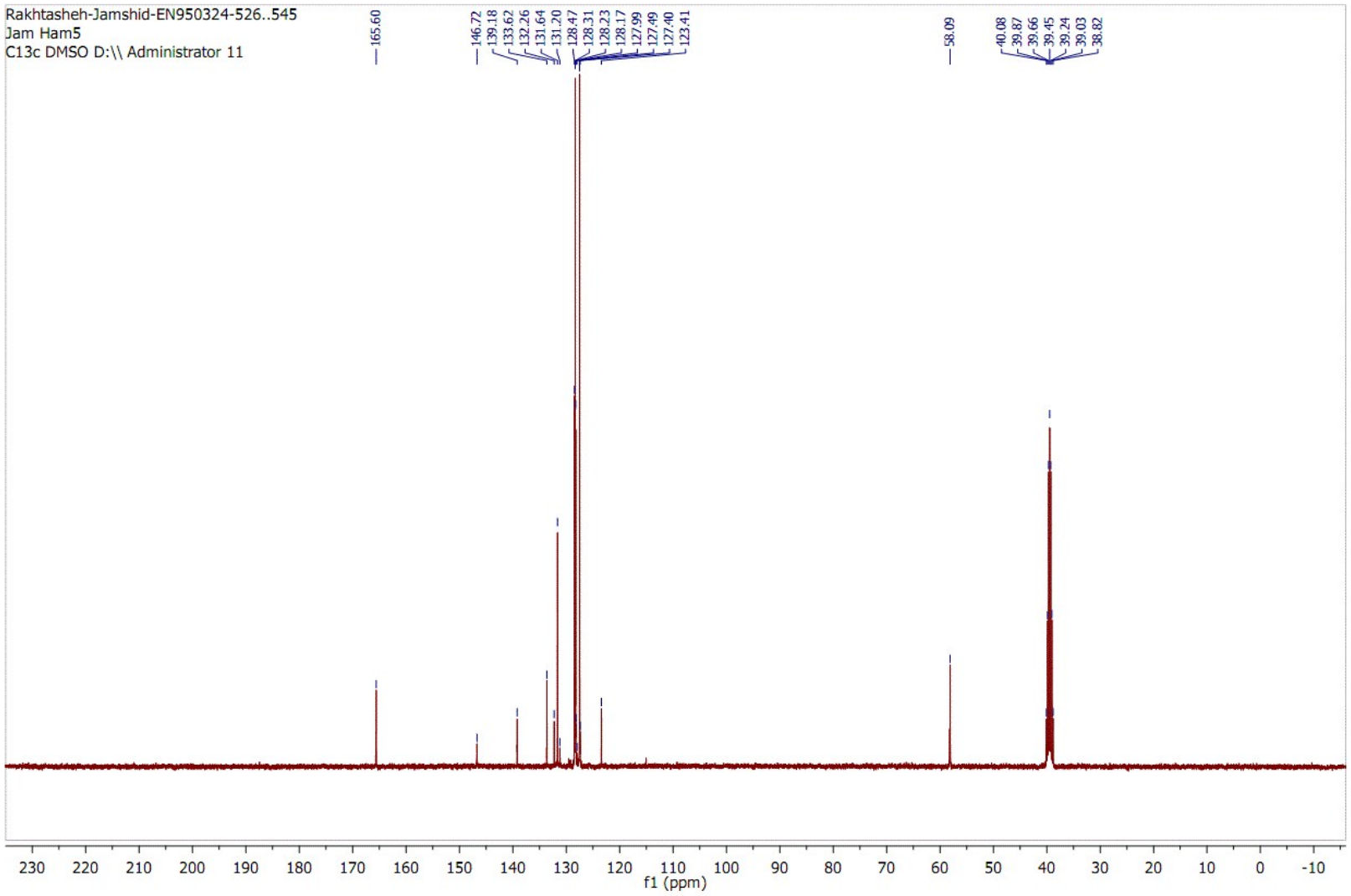


Fig S4.*The ^{13}C NMR of 5-amino-3-(perfluorophenyl)-1-phenyl-1H-pyrazole-4-carbonitrile (Table 3, entry 5)*

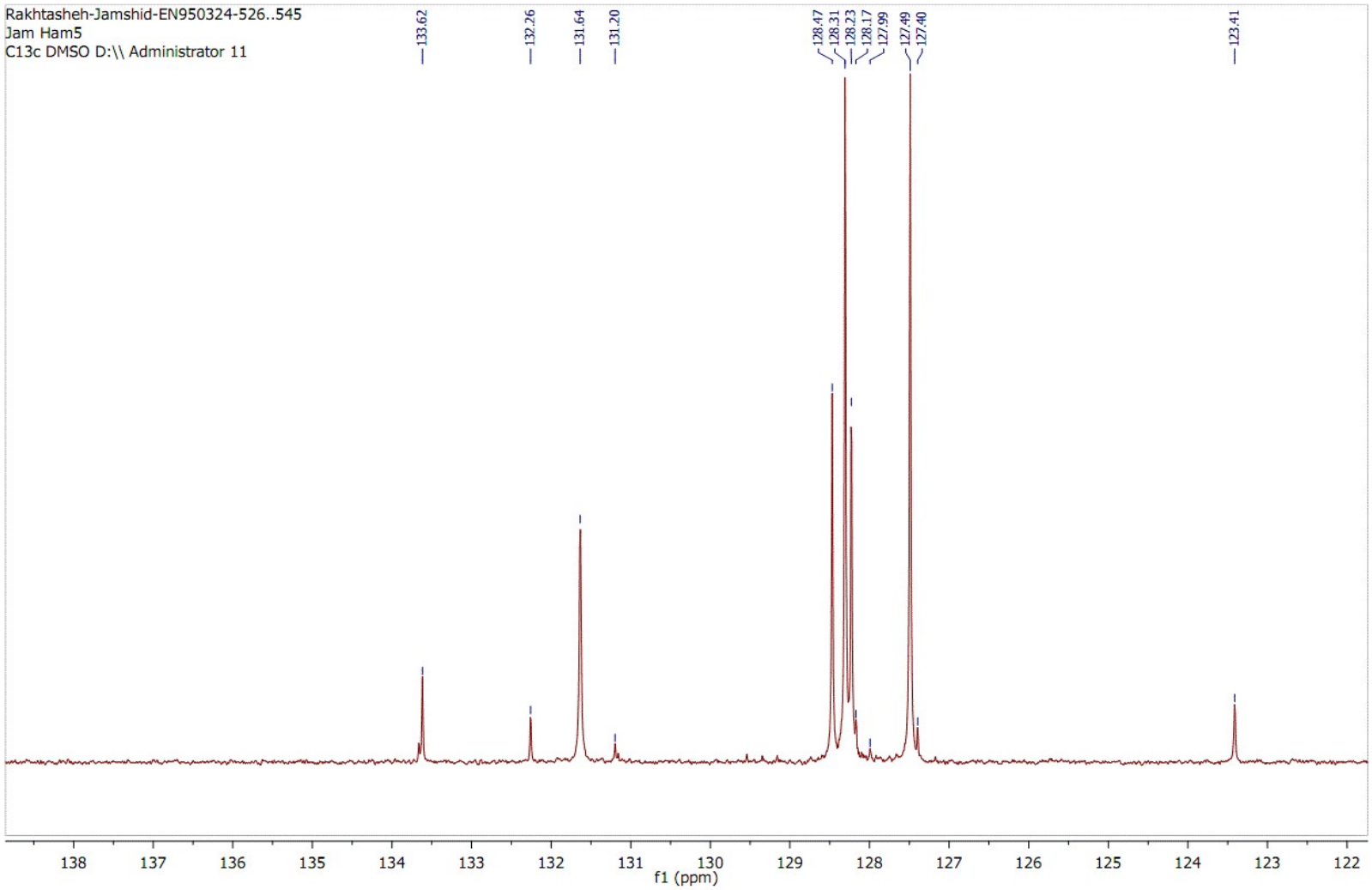


Fig S5.*The expanded* ^{13}C *NMR of 5-amino-3-(perfluorophenyl)-1-phenyl-1H-pyrazole-4-carbonitrile (Table 3, entry 5)*

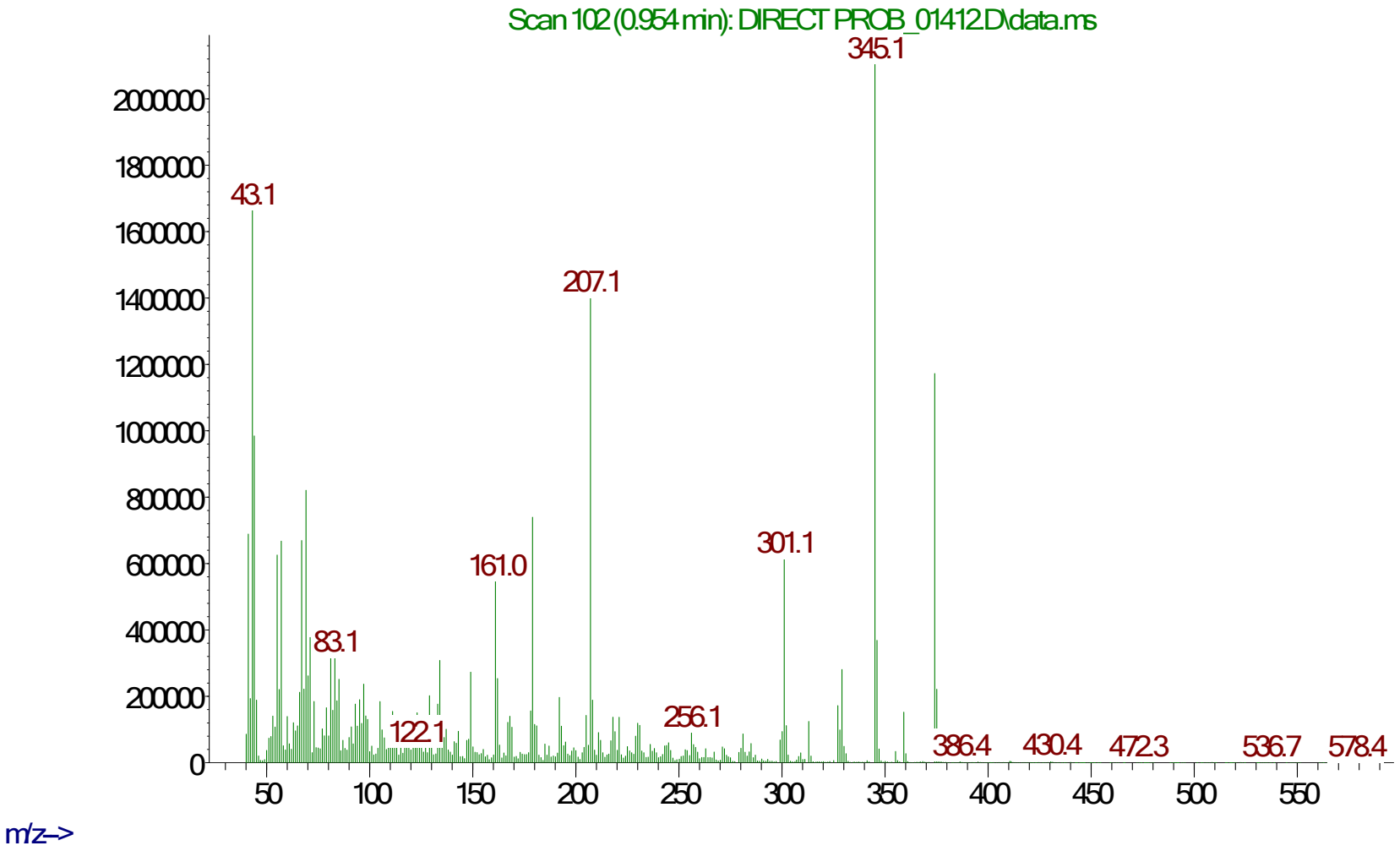


Fig S6. *The Mass spectrea of 5-amino-3-(perfluorophenyl)-1-phenyl-1H-pyrazole-4-carbonitrile (Table 3, entry 5)*

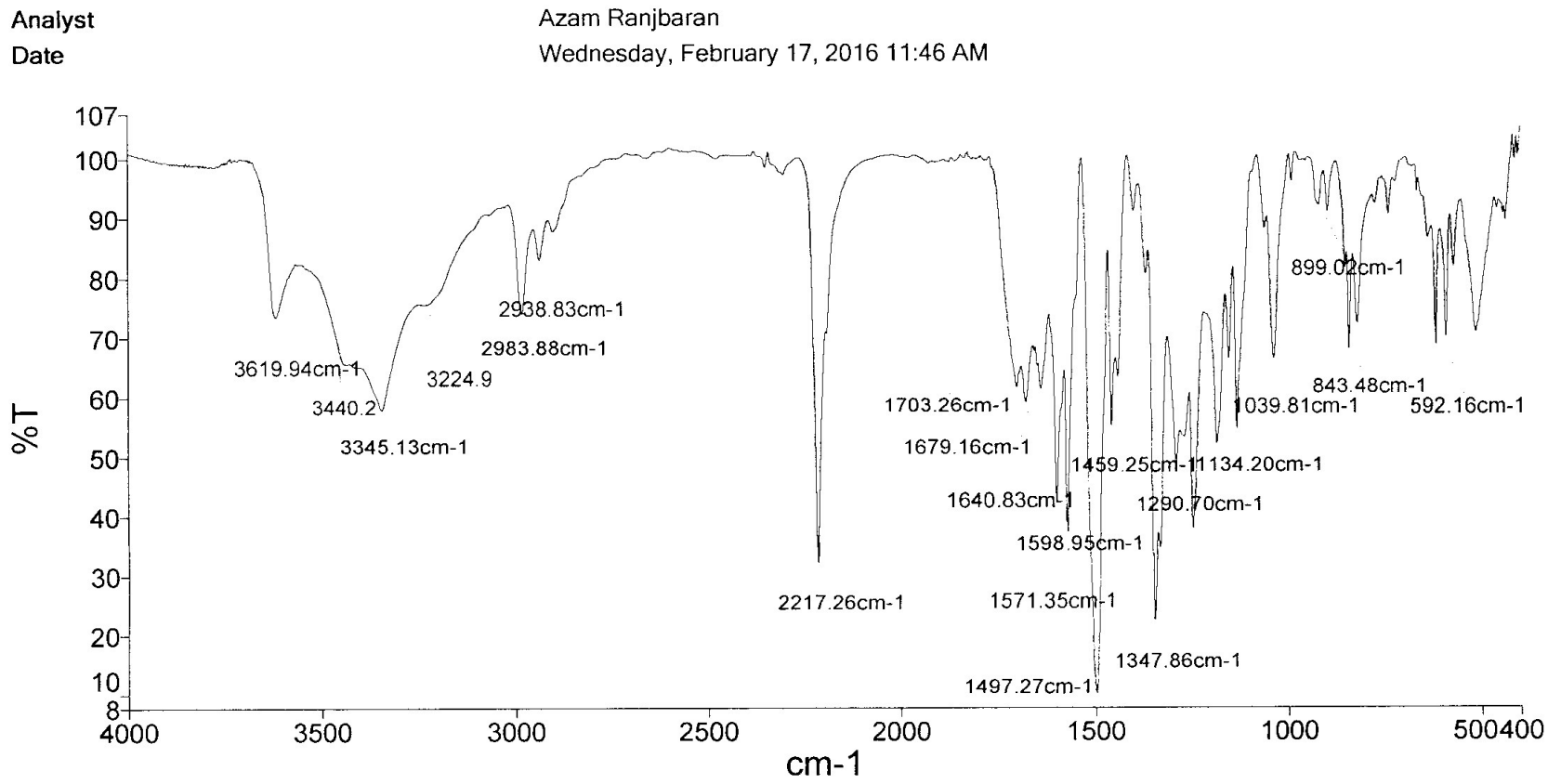


Fig S7.*The IR of 5-amino-1-phenyl-3-(ferrocene-yl)-1H-pyrazole-4-carbonitrile (Table 3, entry 6)*

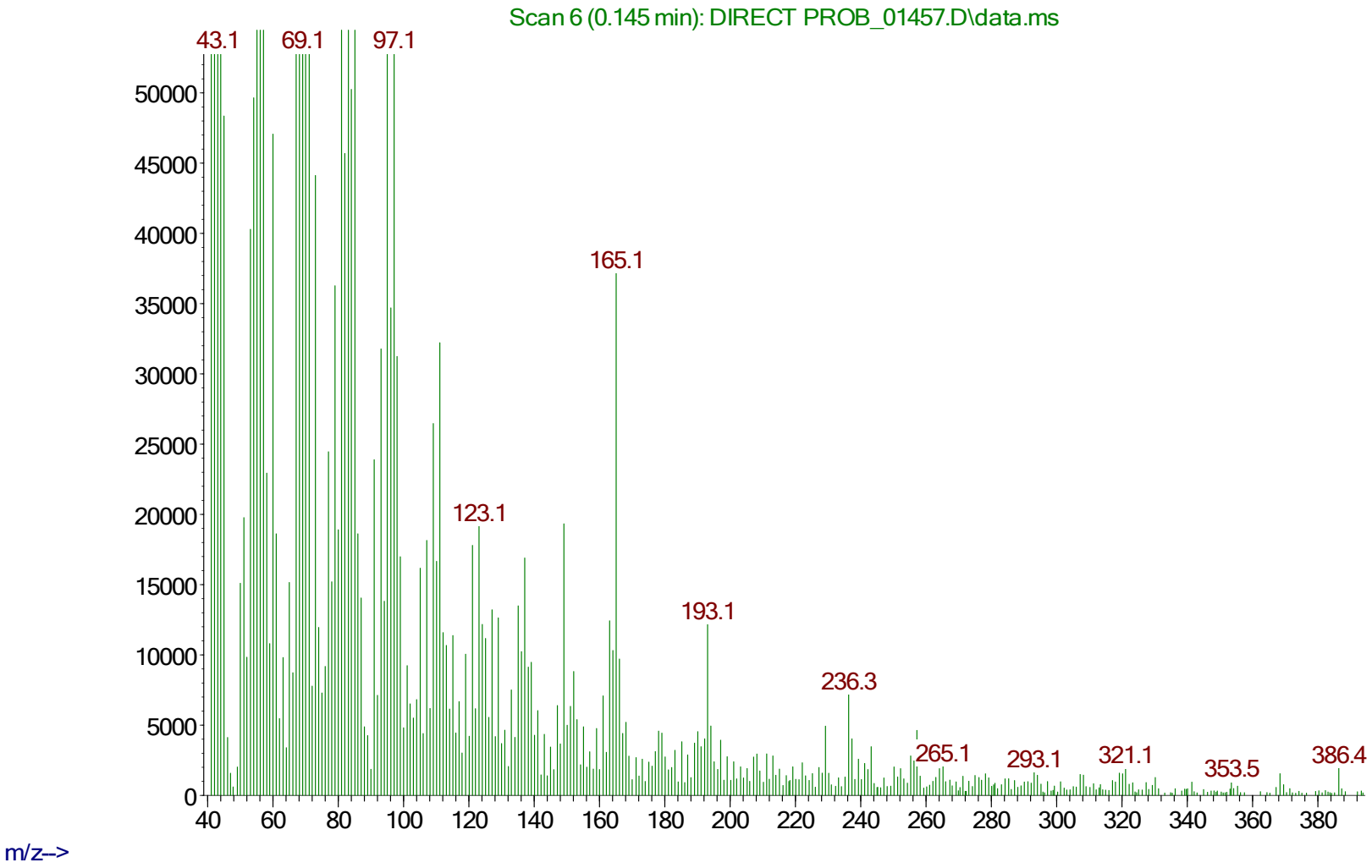


Fig S8.*The Mass spectrea of 5-amino-1-phenyl-3-(ferrocene-yl)-1H-pyrazole-4-carbonitrile (Table 3, entry 6)*

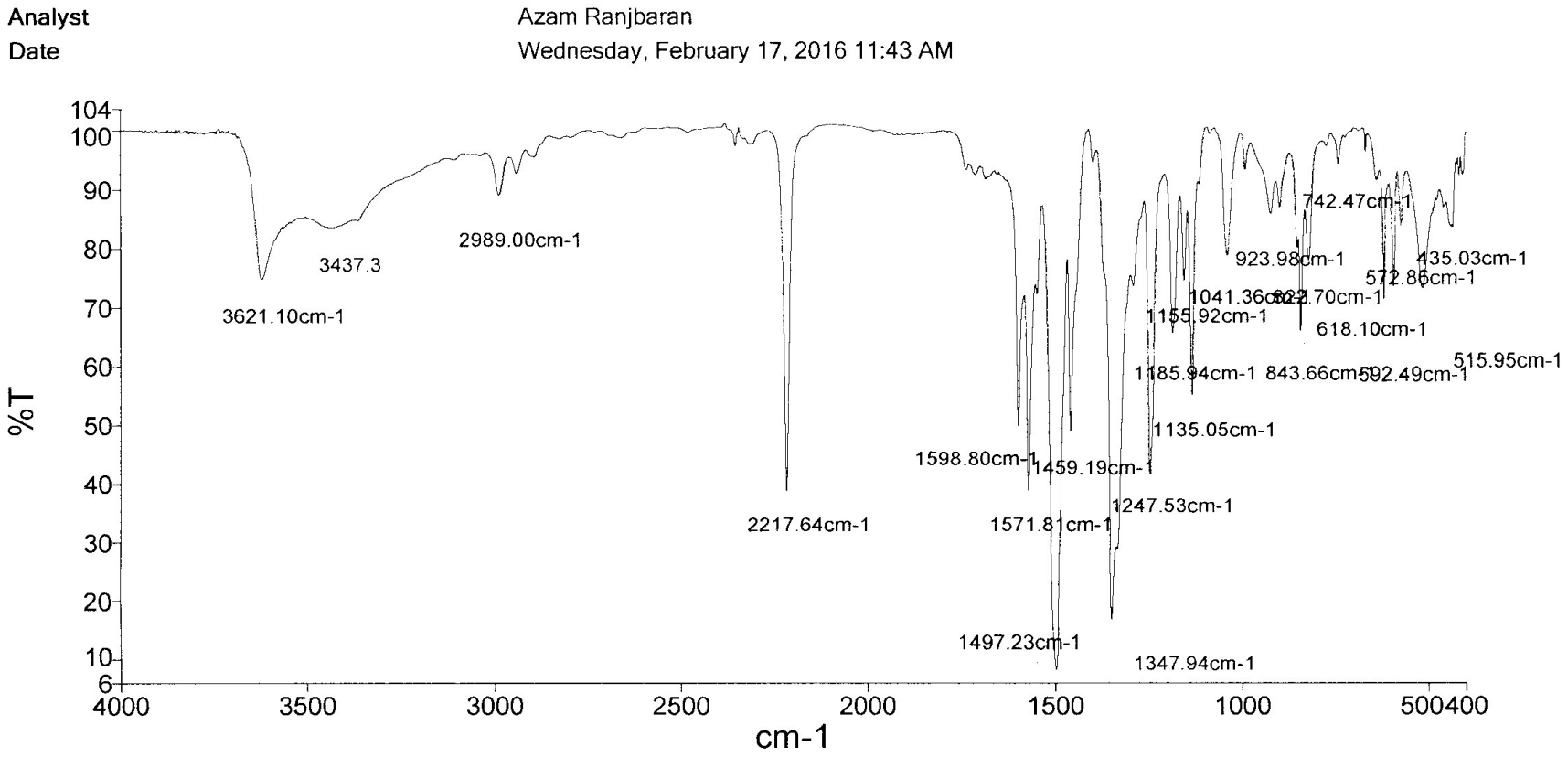


Fig S9.*The IR of 5-amino-3-(5-fluoro-2-hydroxyphenyl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 7)*

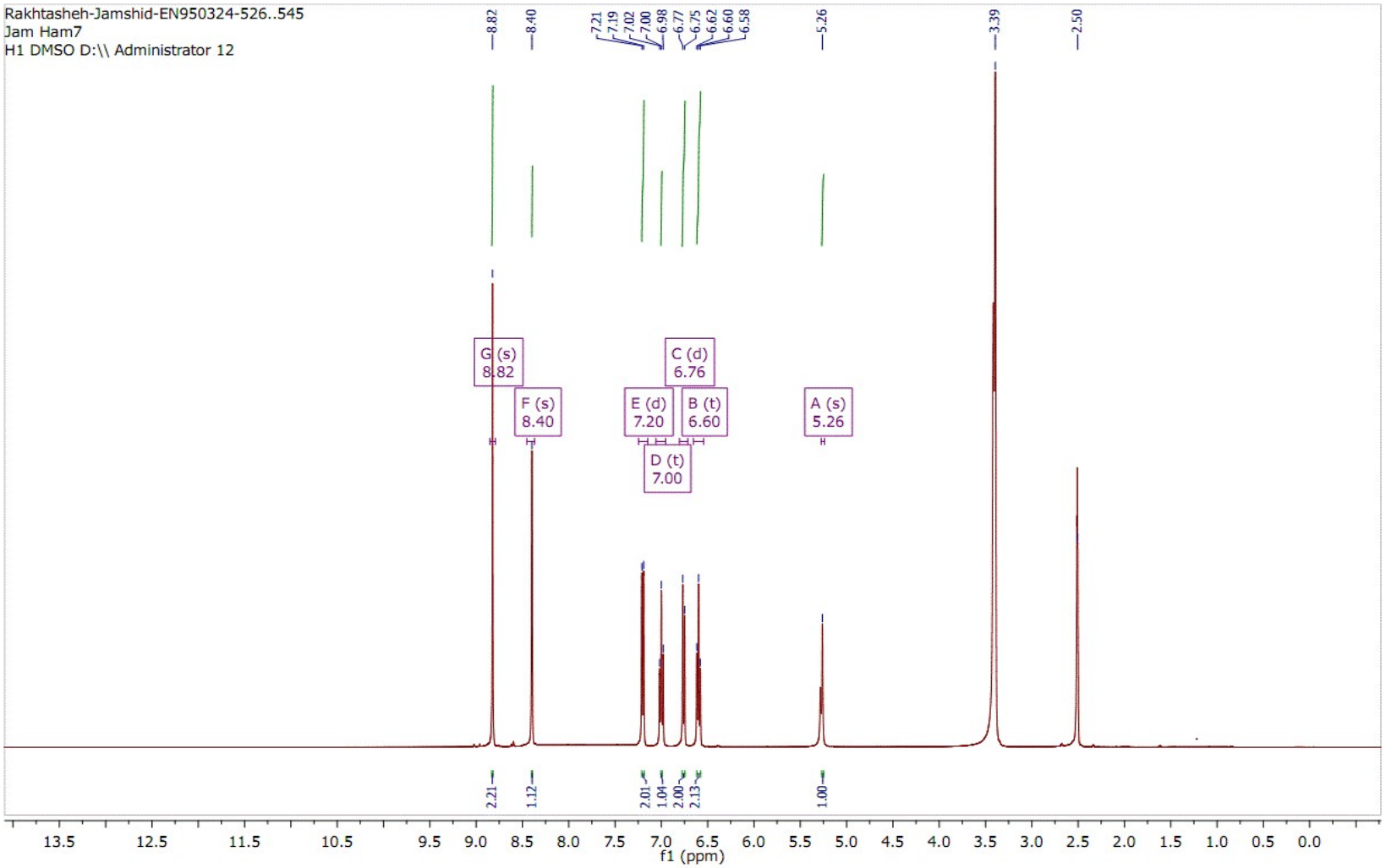


Fig S10.*The [1]H NMR of 5-amino-3-(5-fluoro-2-hydroxyphenyl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 7)*

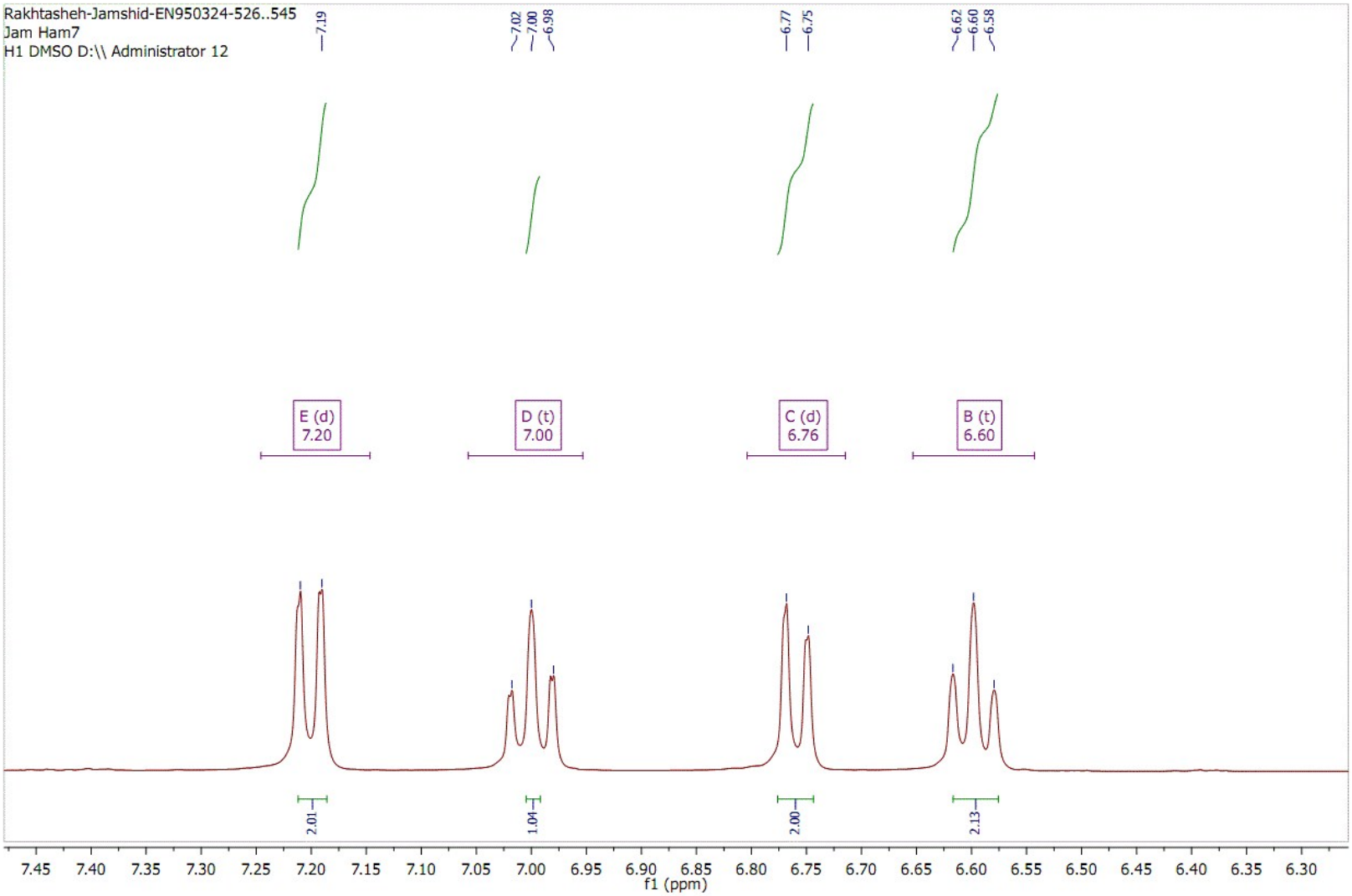


Fig S11.*The expand [1]H NMR of 5-amino-3-(5-fluoro-2-hydroxyphenyl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 7)*

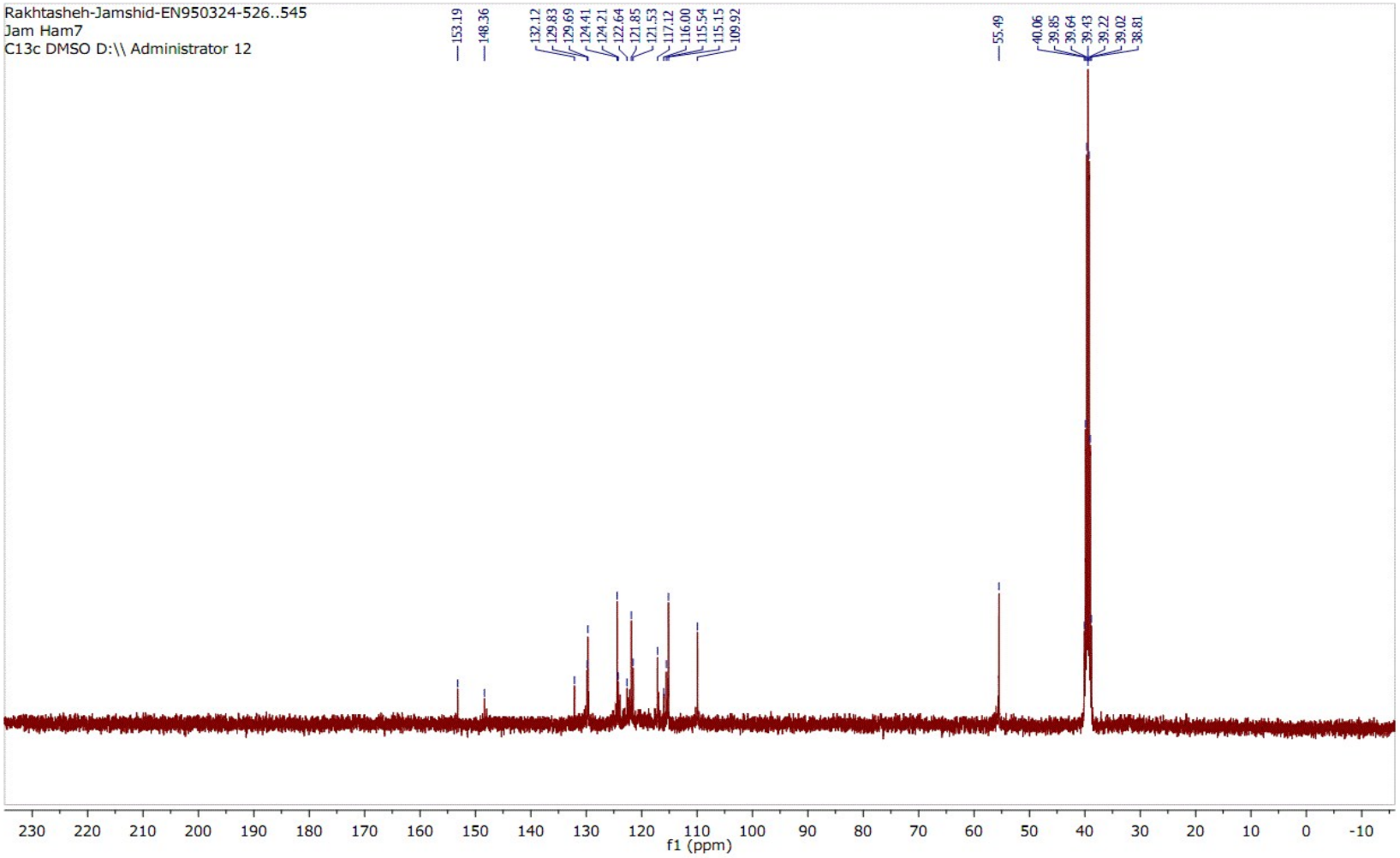


Fig S12.*The ^{13}C NMR of 5-amino-3-(5-fluoro-2-hydroxyphenyl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 7)*

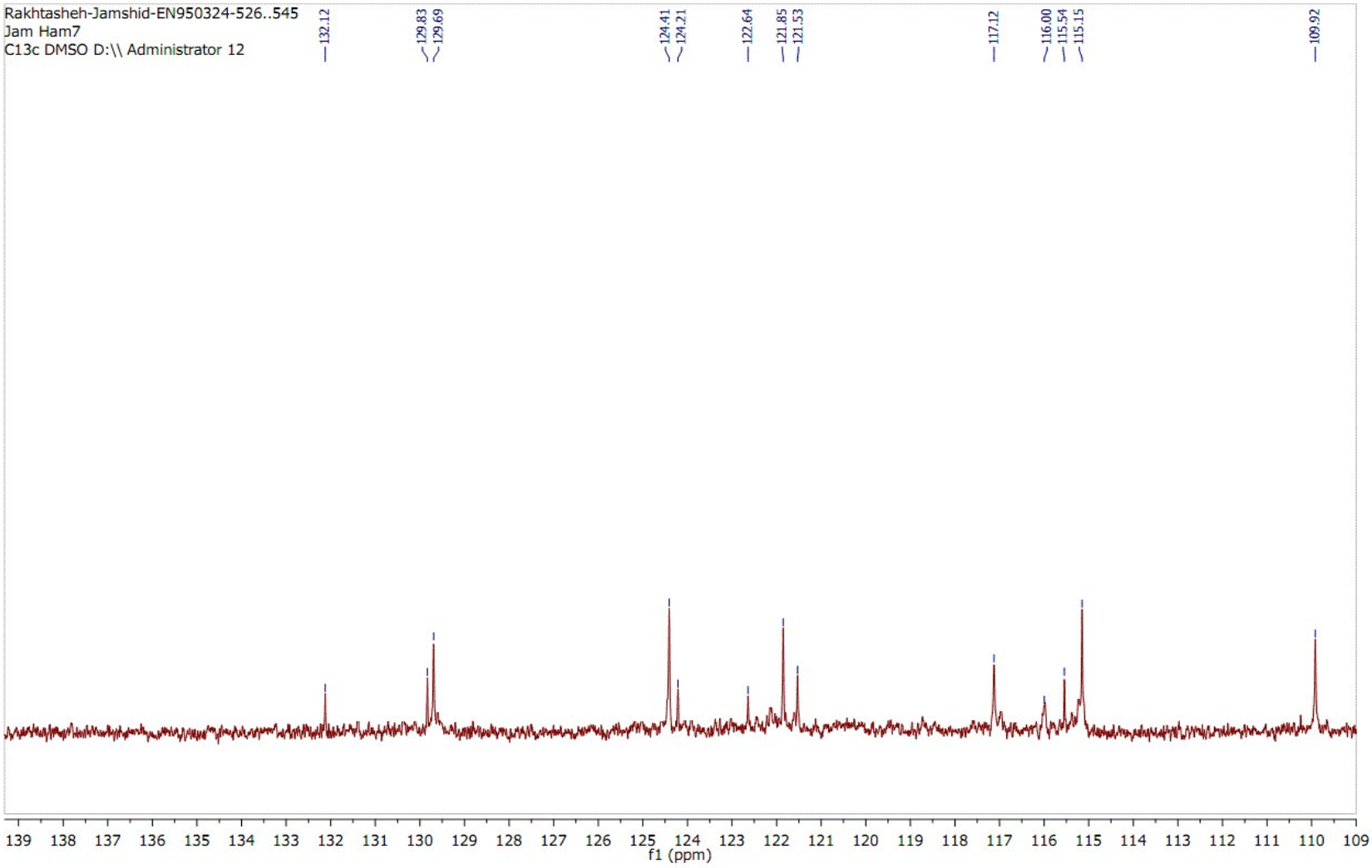


Fig S13.*The expanded ^{13}C NMR of 5-amino-3-(5-fluoro-2-hydroxyphenyl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 7)*

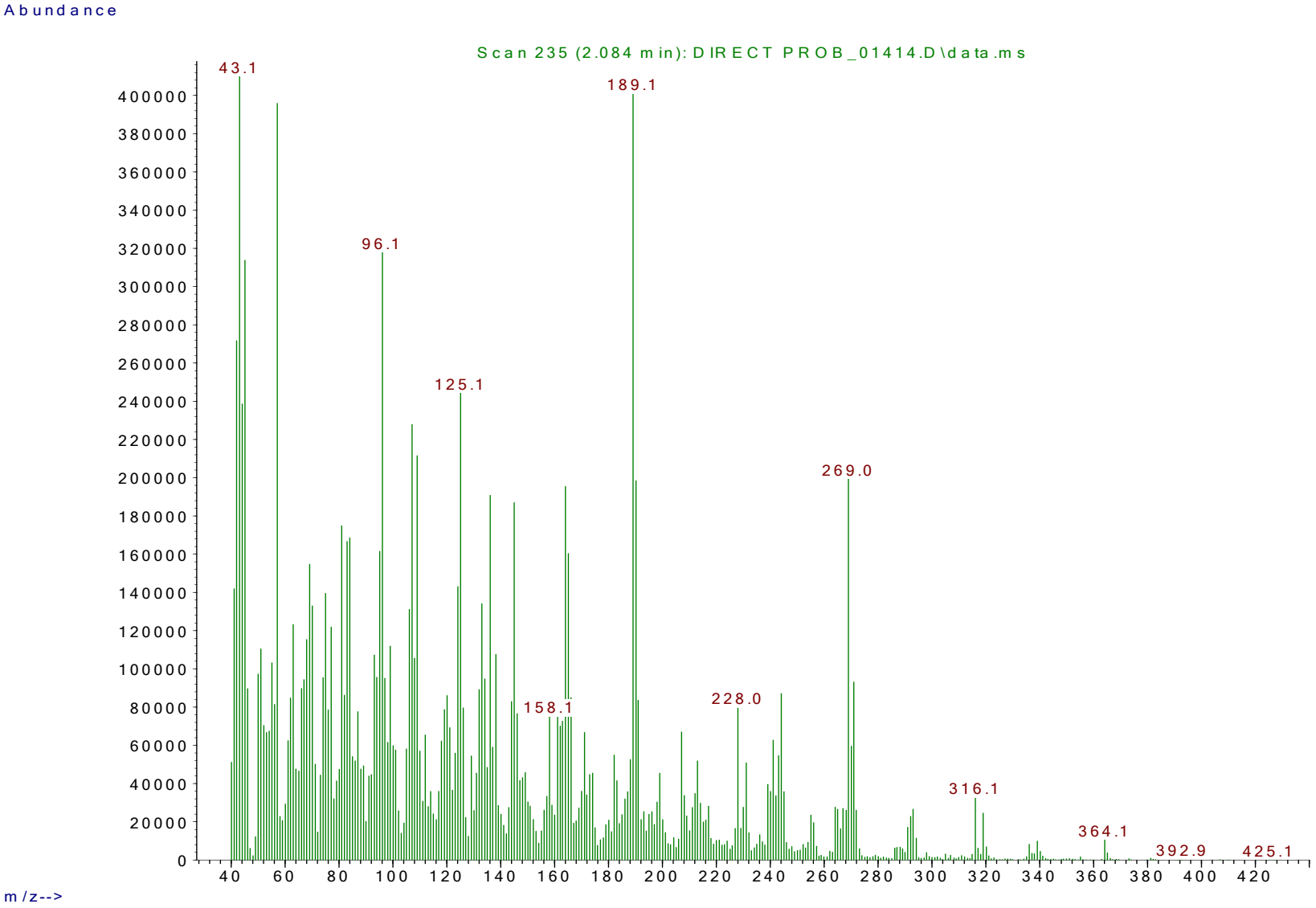


Fig S14.*The Mass spectrea of 5-amino-3-(5-fluoro-2-hydroxyphenyl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 7)*

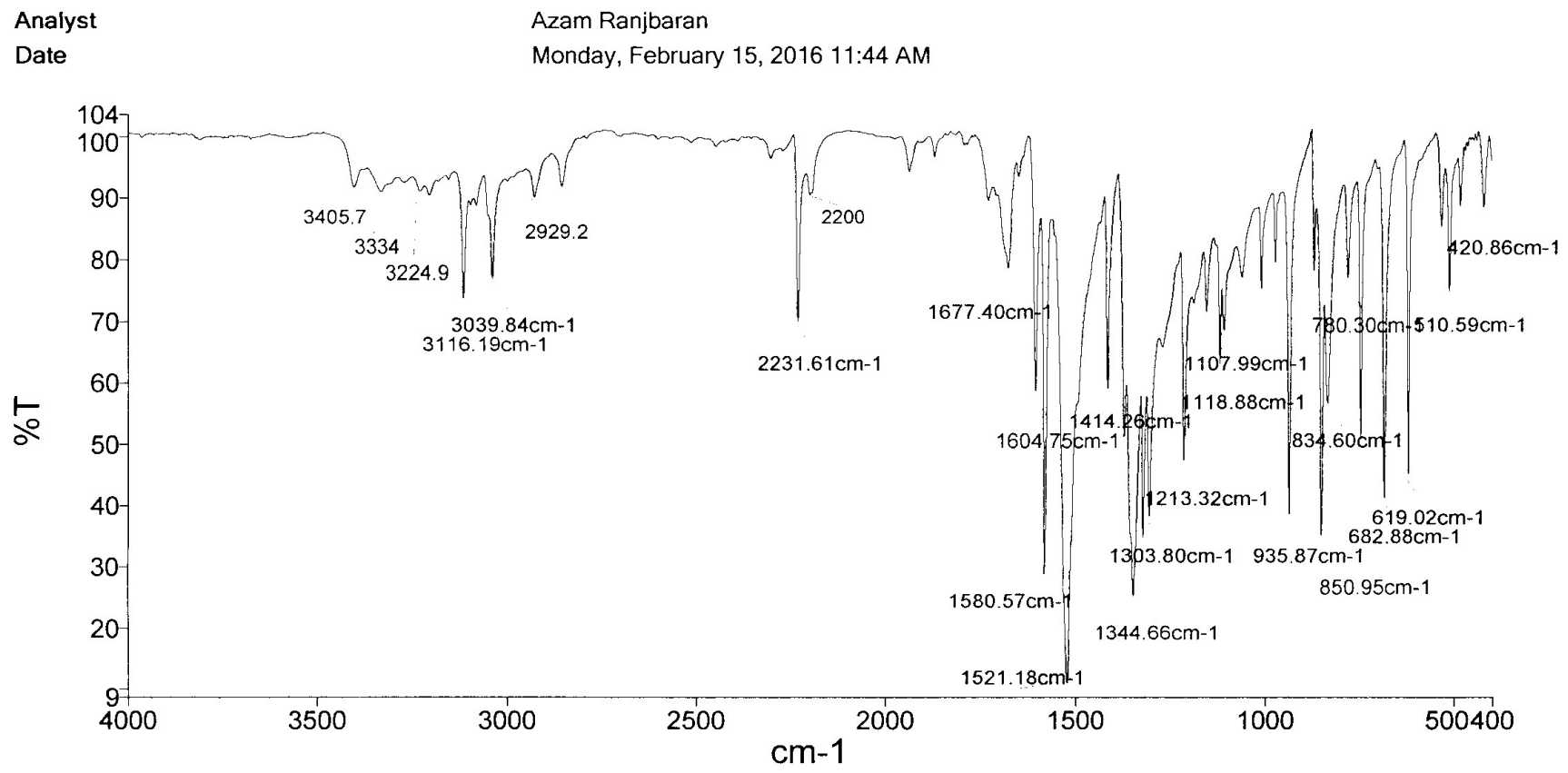


Fig S15.*The IR of 5-amino-1-phenyl-3-(1H-pyrrol-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 8)*

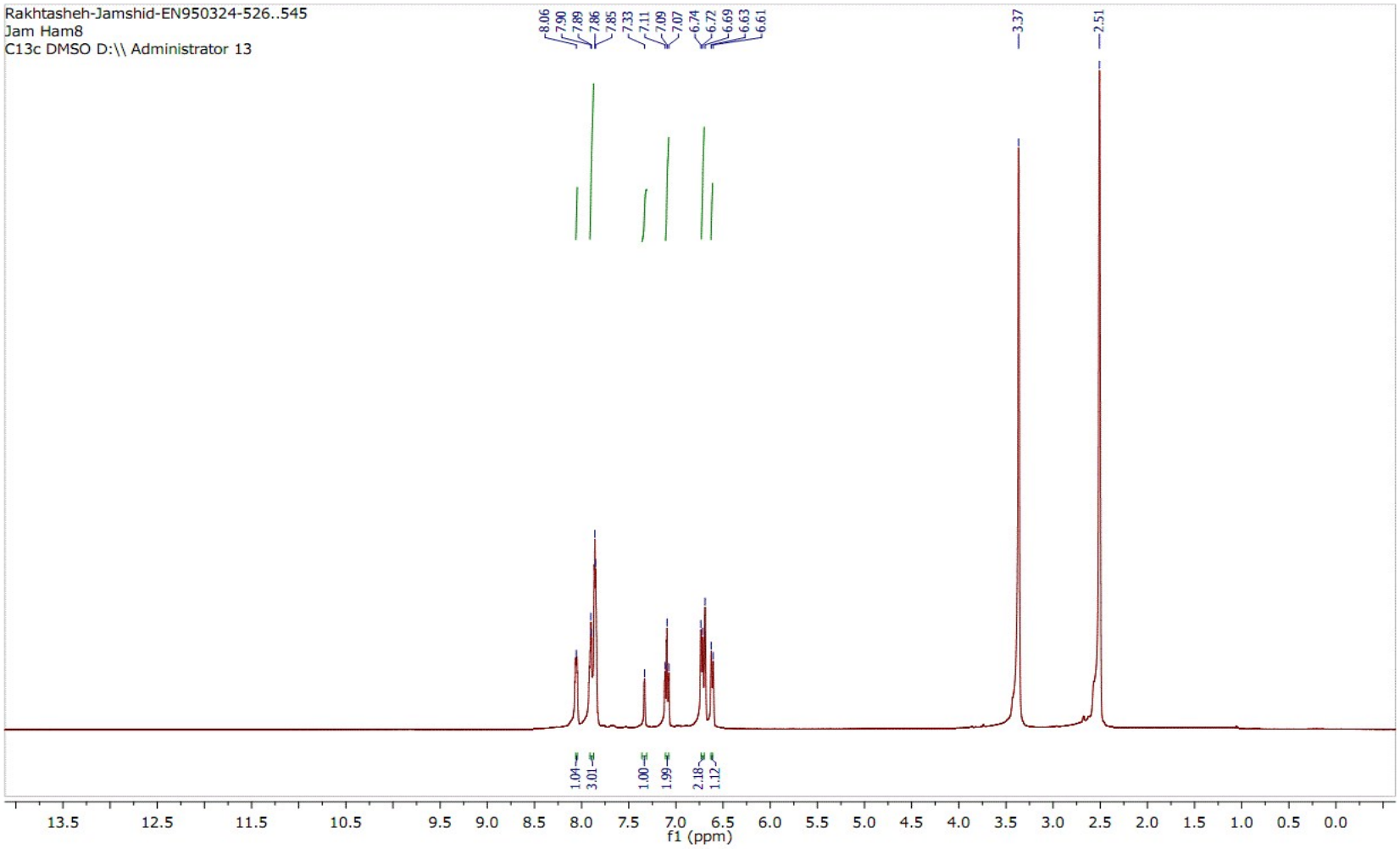


Fig S16.*The [1]H NMR of 5-amino-1-phenyl-3-(1H-pyrrol-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 8)*

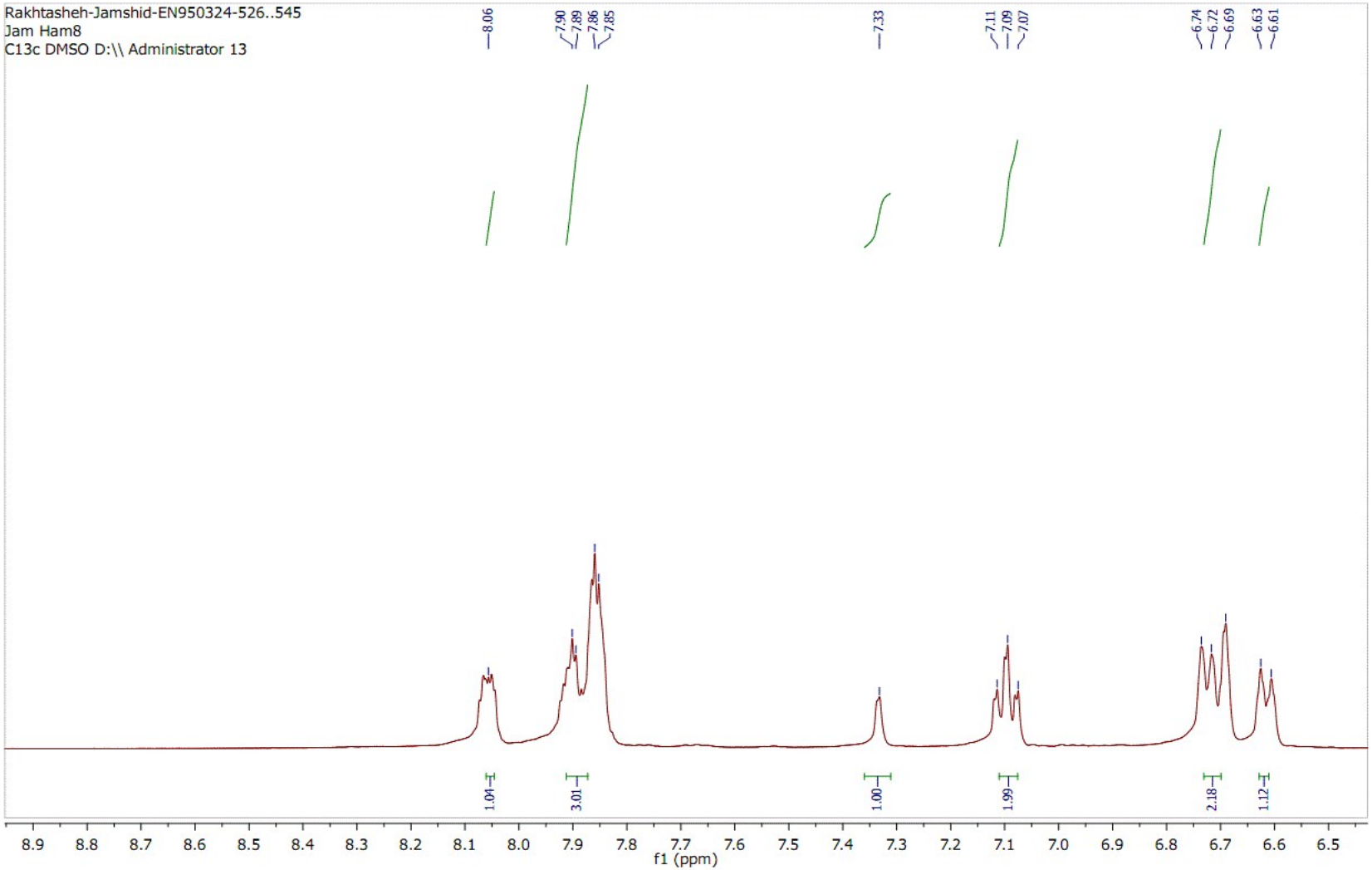


Fig S17.*The expanded [1]H NMR of 5-amino-1-phenyl-3-(1H-pyrrol-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 8)*

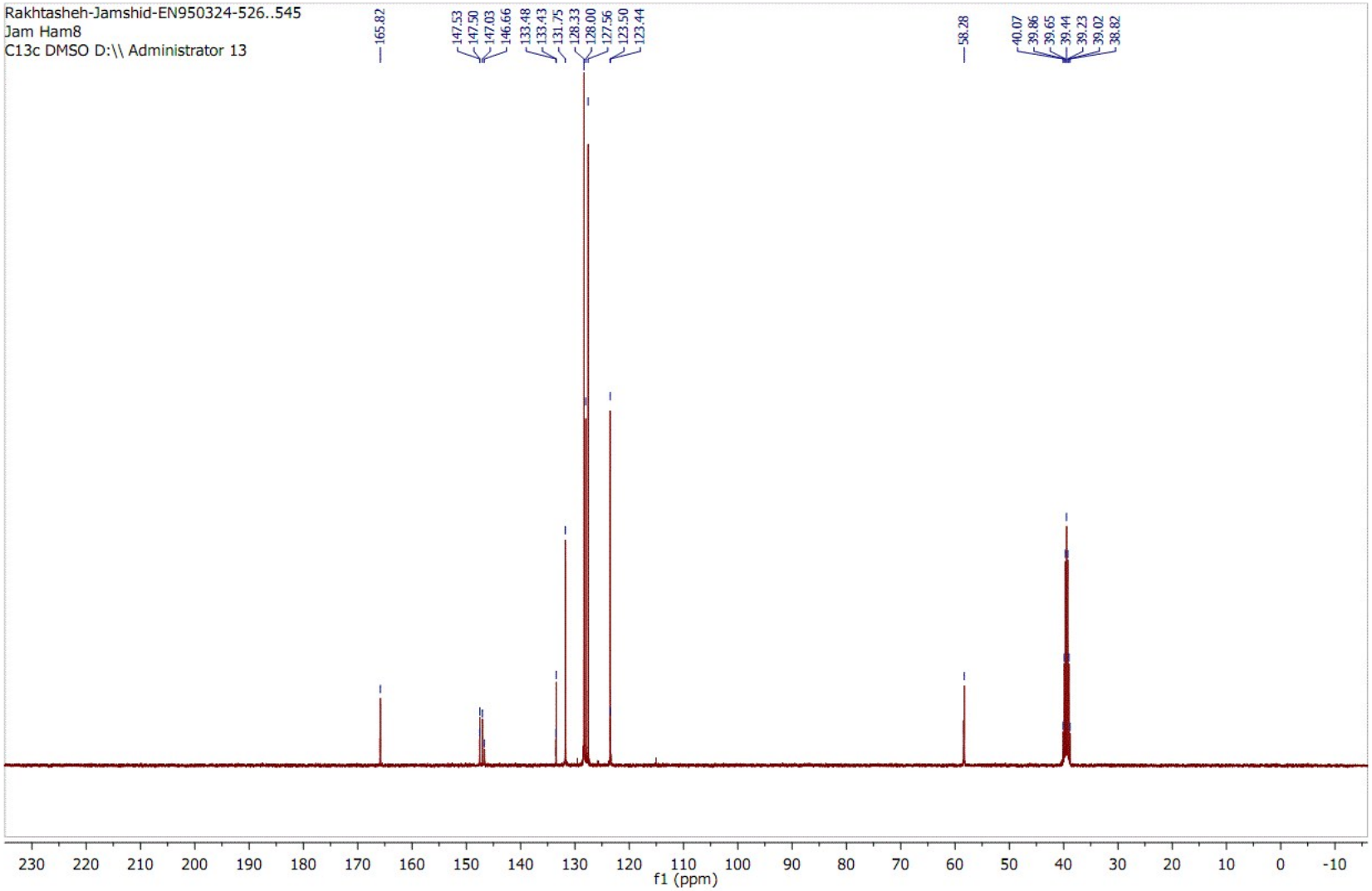


Fig S18.*The ^{13}C NMR of 5-amino-1-phenyl-3-(1H-pyrrol-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 8)*

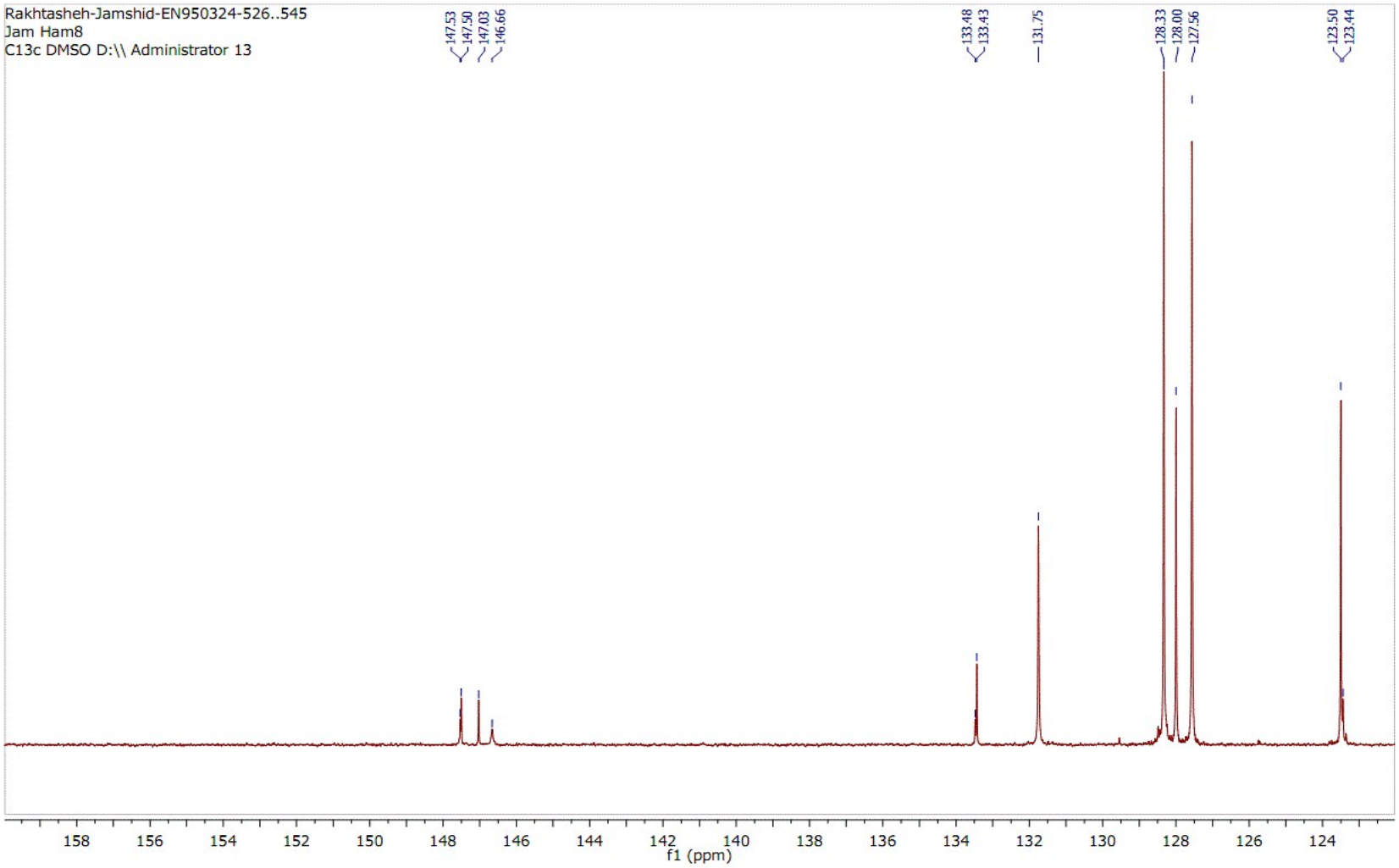


Fig S19.*The expanded ^{13}C NMR of 5-amino-1-phenyl-3-(1H-pyrrol-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 8)*

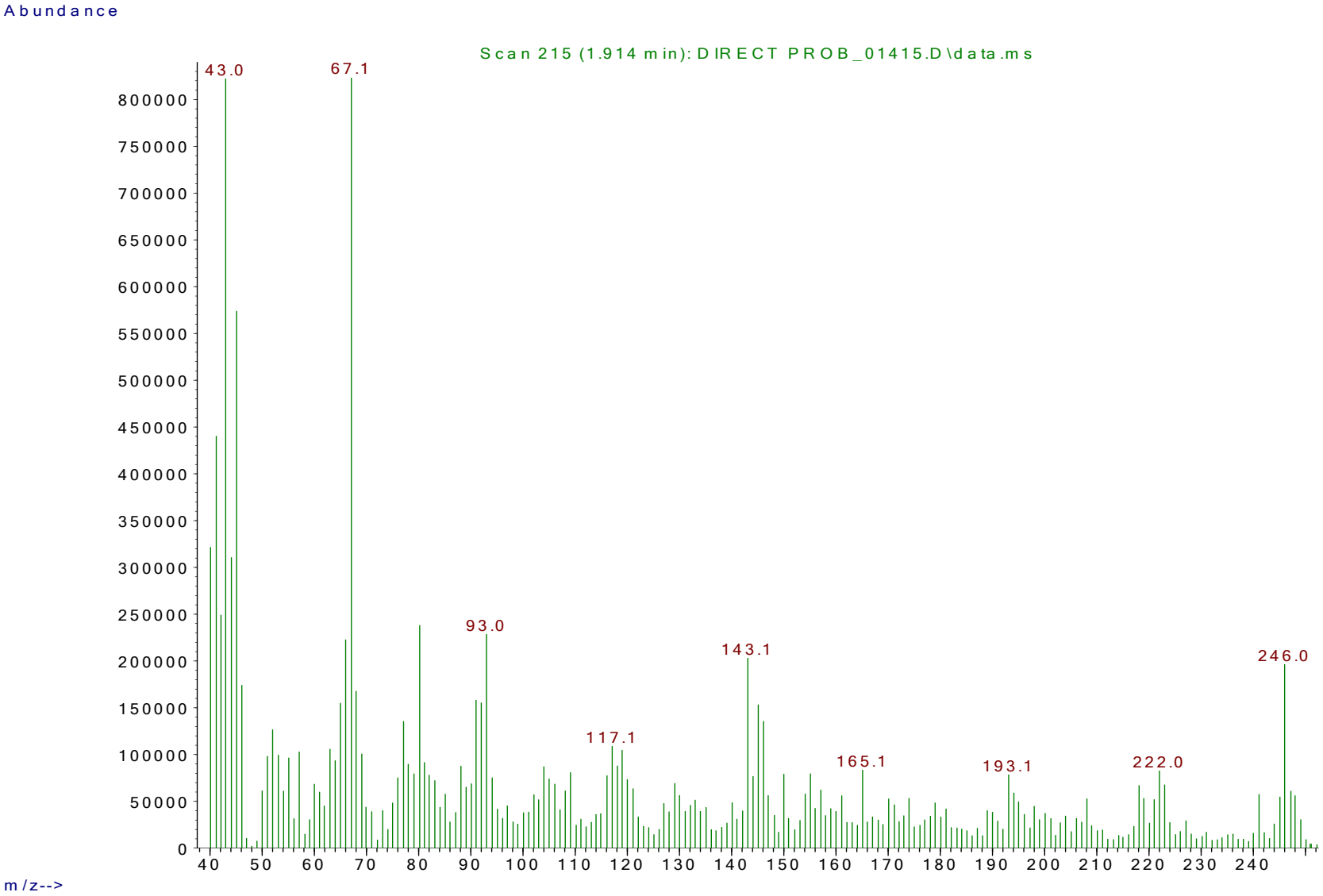


Fig S20.*The Mass spectrea of 5-amino-1-phenyl-3-(1H-pyrrol-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 8)*

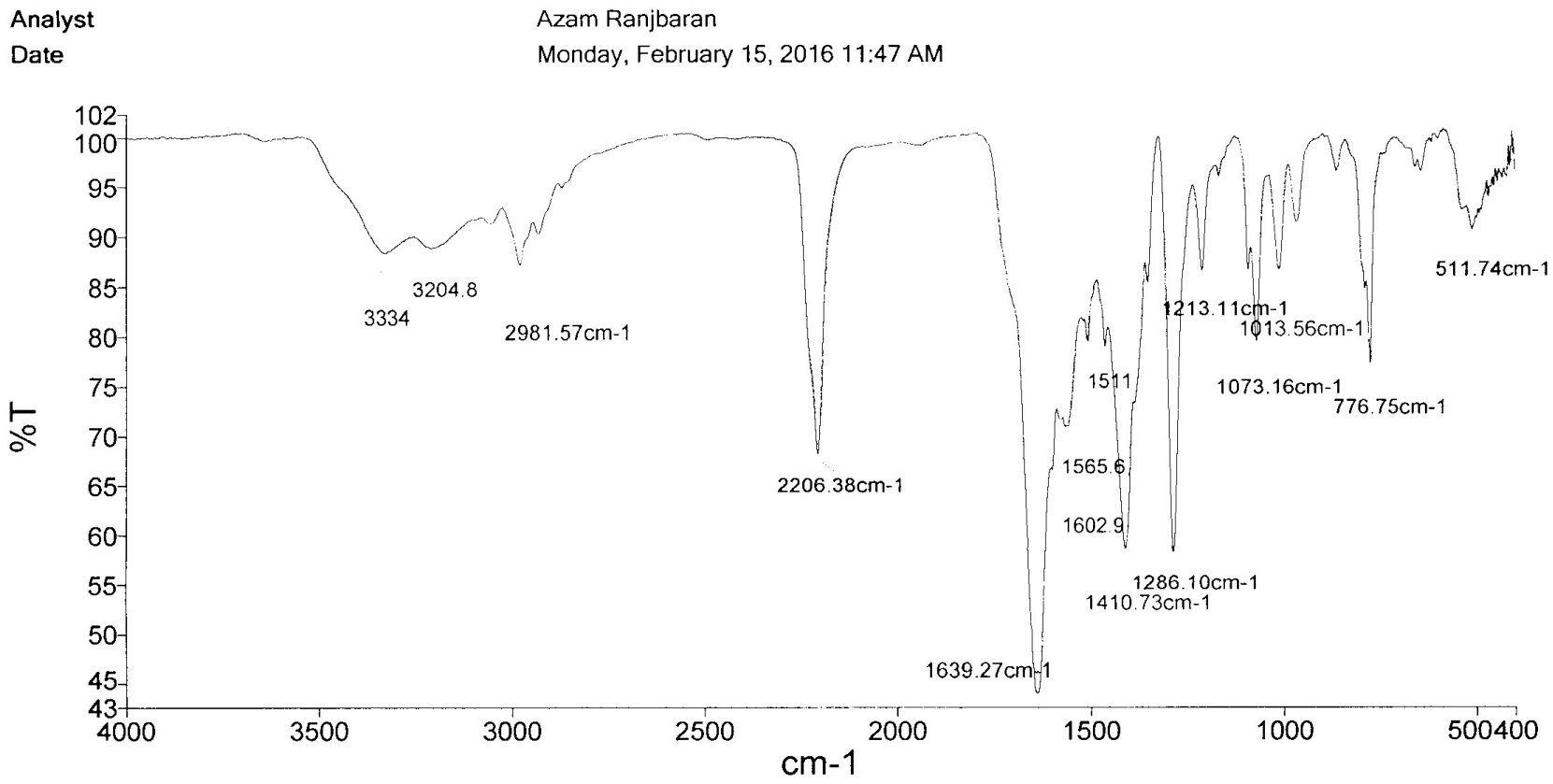


Fig S21.*The IR of 5-amino-3-(furan-2-yl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 12)*

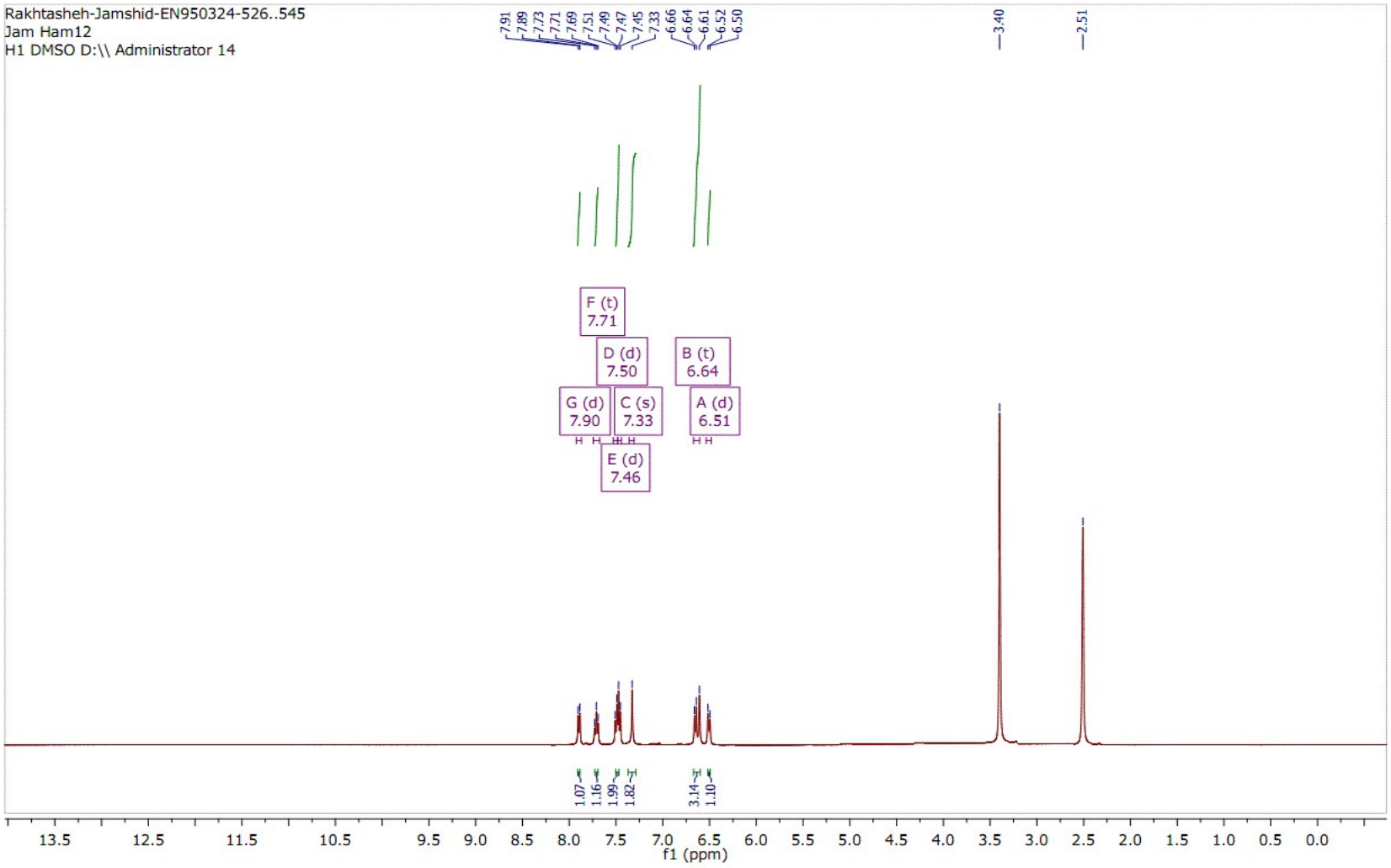


Fig S22.*The [1]H NMR of 5-amino-3-(furan-2-yl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 12)*

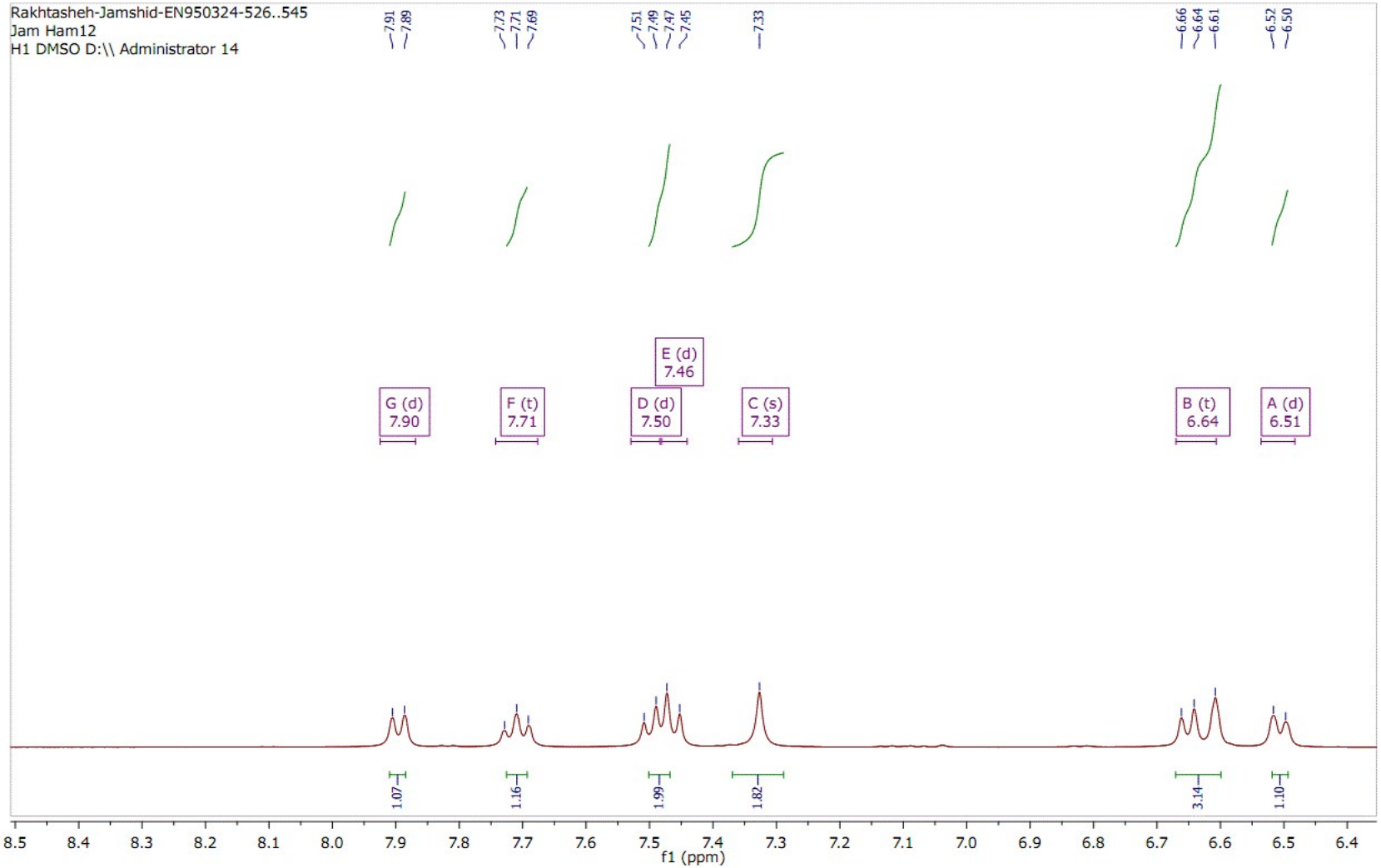


Fig S23.*The expanded [1]H NMR of 5-amino-3-(furan-2-yl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 12)*

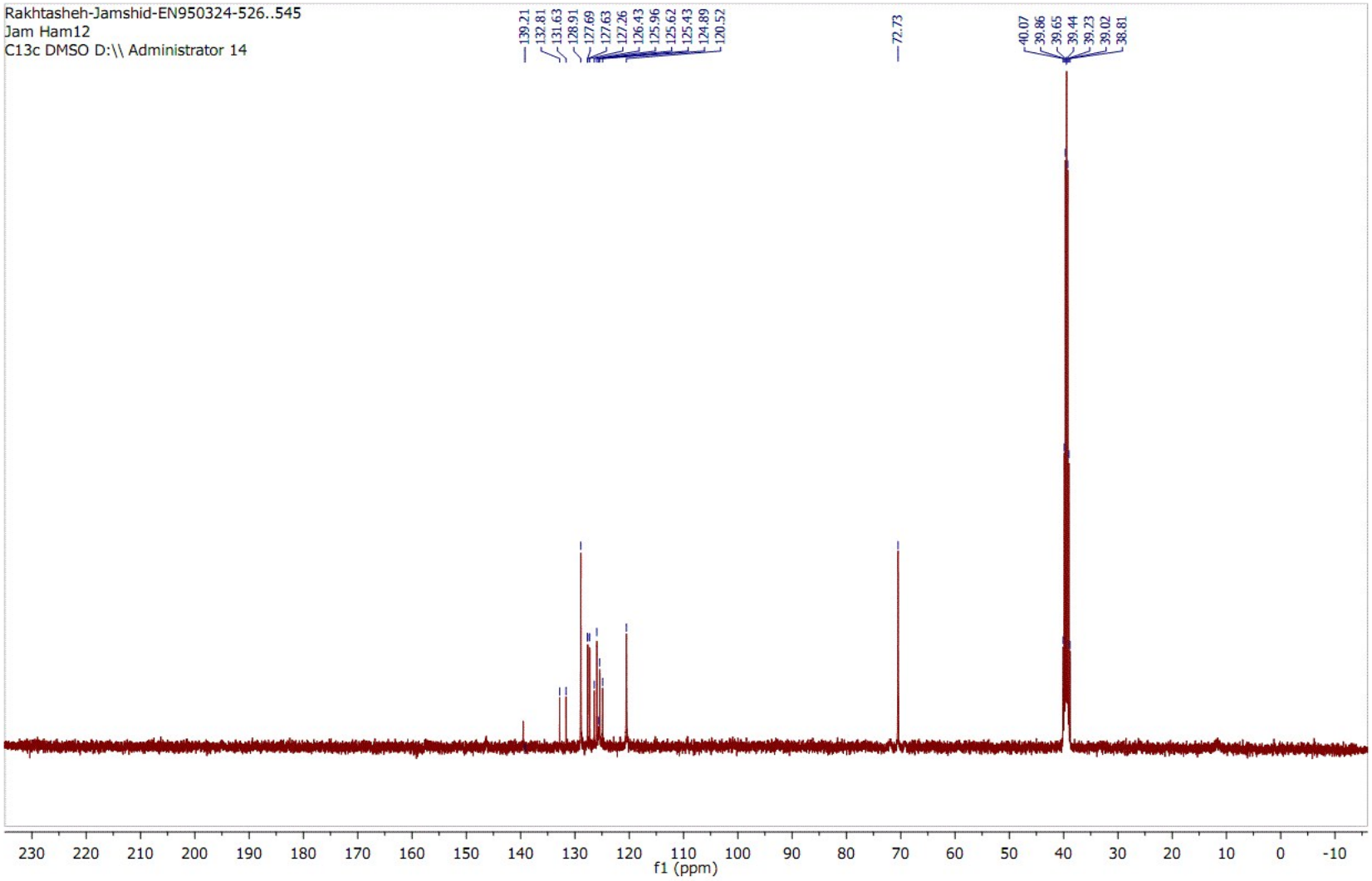


Fig S24.*The ^{13}C NMR of 5-amino-3-(furan-2-yl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 12)*

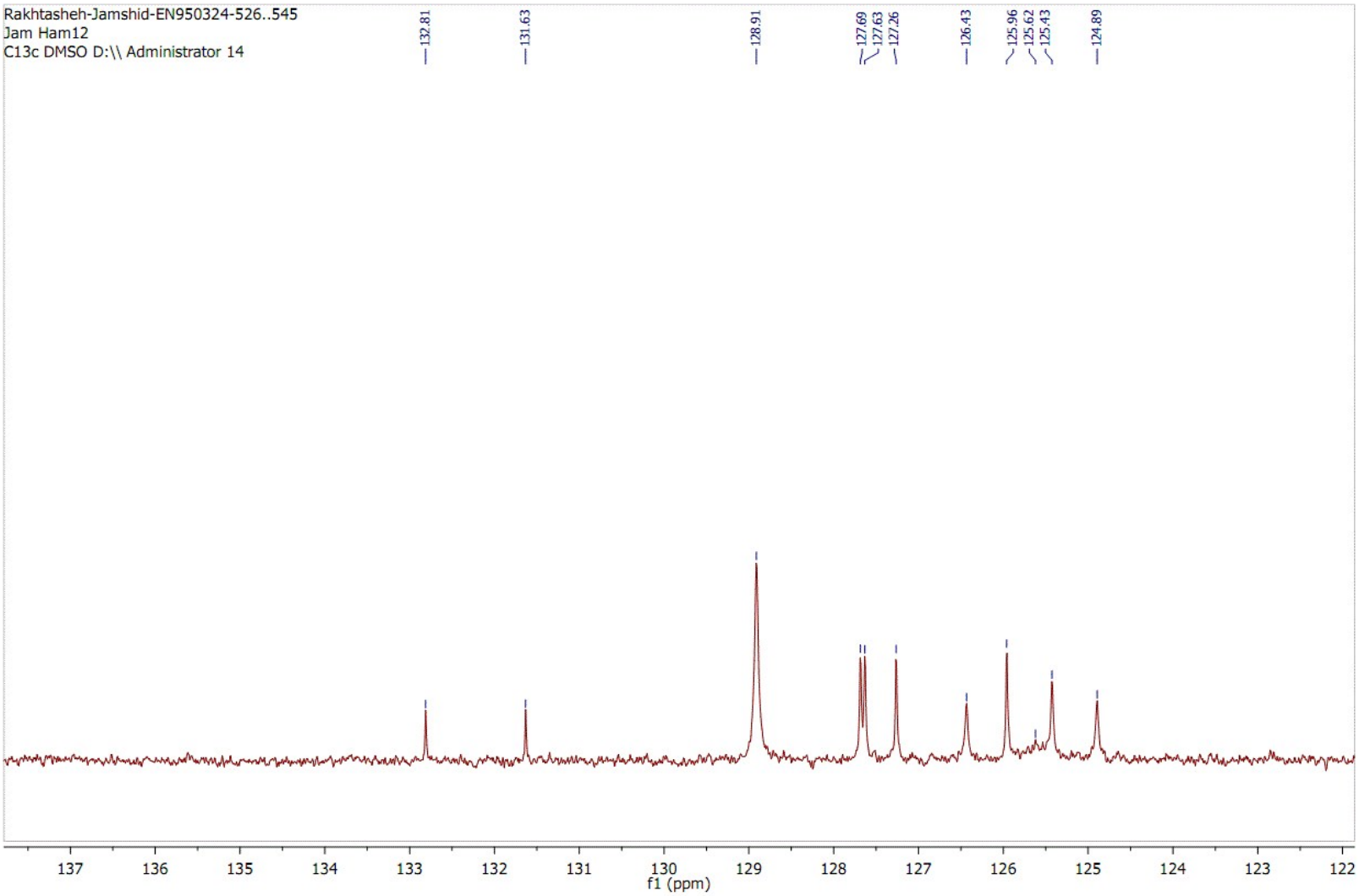


Fig S25.*The expanded ^{13}C NMR of 5-amino-3-(furan-2-yl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 12)*

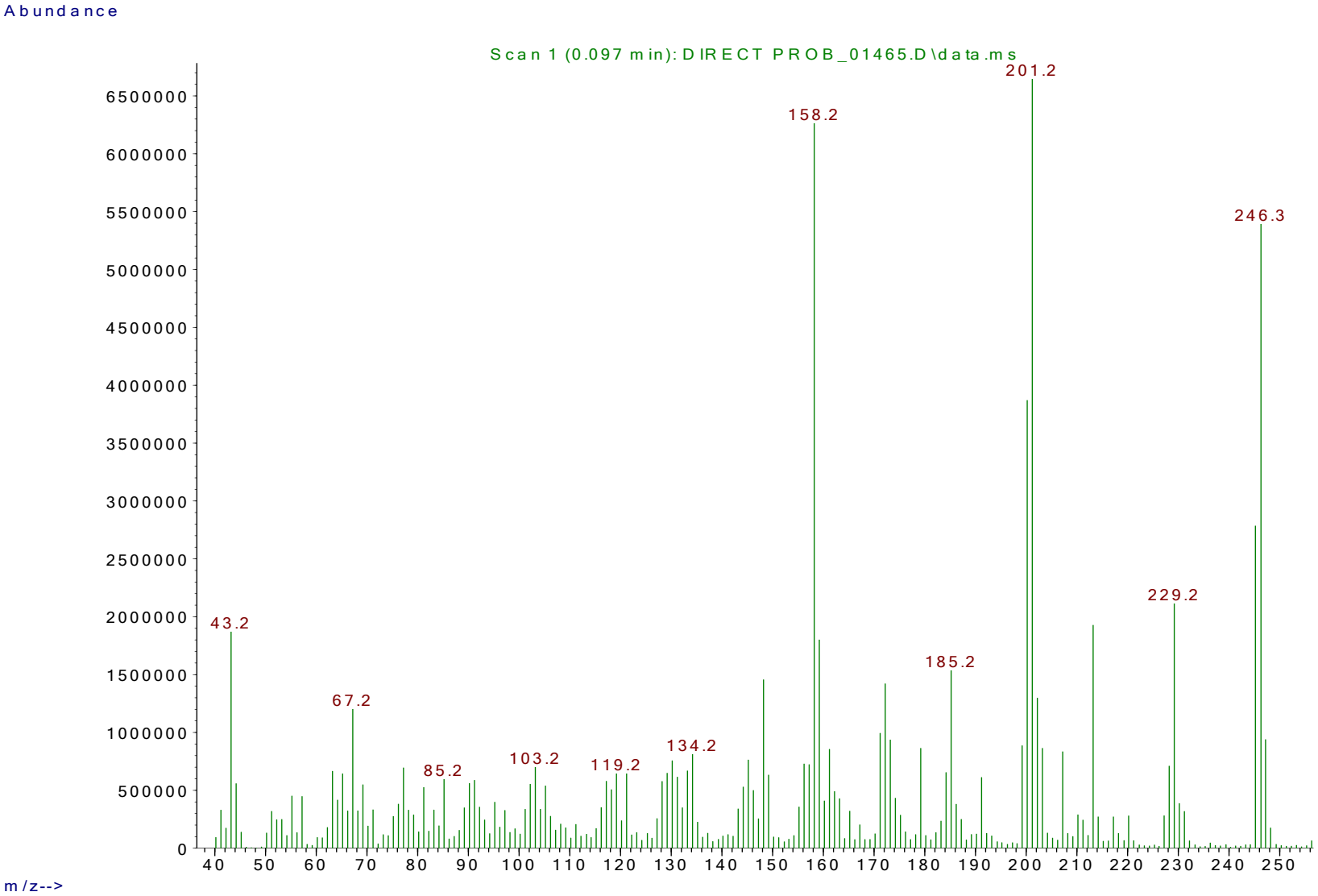


Fig S26.*The Mass spectrea of 5-amino-3-(furan-2-yl)-1-phenyl-1H-pyrazole-4-carbonitrile: (Table 3, entry 12)*

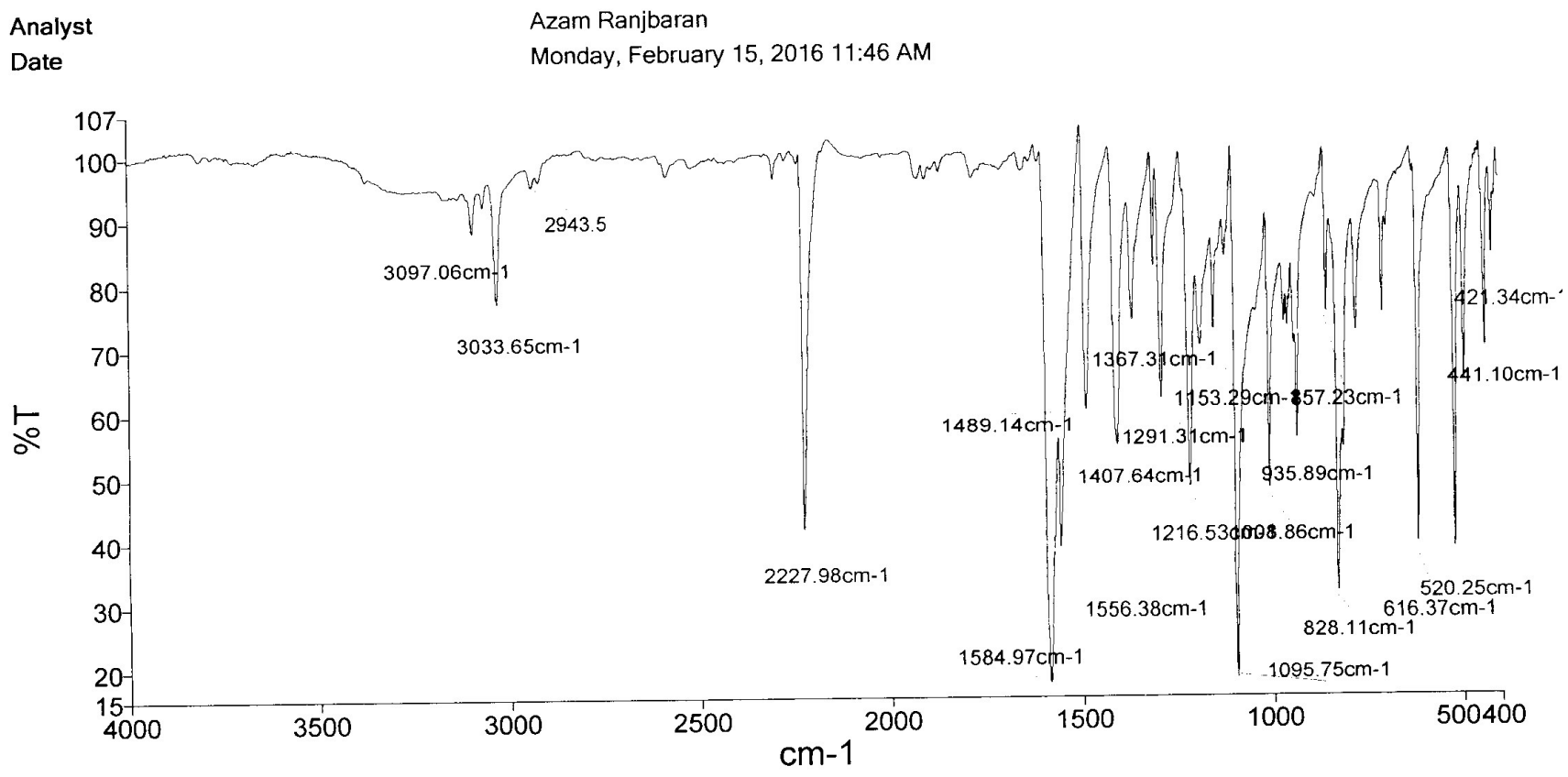


Fig S27.*The IR of 5-amino-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbonitrile: (Table 3, entry 13)*

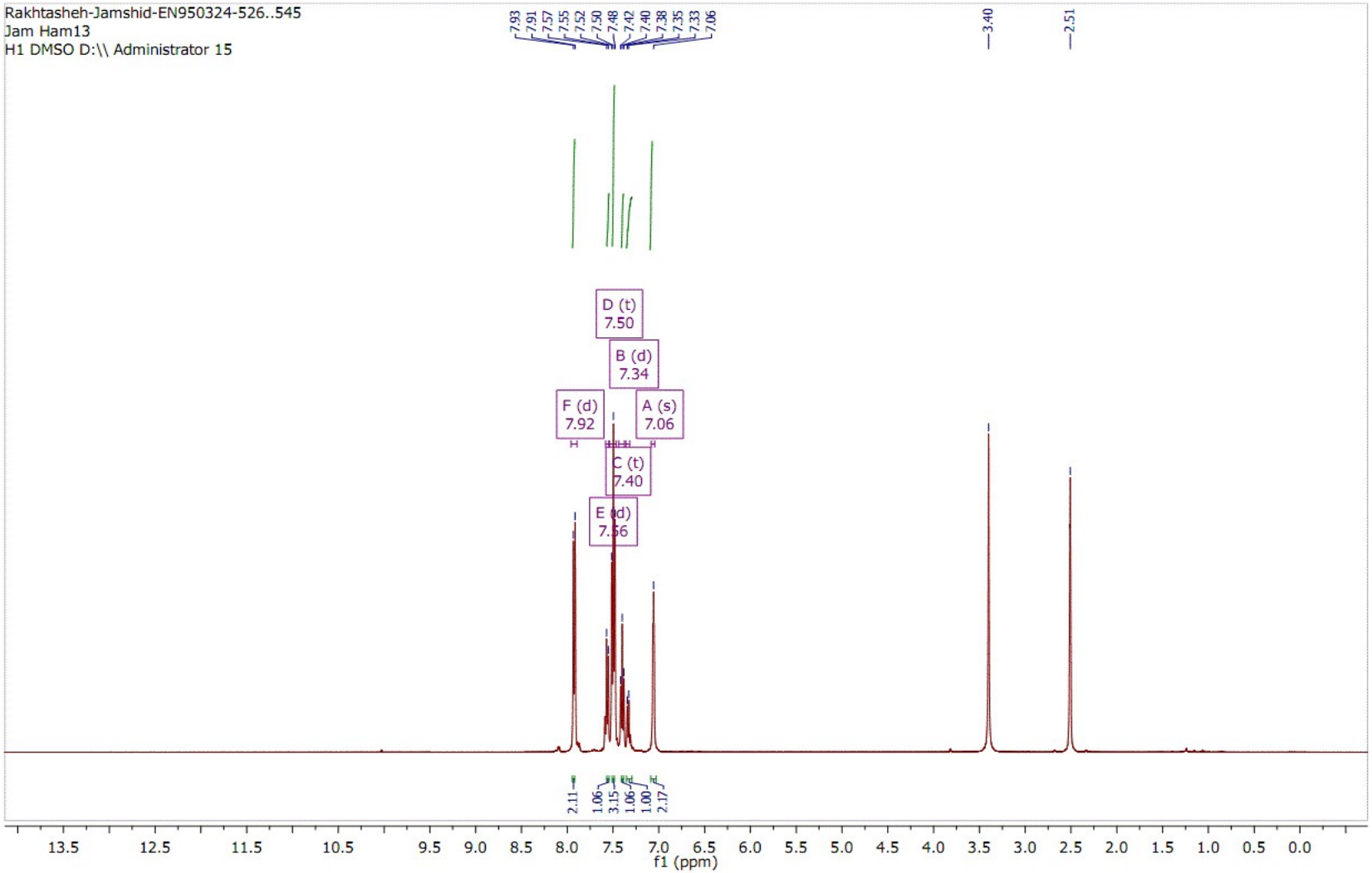


Fig S28.*The [1]H NMR of 5-amino-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbonitrile :(Table 3, entry 13)*

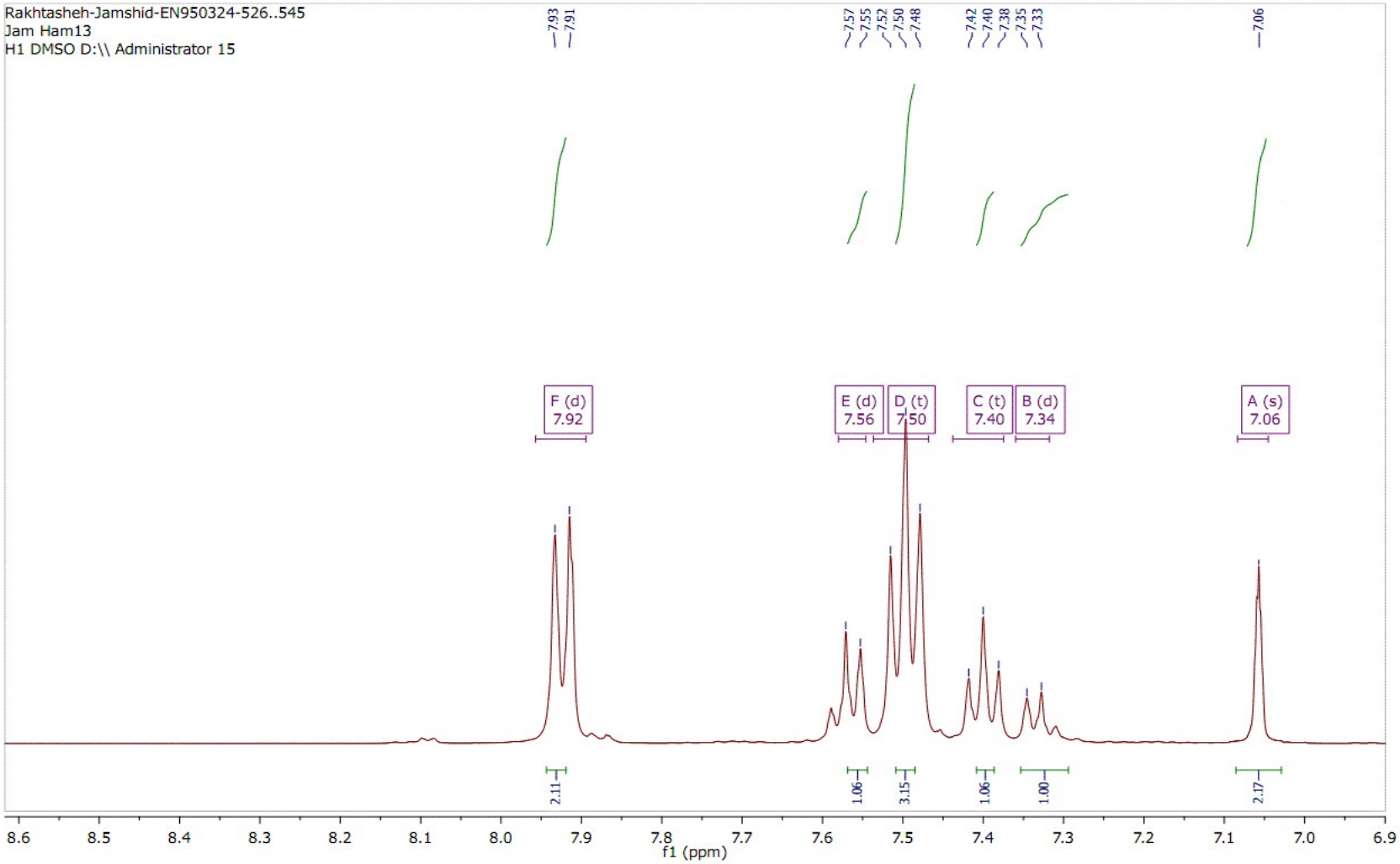


Fig S29.*The expanded [1]H NMR of 5-amino-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbonitrile :(Table 3, entry 13)*

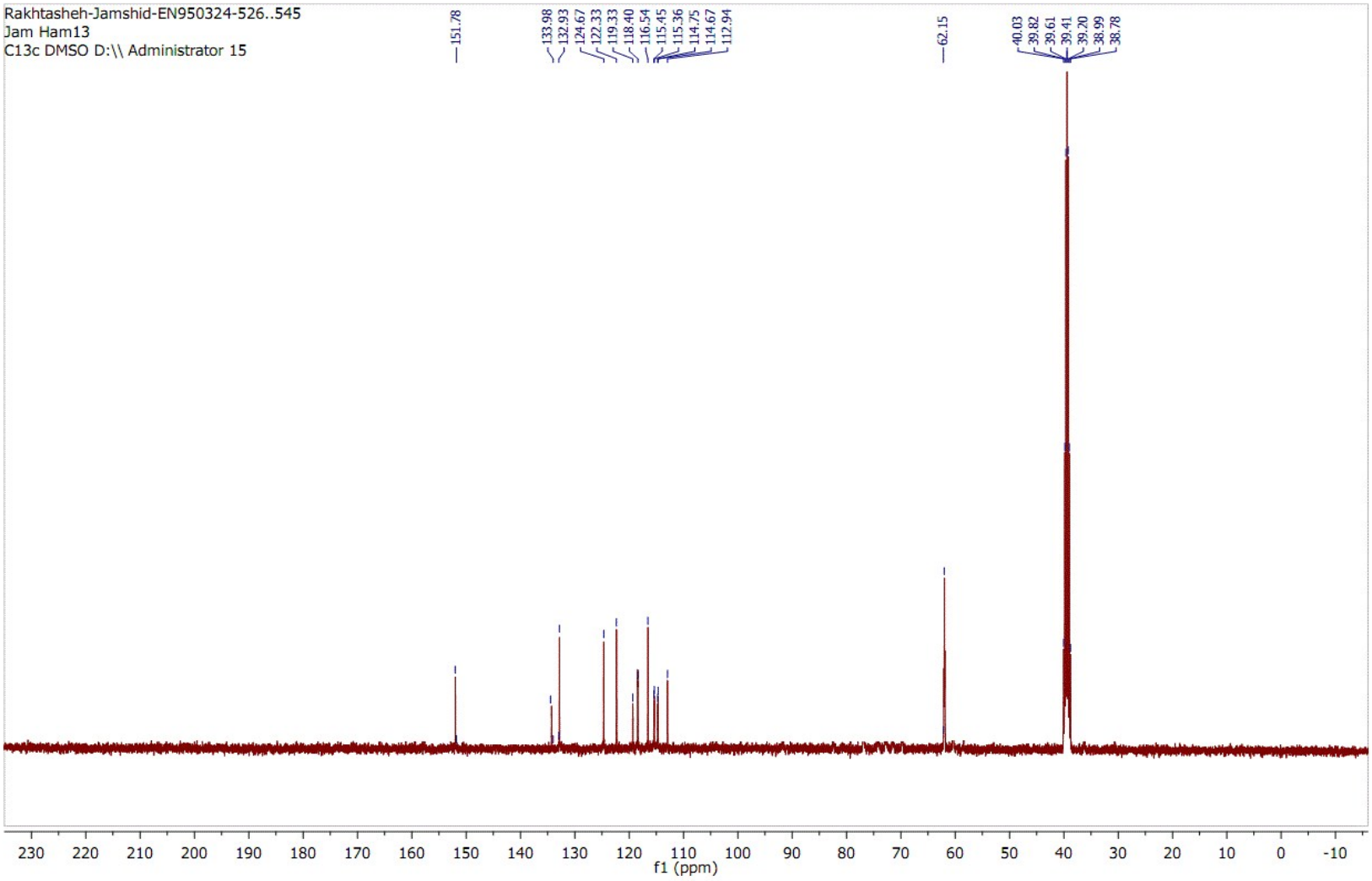


Fig S30.*The ^{13}C NMR of 5-amino-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbonitrile :(Table 3, entry 13)*

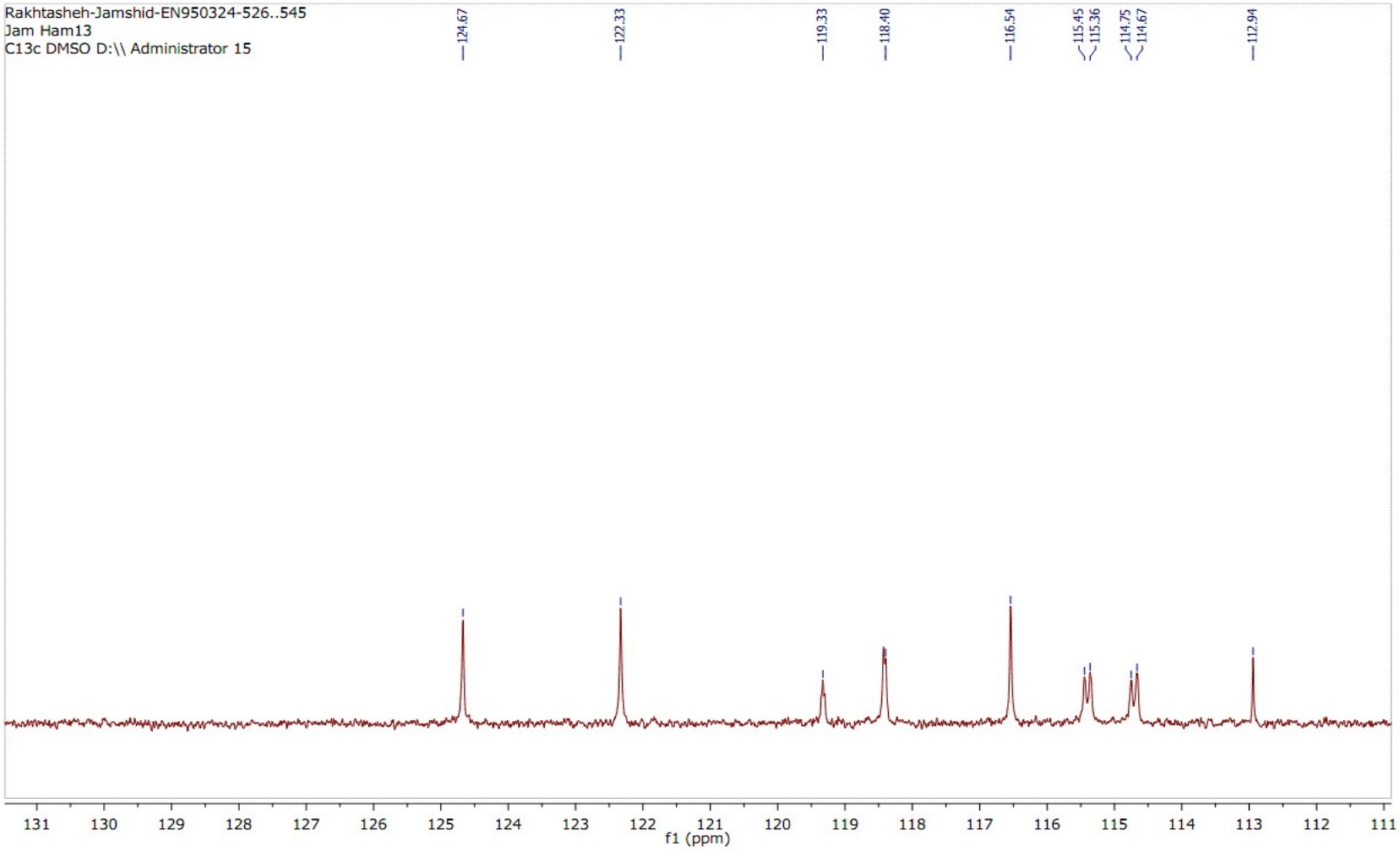


Fig S31.*The expanded ^{13}C NMR of 5-amino-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbonitrile :(Table 3, entry 13)*

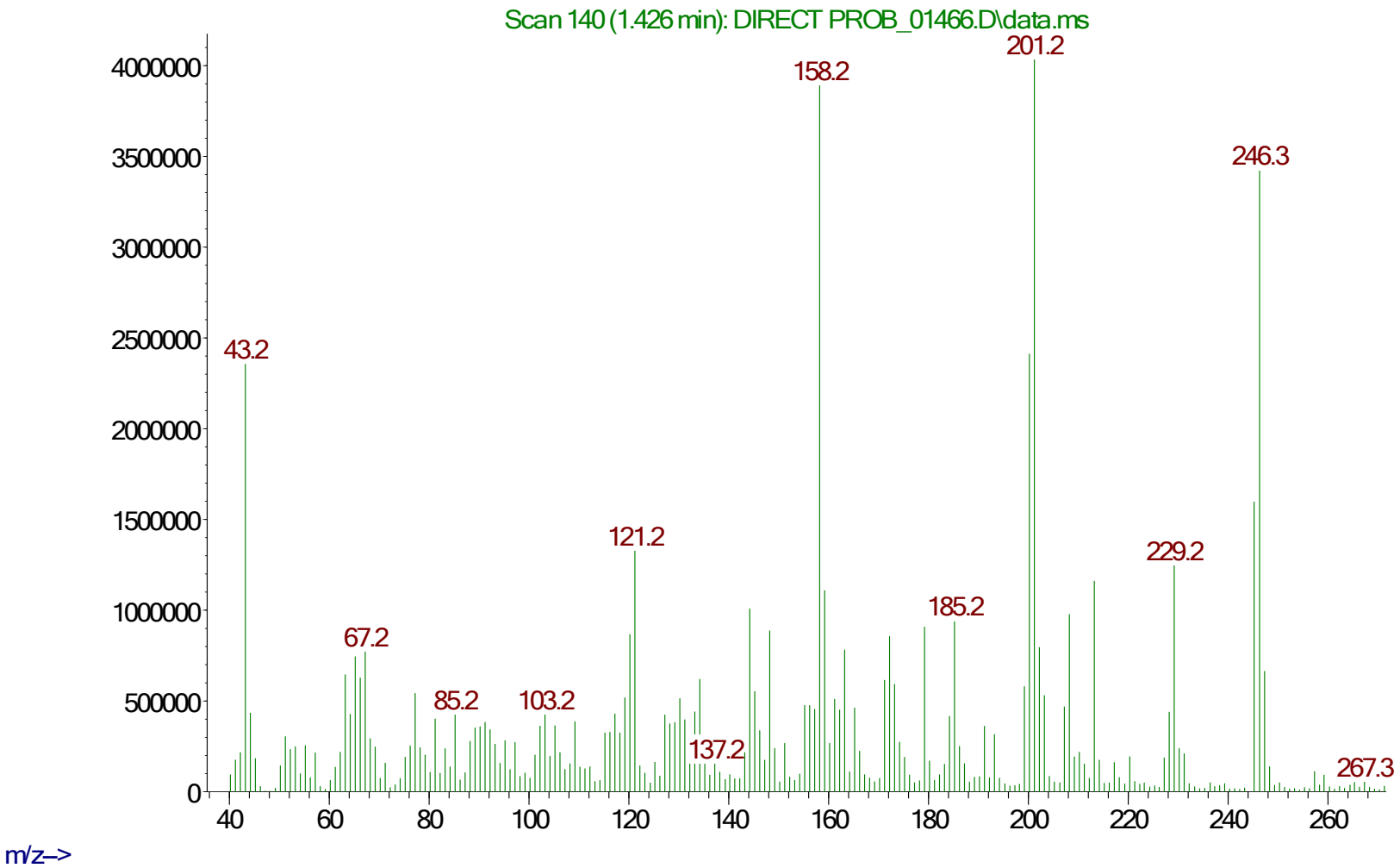
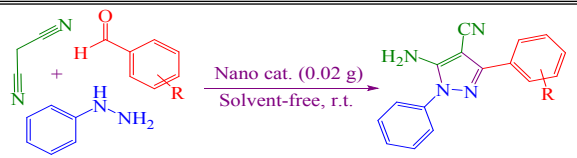
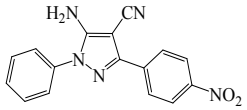
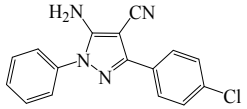
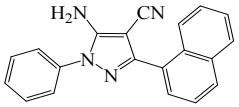
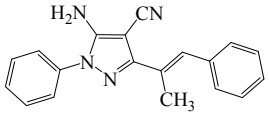
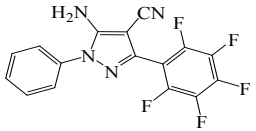
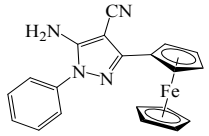
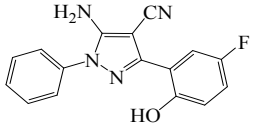
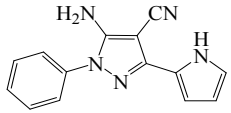
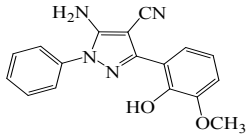
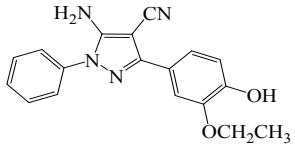
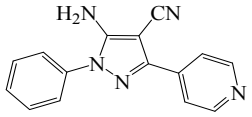
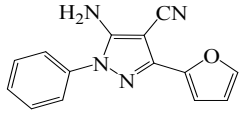
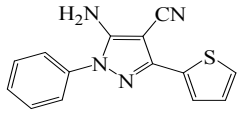
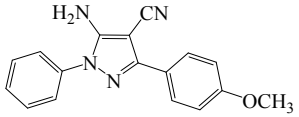
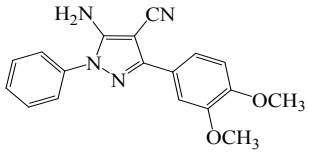
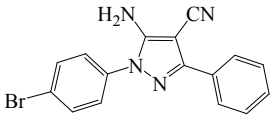


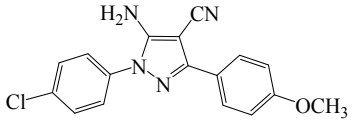
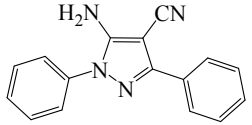
Fig S32.*The Mass spectrea of 5-amino-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbonitrile :(Table 3, entry 13)*

Table 3. *The three-component synthesis of 5-amino-pyrazole-4-carbonitrile derivatives in the presence of 0.02 g of nano catalyst.*[a]



Entry	Product	Time (min)	Yield[b] (%)	M.p (°C) [Lit.][Ref.]
1		10	95	175-177 (Yellow)[30]
2		15	93	221-223 (White)[30]
3		15	92	163-165 (Yellow)[30]
4		25	88	235-237 (Orange)[30]
5		10	94	158-160 (Orange)
6		25	88	>300 (Violet)
7		20	90	161-163 (Brown)

8		25	88	260-262 (Brown)
9		20	89	284-286 (Orange)[30]
10		20	90	225-227 (Orange)[30]
11		25	89	218-220 (Brown)[43]
12		25	87	168-170 (Brown)
13		25	87	163-165 (Brown)
14		20	90	112-114 (Red)[43]
15		20	90	125-127 (Orange)[43]
16		30	85	180-182 (Brown)[45]

17		25	85	210-212 (Orange)45
18		25	88	158-160 (Brown)44

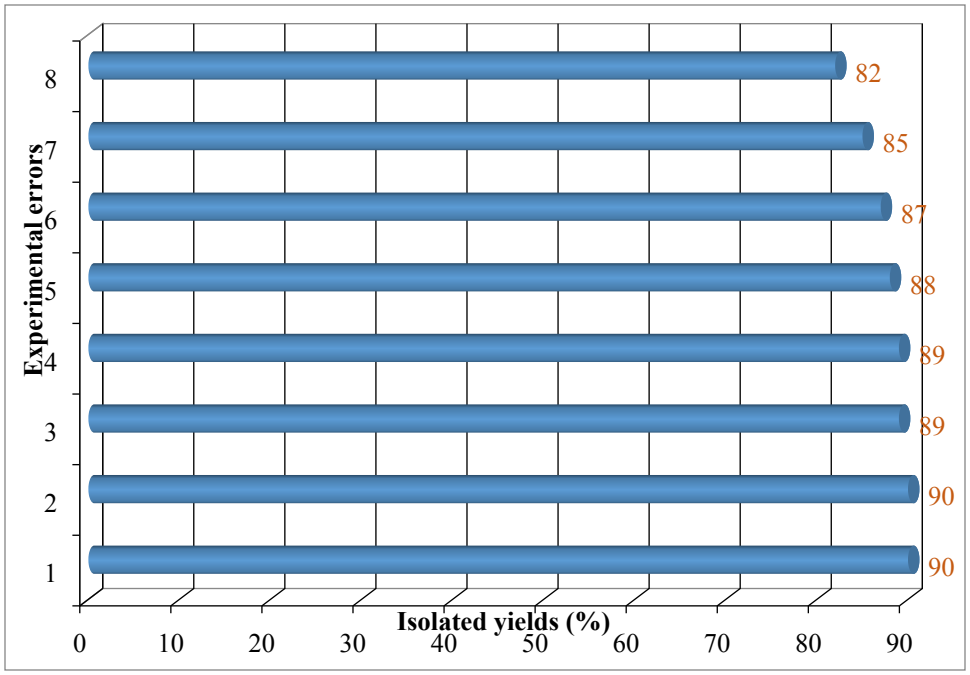


Fig S33. *Reusability of Fe_3O_4@Si@MoO_2 as a heterogeneous catalyst in 20 minutes.*