

Article

α -(Imino)pyridyldifluoroethyl Phosphonates: Novel Promising Building Blocks in Synthesis of Biorelevant Aminophosphonic Acids Derivatives

Oksana M. Shavrina ¹, Lyudmyla V. Bezgubenko ¹, Andrii V. Bezdudny ¹, Petro P. Onys'ko ^{1,*} and Yuliya V. Rassukana ^{1,2}

¹ Institute of Organic Chemistry, National Academy of Sciences of Ukraine, 5 Murmans'ka Str., Kyiv 02660, Ukraine; petruk94oksana@ukr.net (O.M.S.); bezgubenko@ukr.net (L.V.B.); bezdudny@ioch.kiev.ua (A.V.B.); juravi@ioch.kiev.ua (Y.V.R.)

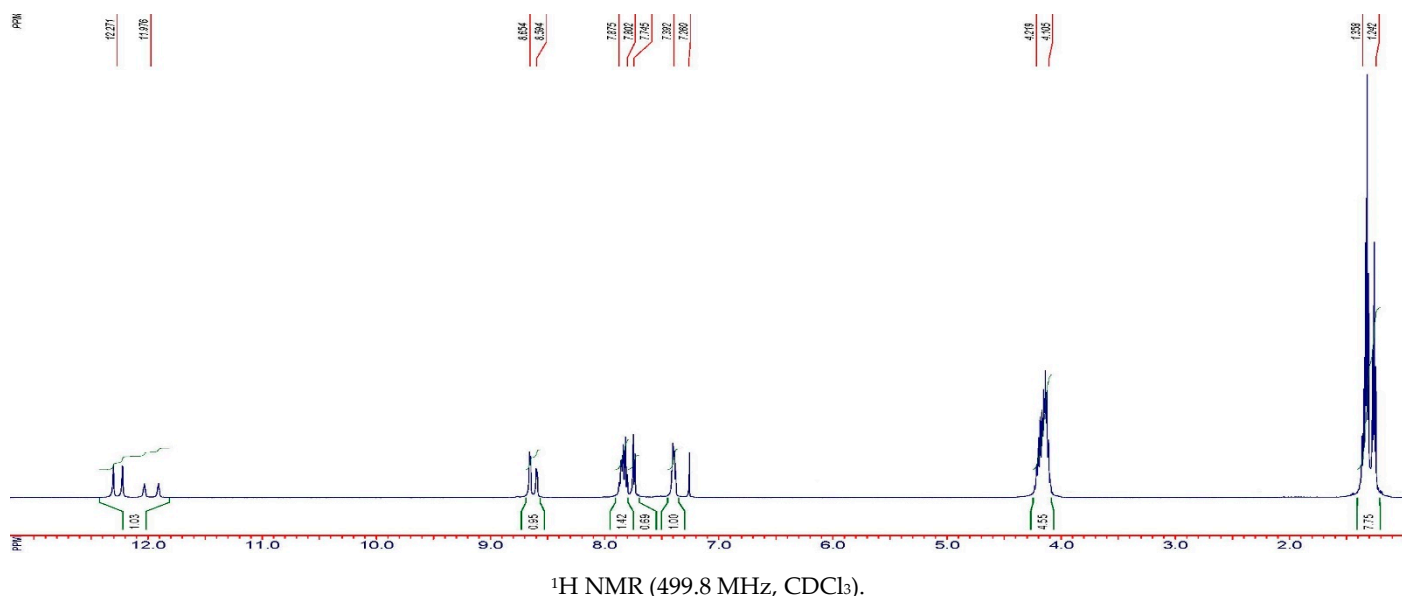
² Department of Organic Chemistry, National Technical University of Ukraine "Kyiv Polytechnic Institute", 37, Prospect Peremogy, Kyiv 03056, Ukraine

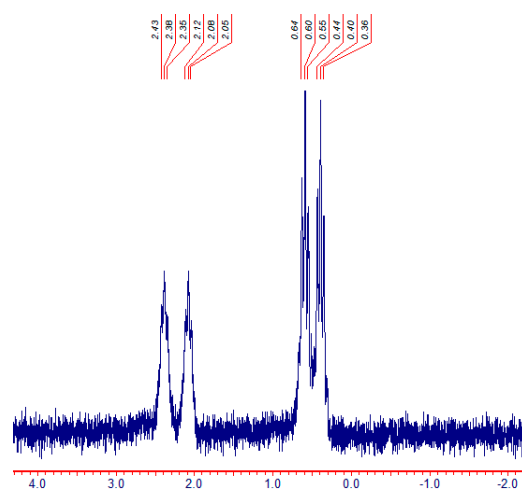
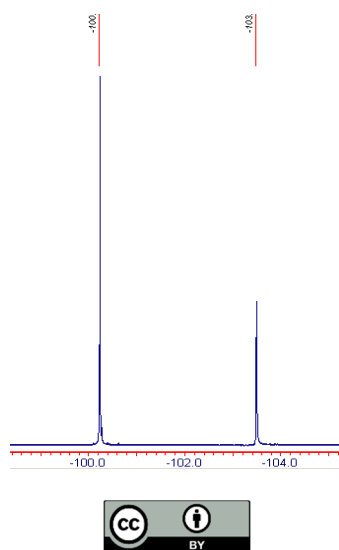
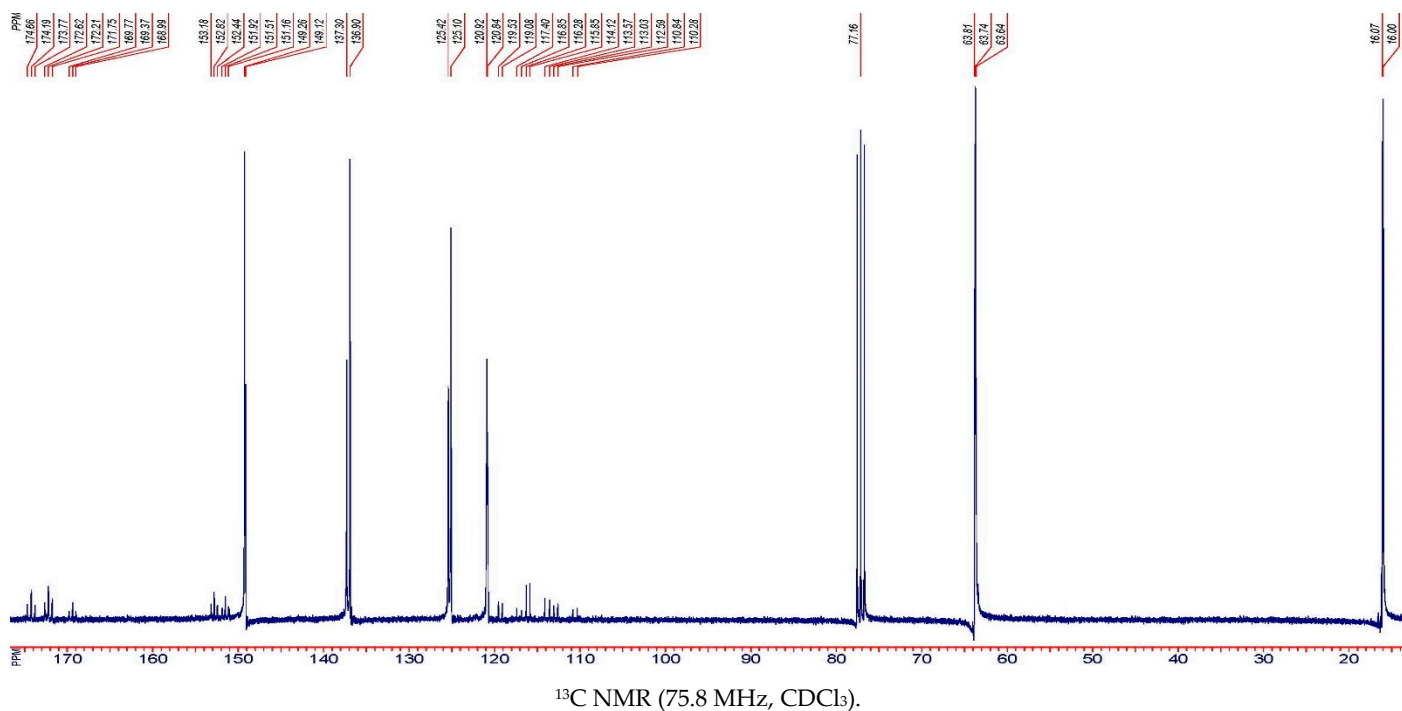
* Correspondence: onysko@ioch.kiev.ua

Supporting information

¹H, ¹⁹F, and ¹³C NMR spectra were recorded using Bruker Avance NMR spectrometers operating at 302, 400 and 499.8 ¹H frequencies; 75.8, 125.7 and 150.8 MHz for ¹³C experiments; 188, 376.5 and 470.3 MHz for ¹⁹F; 81 and 202.3 MHz for ³¹P. Chemical shifts are reported relative to internal TMS (¹H) or CFCl₃ (¹⁹F) and external 85%-H₃PO₄ (³¹P) standards. Melting points are uncorrected. Solvents were dried before use according to standard methods. Elemental analysis was carried out in the analytical laboratory of Institute of Organic Chemistry, NAS of Ukraine.

Diethyl (2,2-difluoro-1-imino-2-(pyridin-2-yl)ethyl)phosphonate **2a**

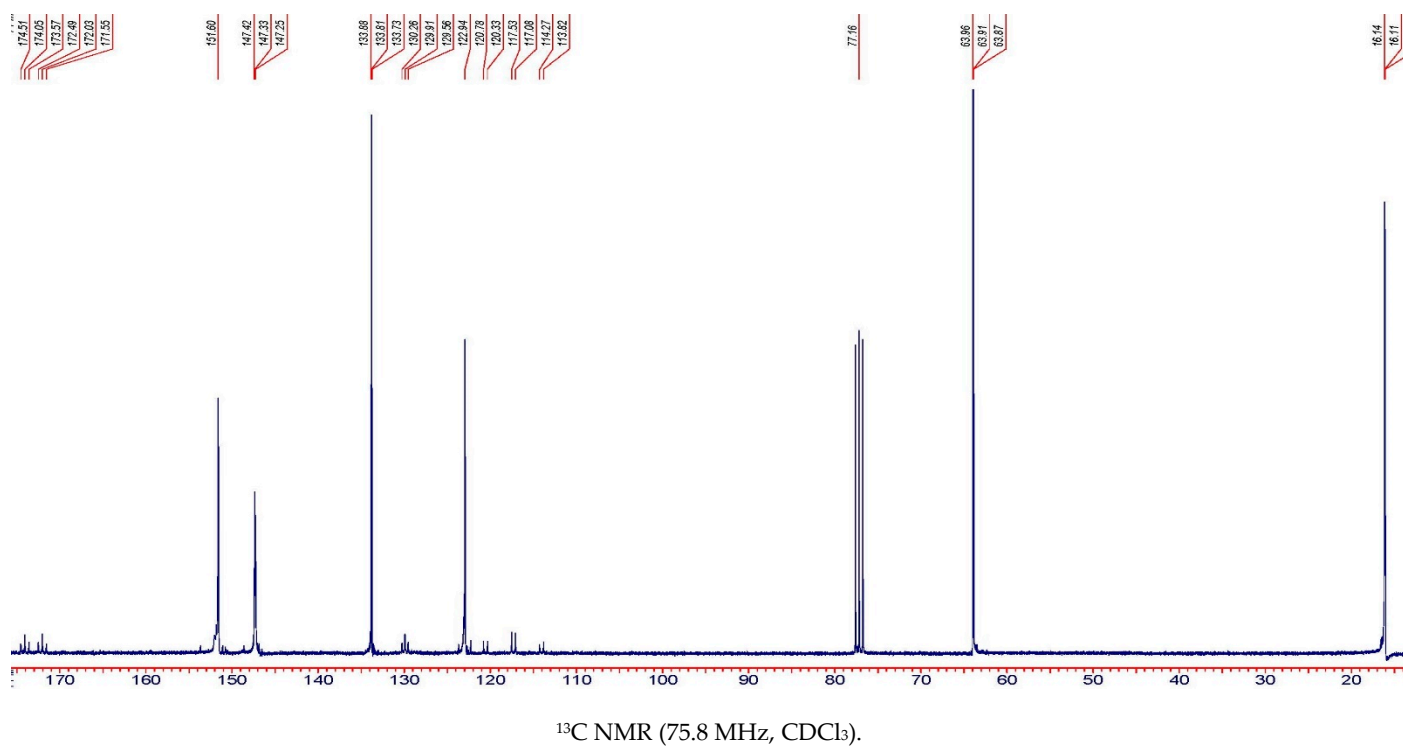
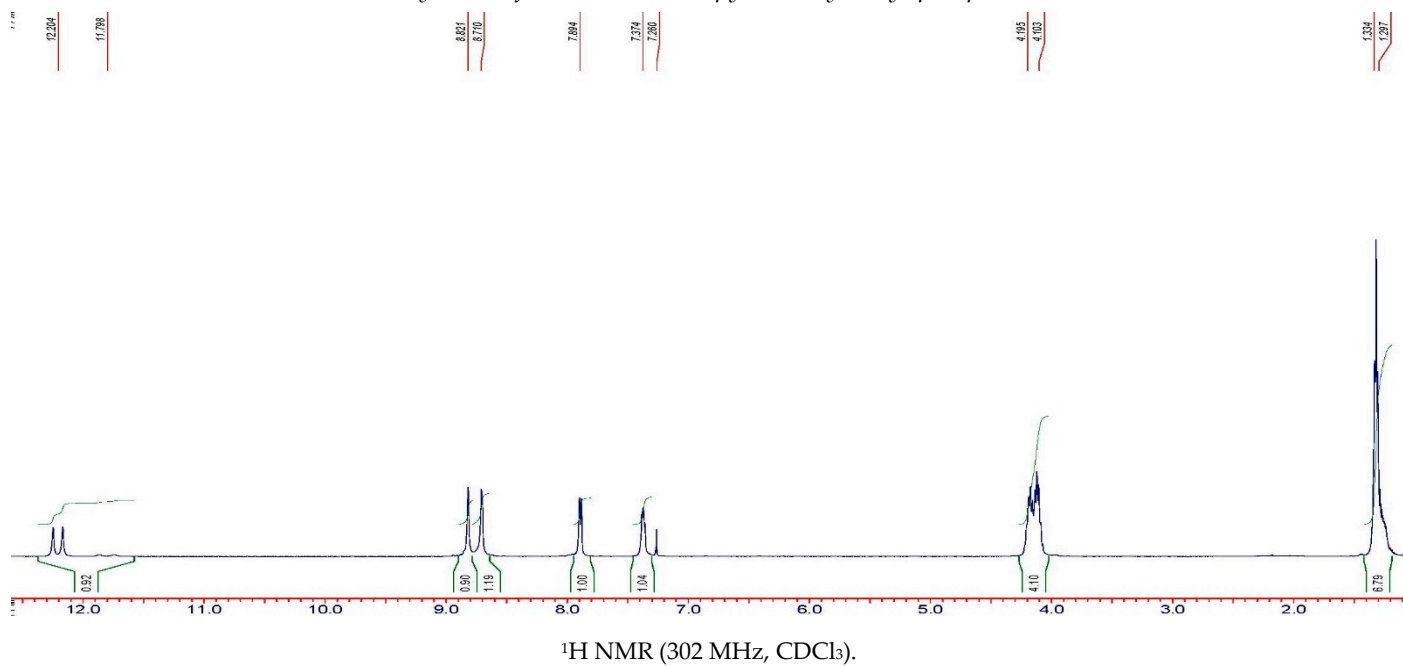


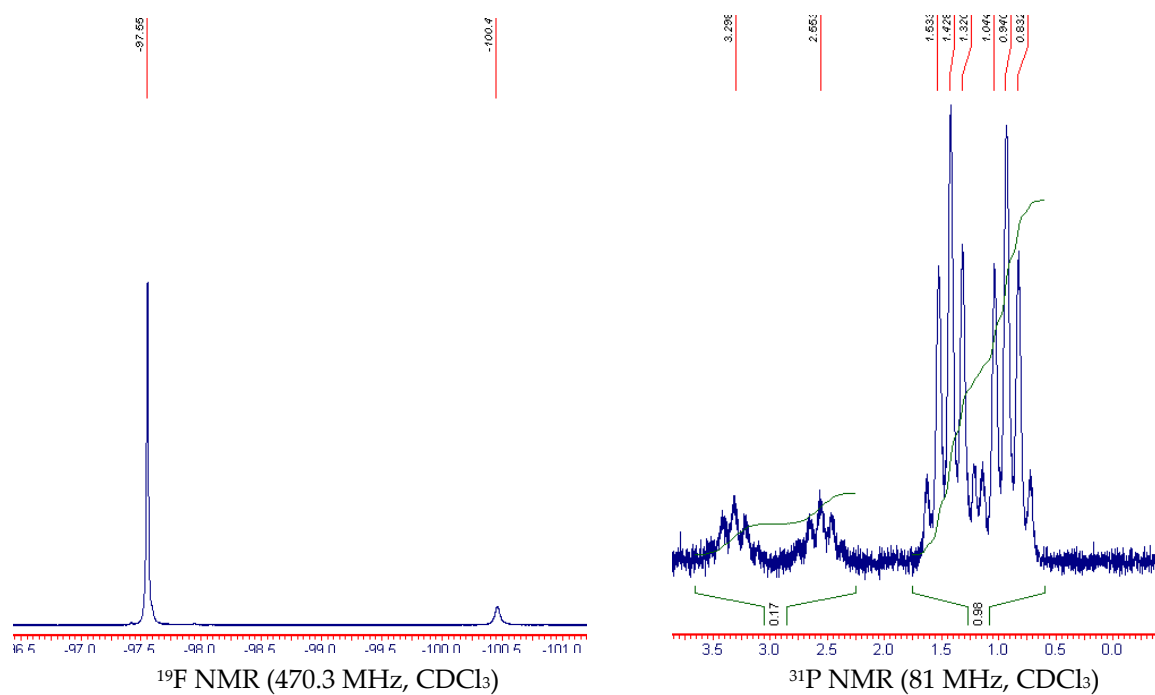


Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

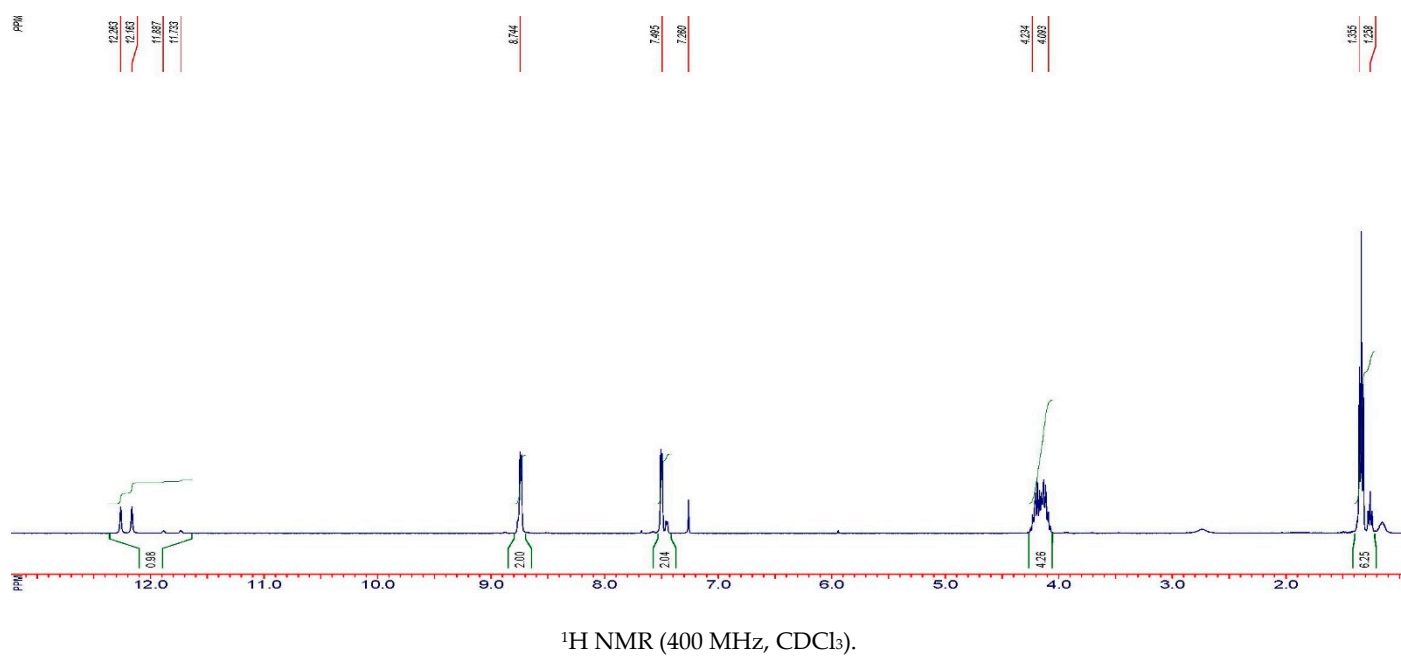
¹⁹F NMR (470.3 MHz, CDCl₃)

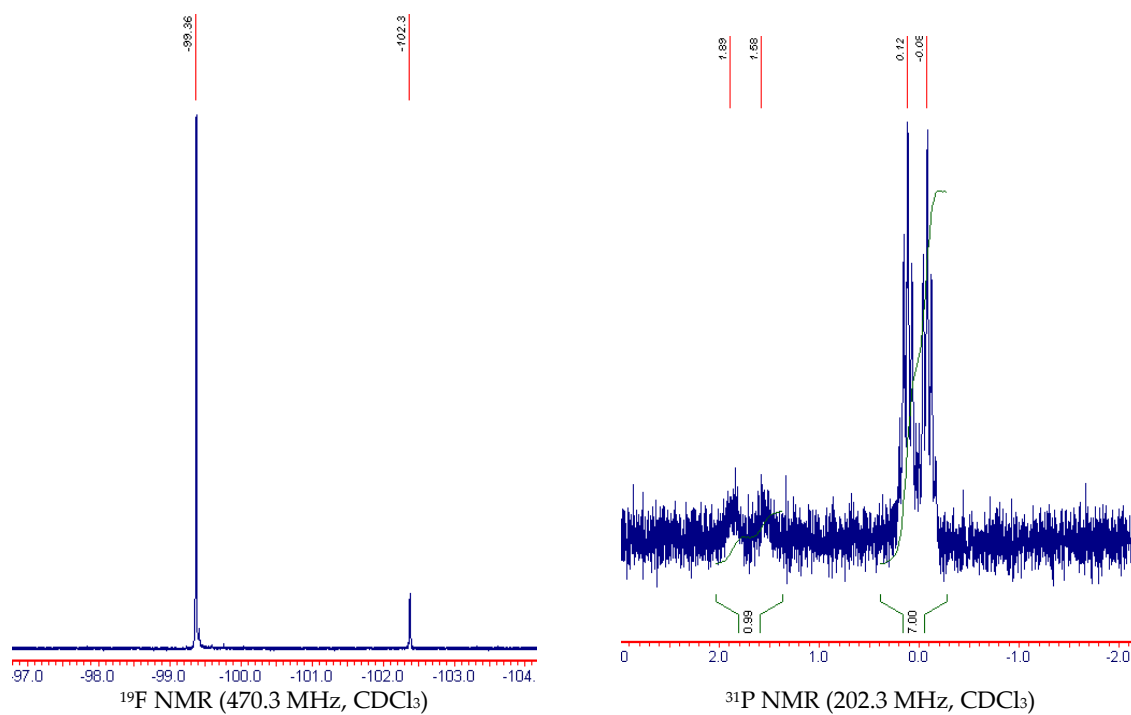
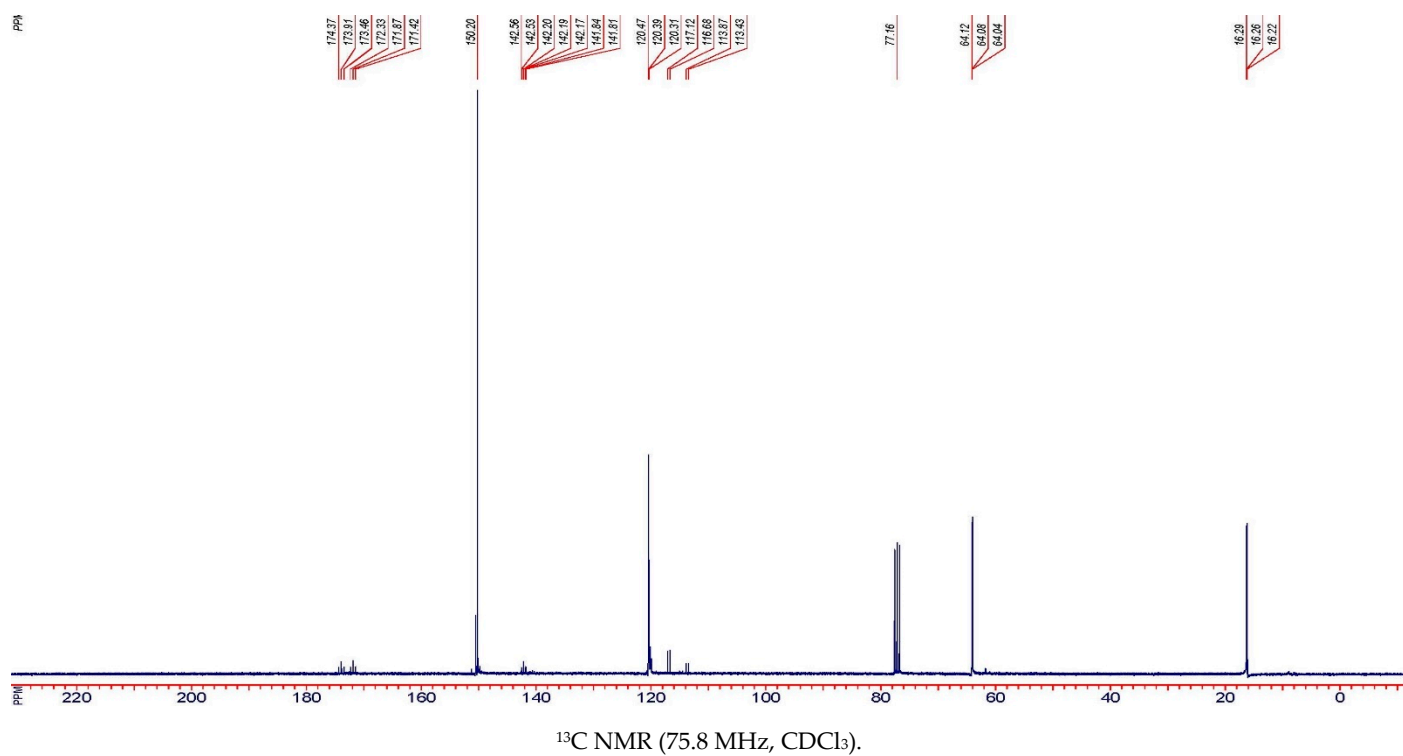
³¹P NMR (202.3 MHz, CDCl₃)

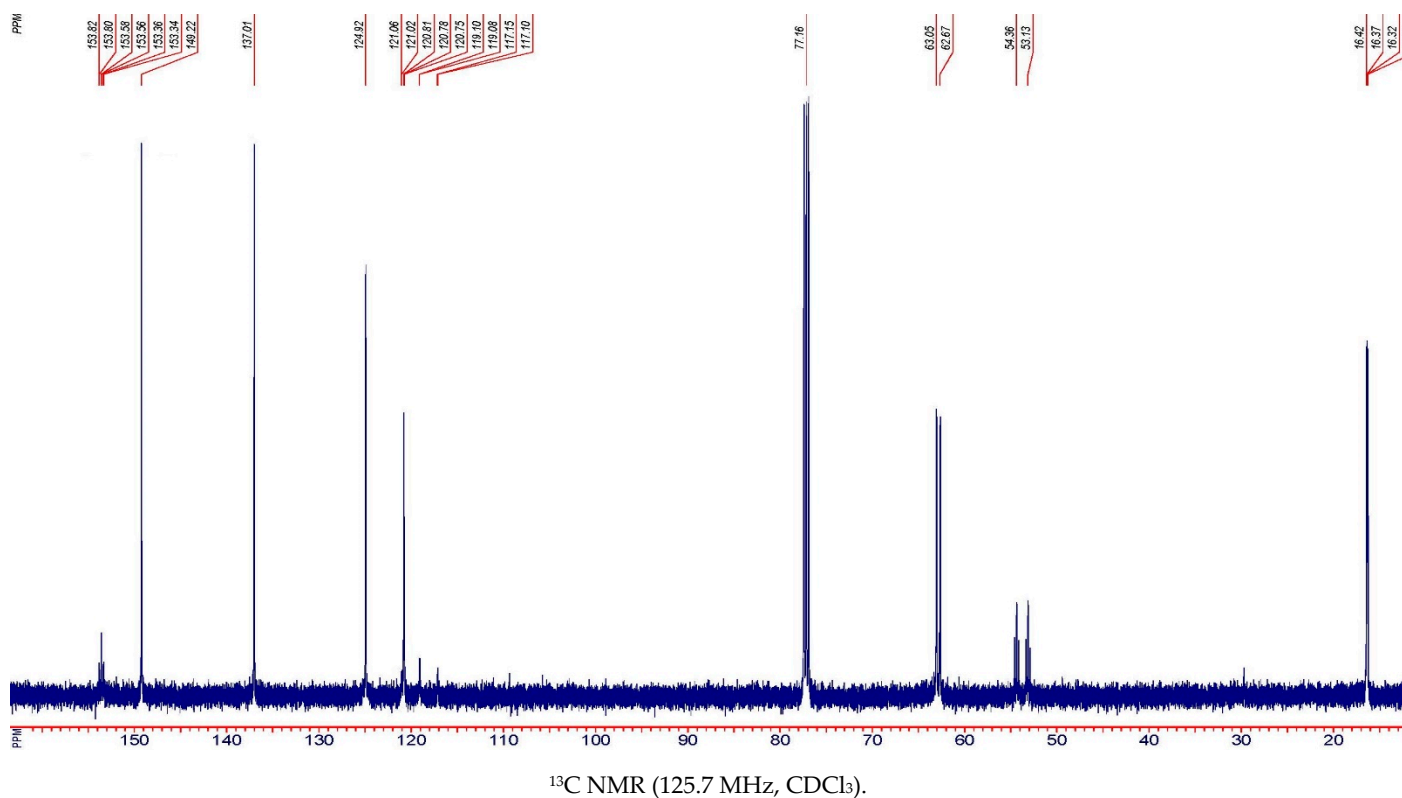
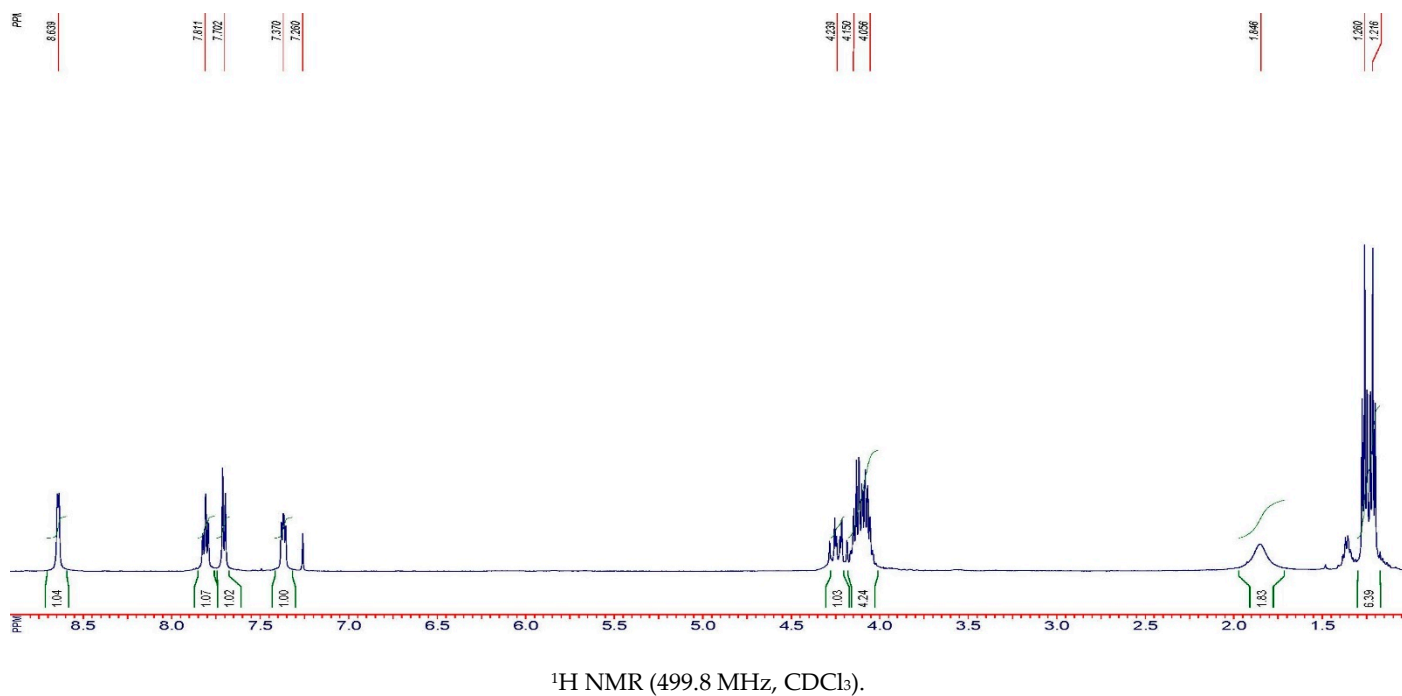
Diethyl (2,2-difluoro-1-imino-2-(pyridin-3-yl)ethyl)phosphonate 2b

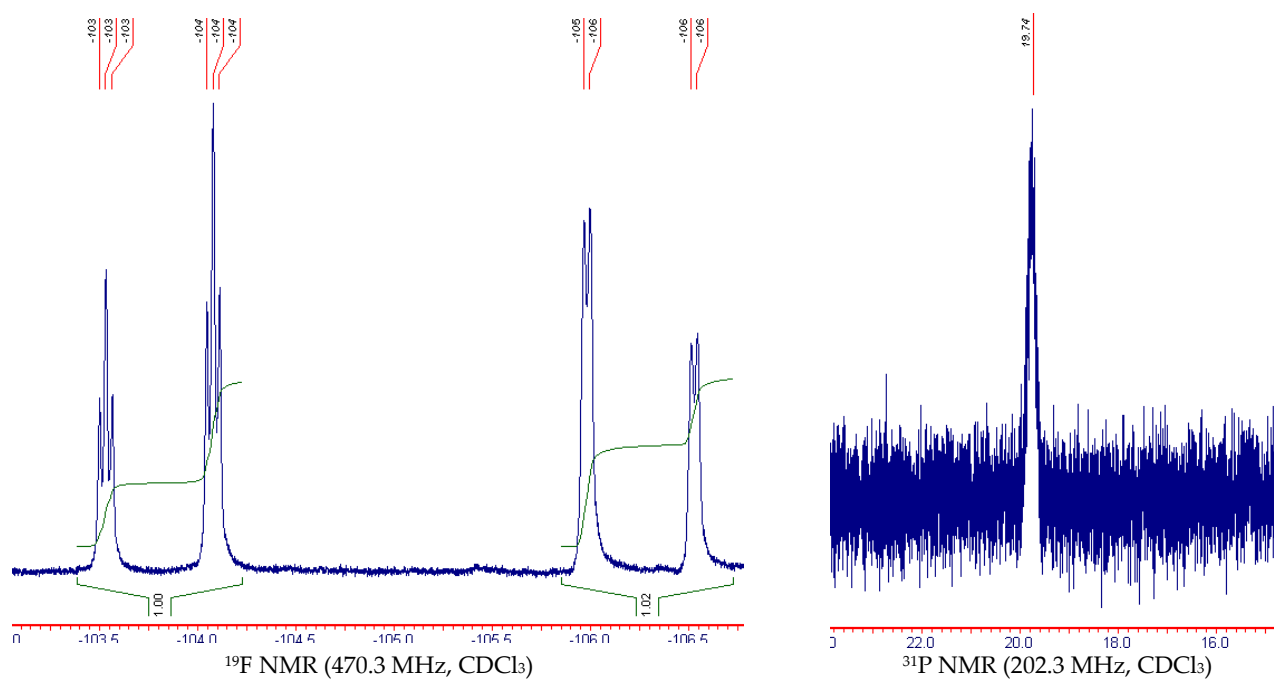


Diethyl (2,2-difluoro-1-imino-2-(pyridin-4-yl)ethyl)phosphonate 2c

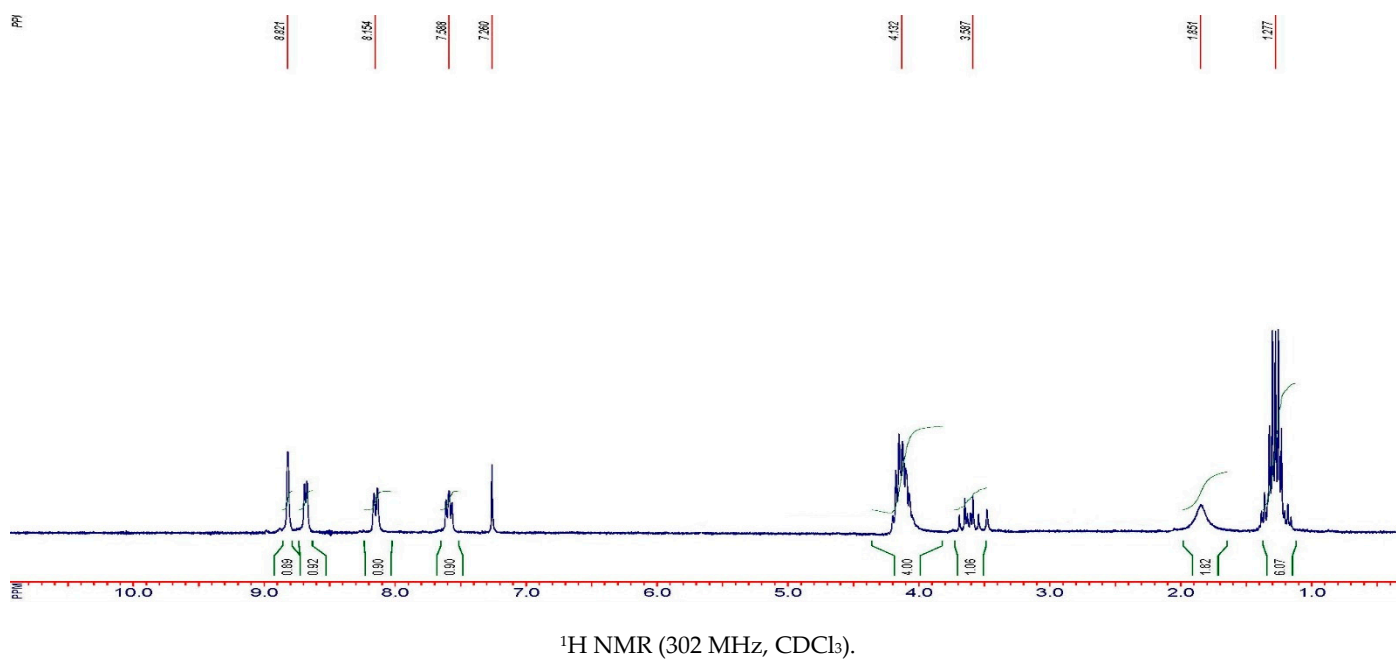


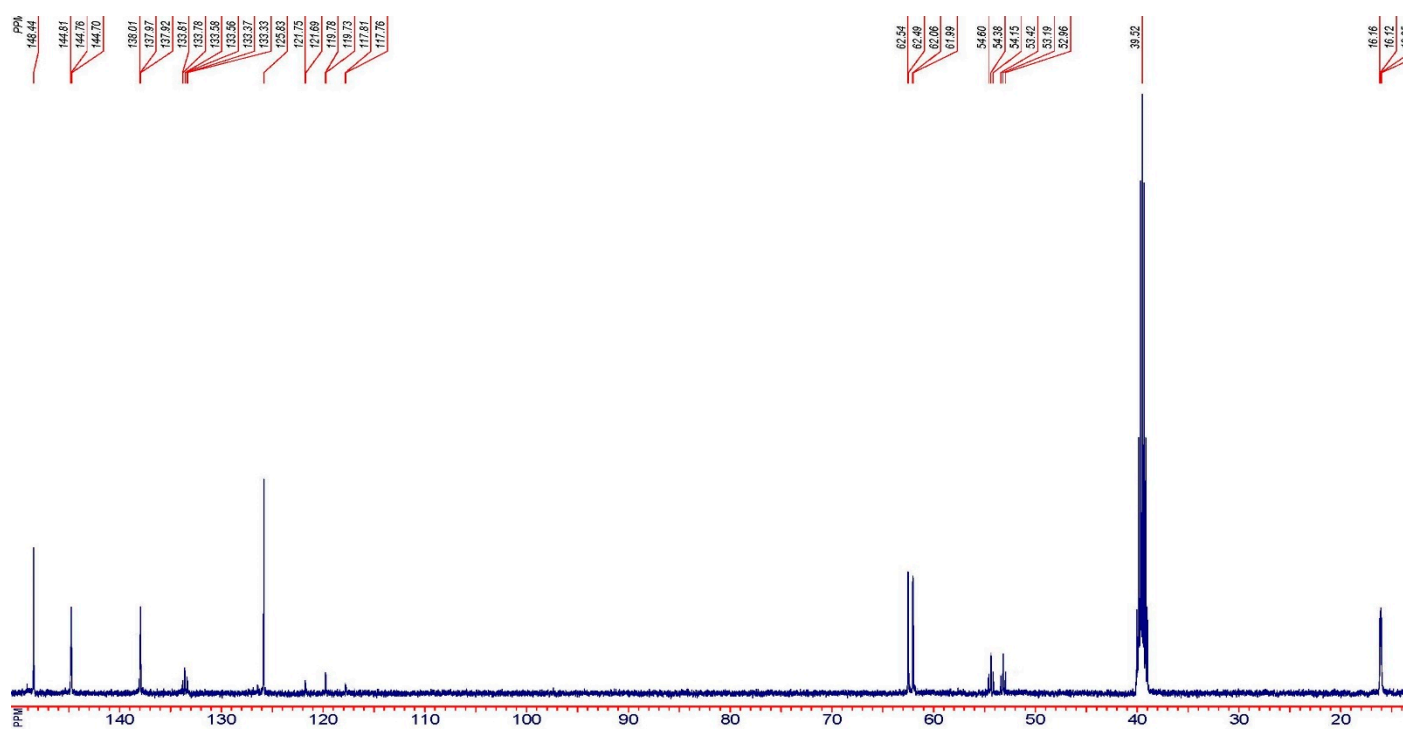


Diethyl (1-amino-2,2-difluoro-2-(pyridin-2-yl)ethyl)phosphonate 7a

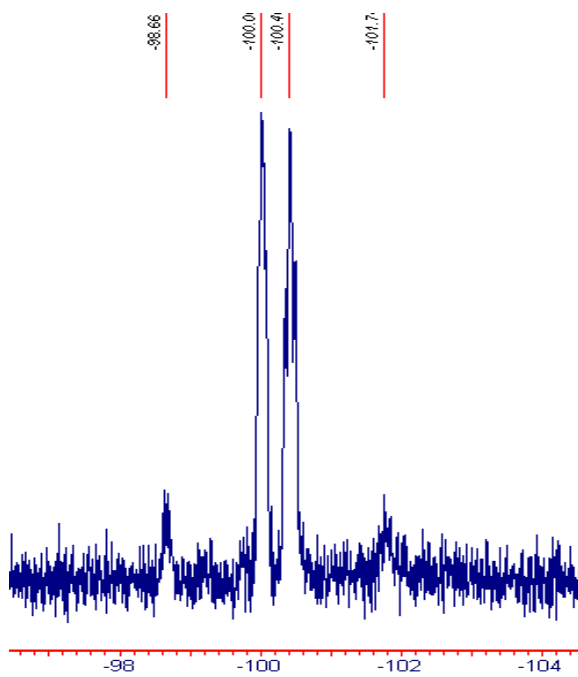


Diethyl (1-amino-2,2-difluoro-2-(pyridin-3-yl)ethyl)phosphonate 7b





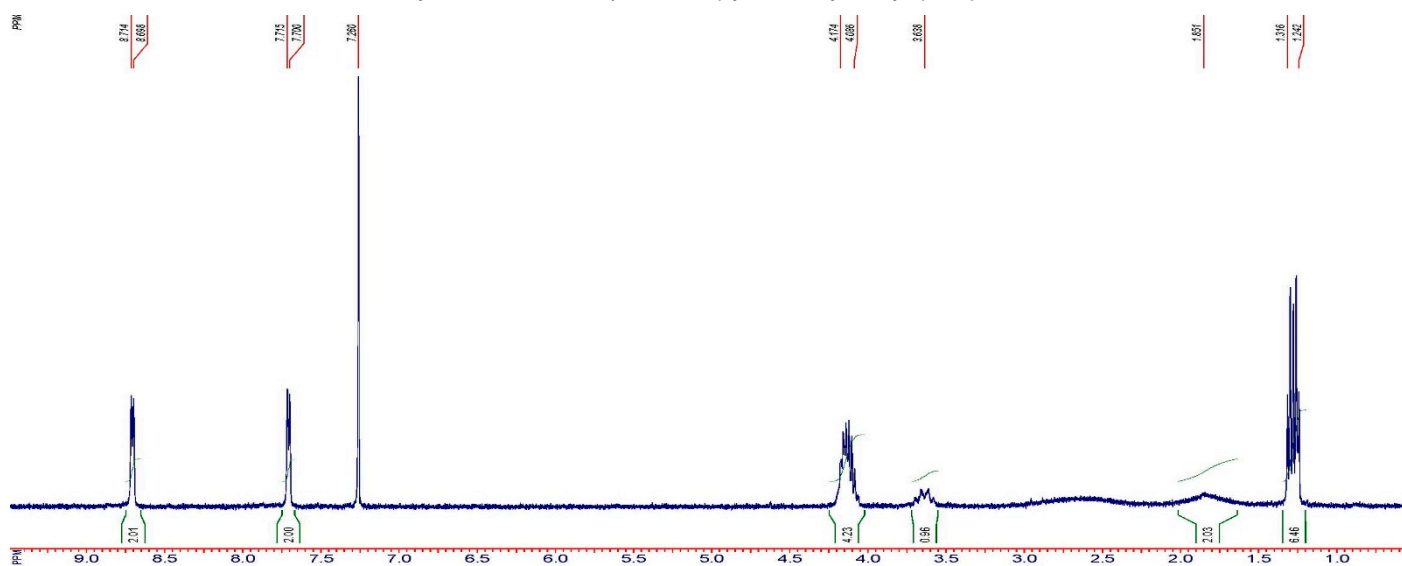
¹³C NMR (125.7 MHz, DMSO-d₆).



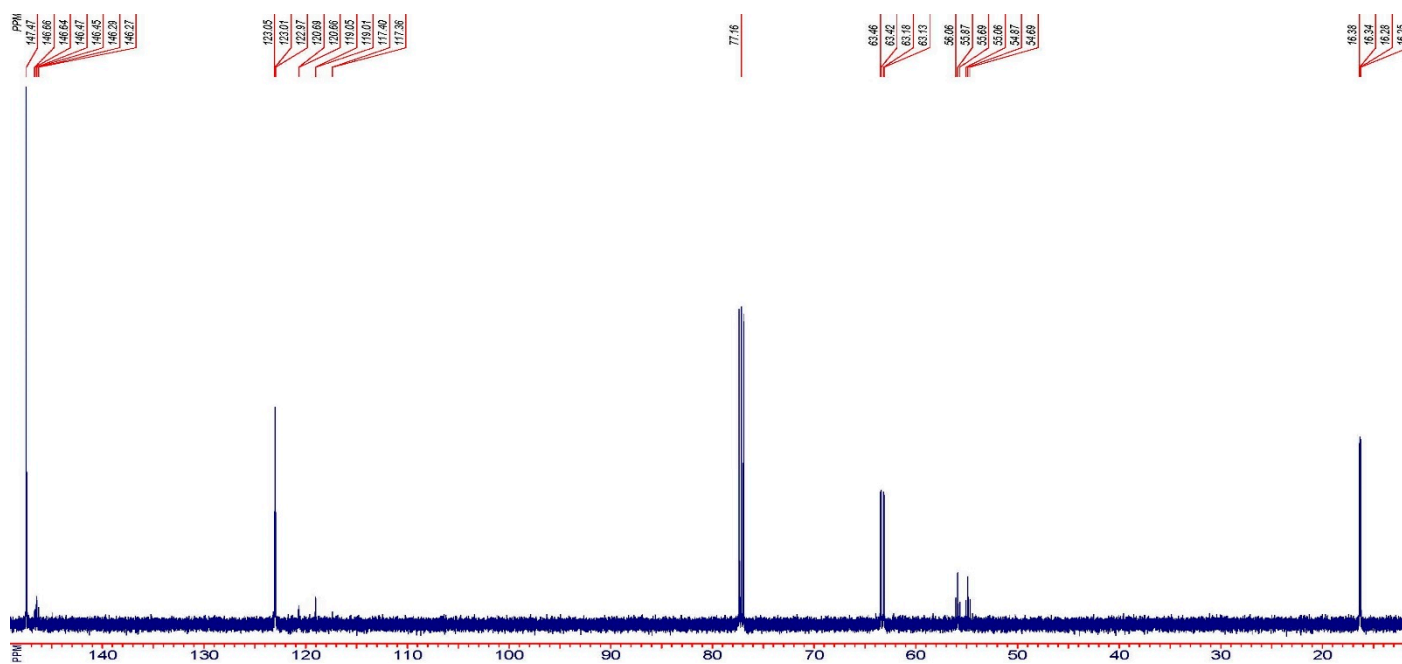
¹⁹F NMR (470.3 MHz, CDCl₃)



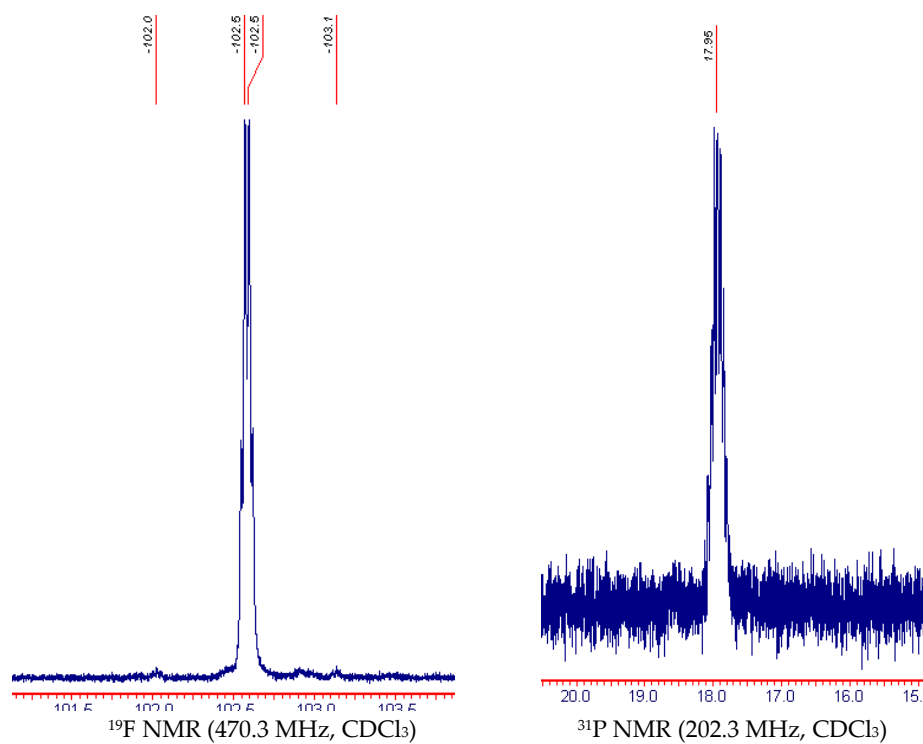
³¹P NMR (202.3 MHz, CDCl₃)

Diethyl (1-amino-2,2-difluoro-2-(pyridin-4-yl)ethyl)phosphonate 7c

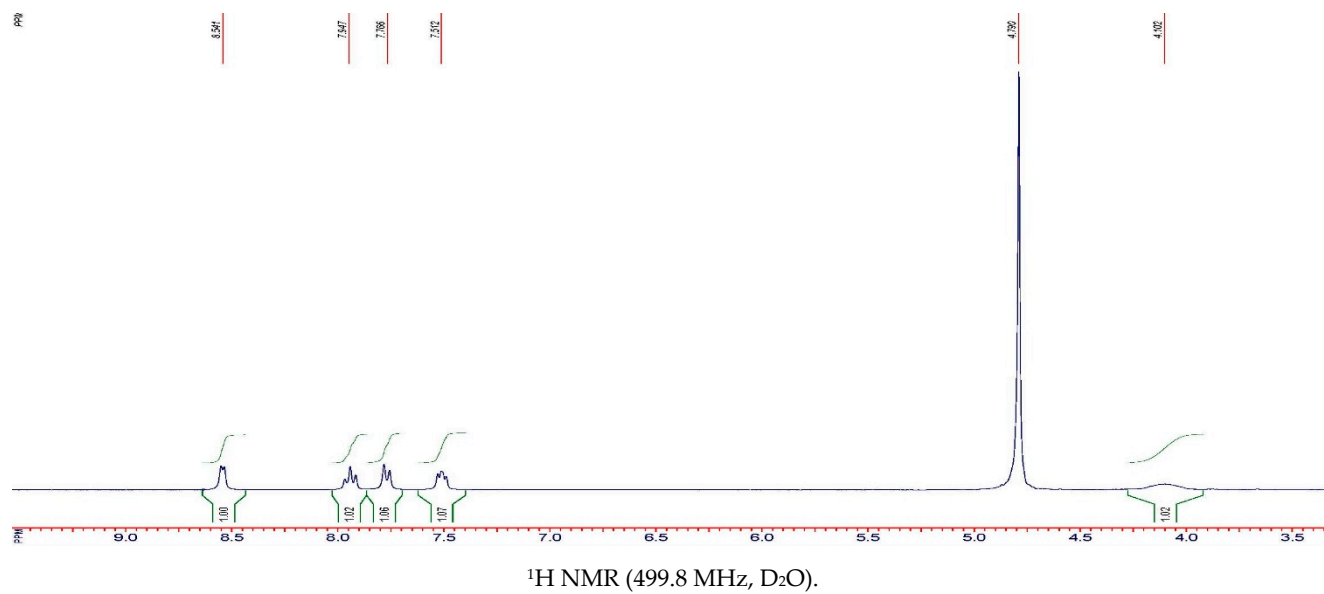
¹H NMR (302 MHz, CDCl₃).

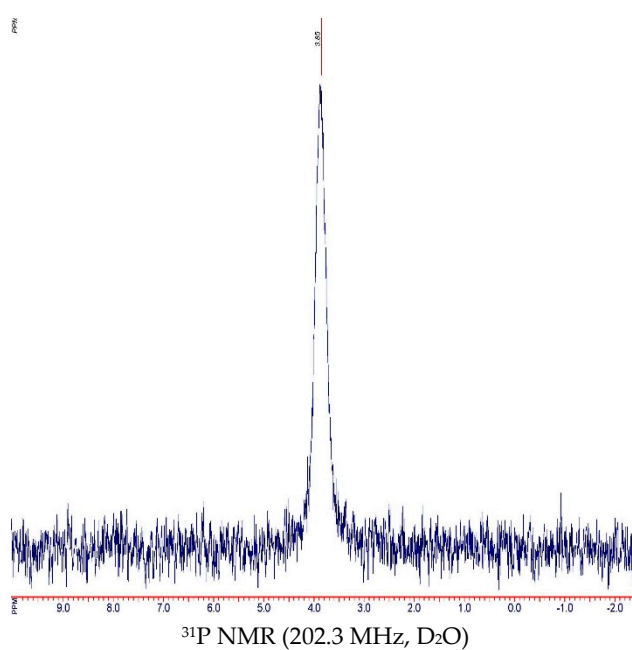
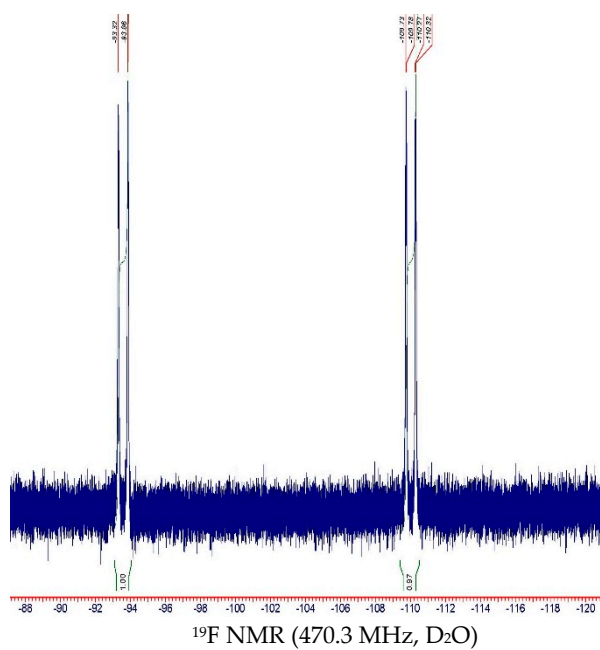
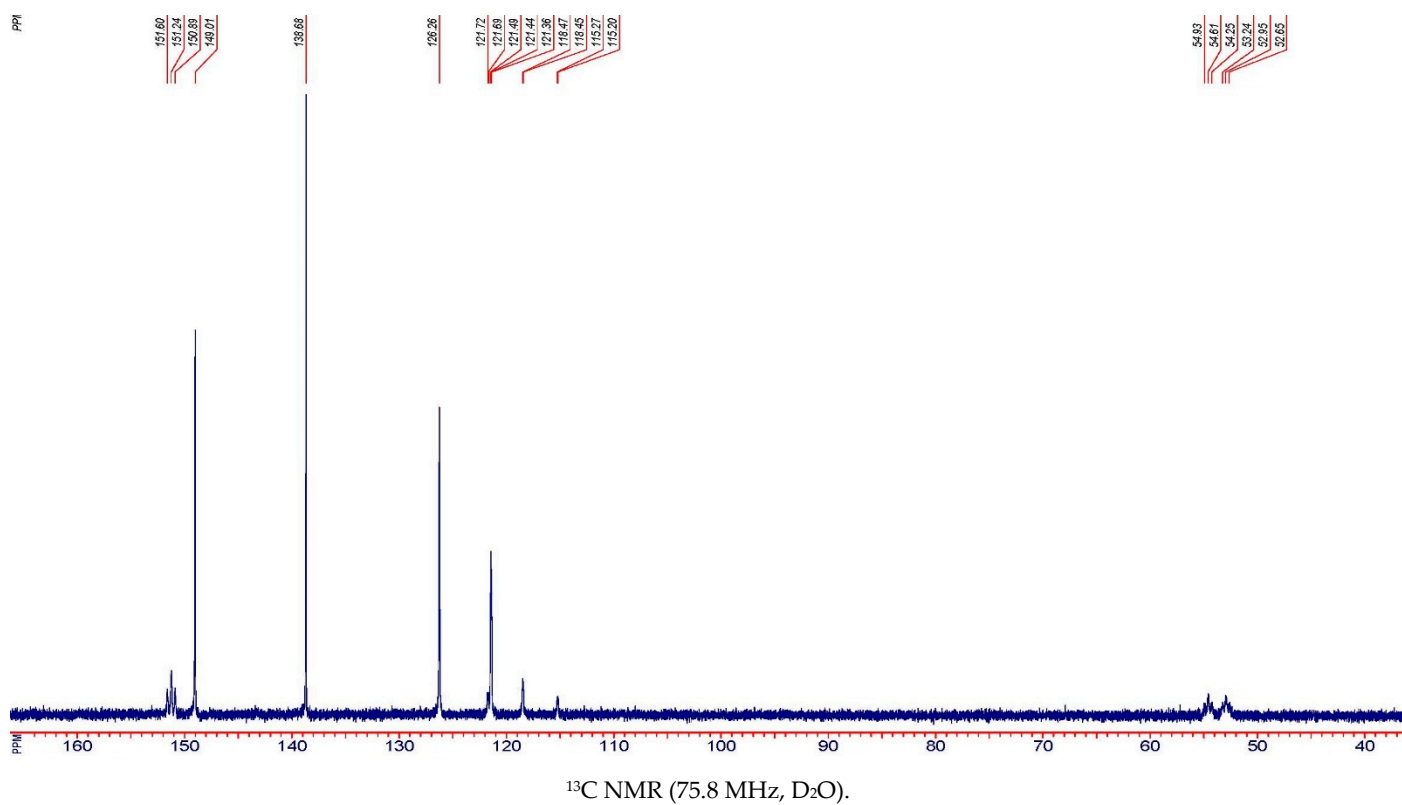


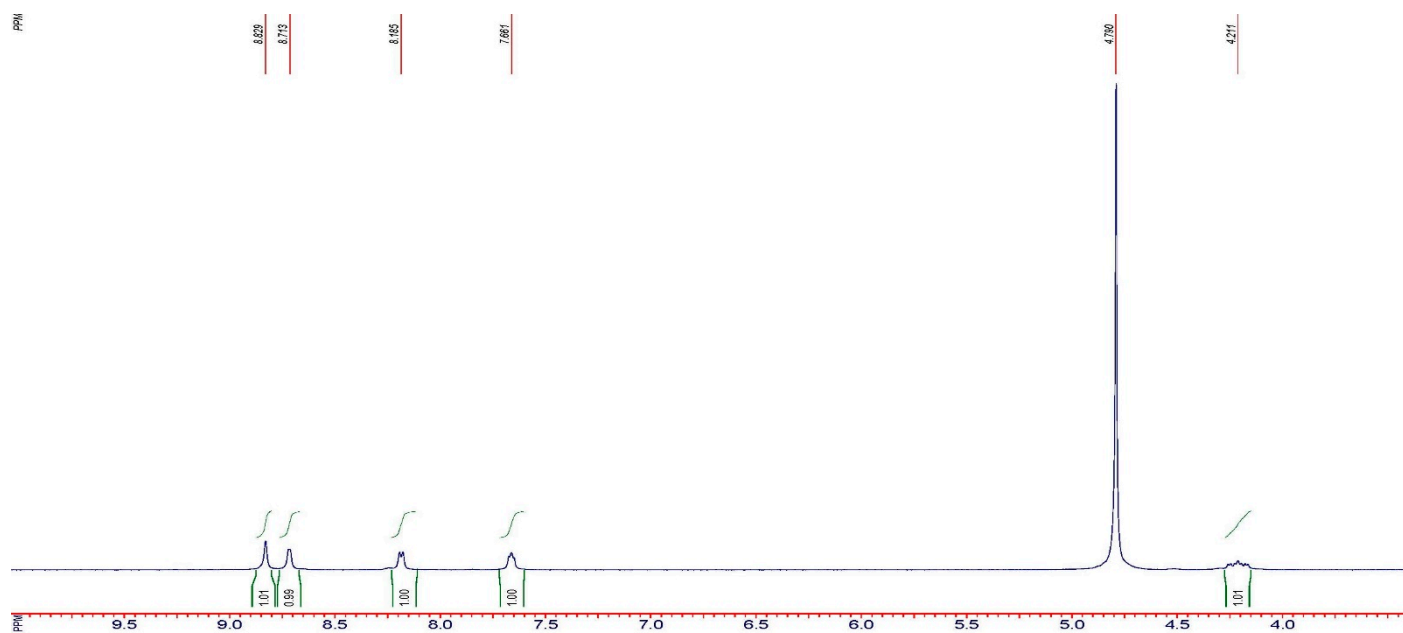
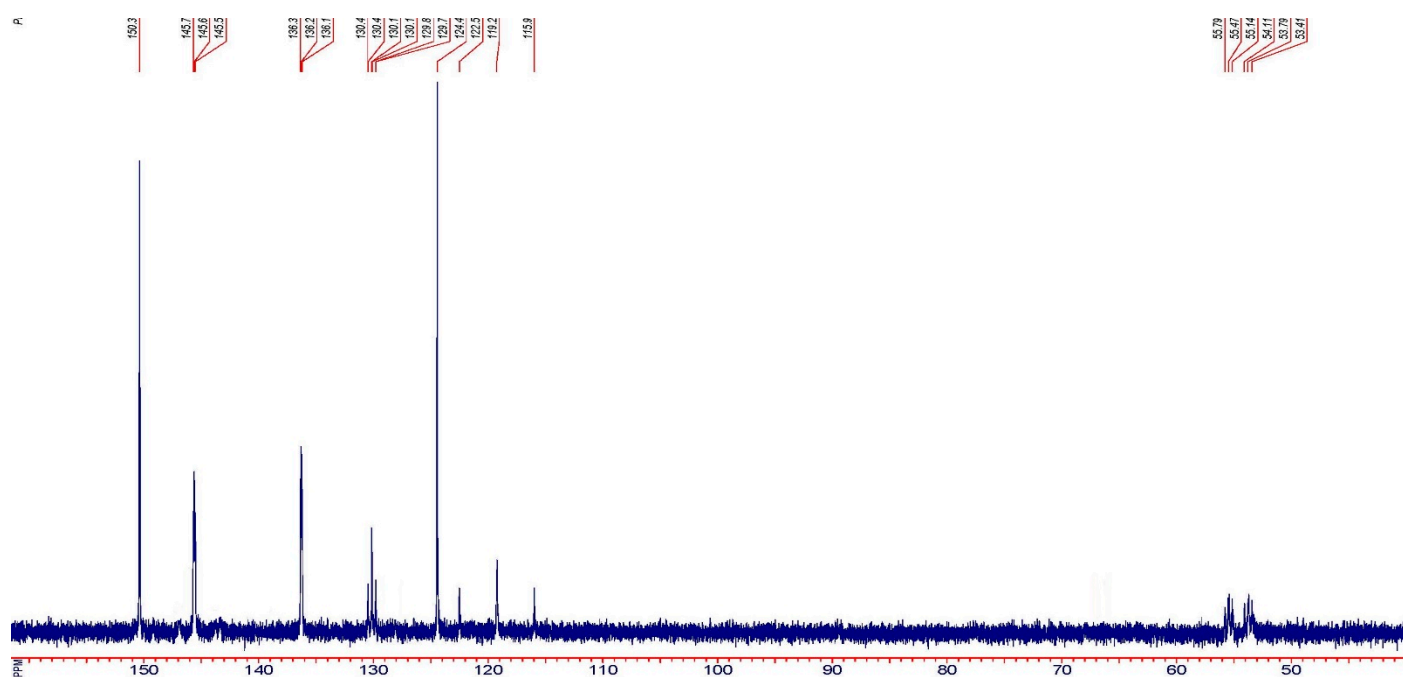
¹³C NMR (150.8 MHz, CDCl₃).

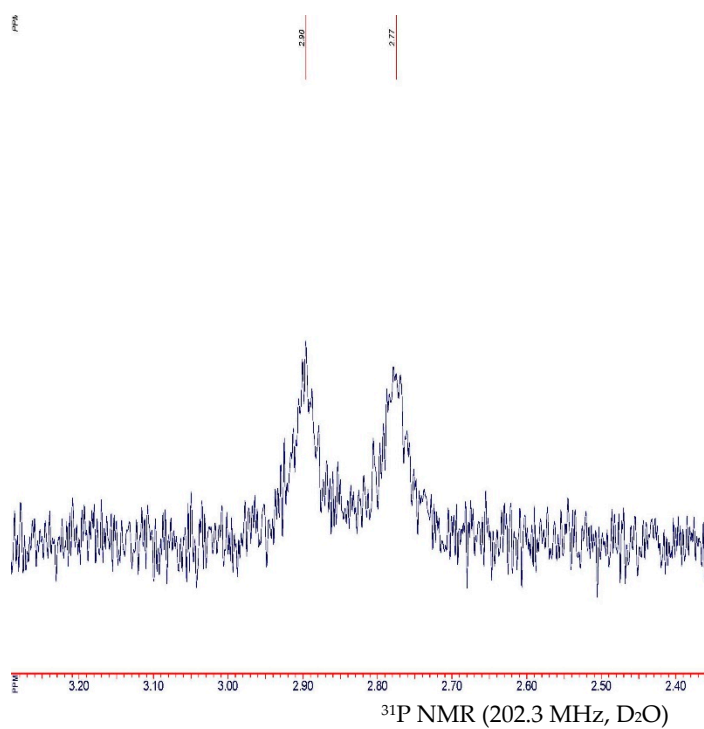
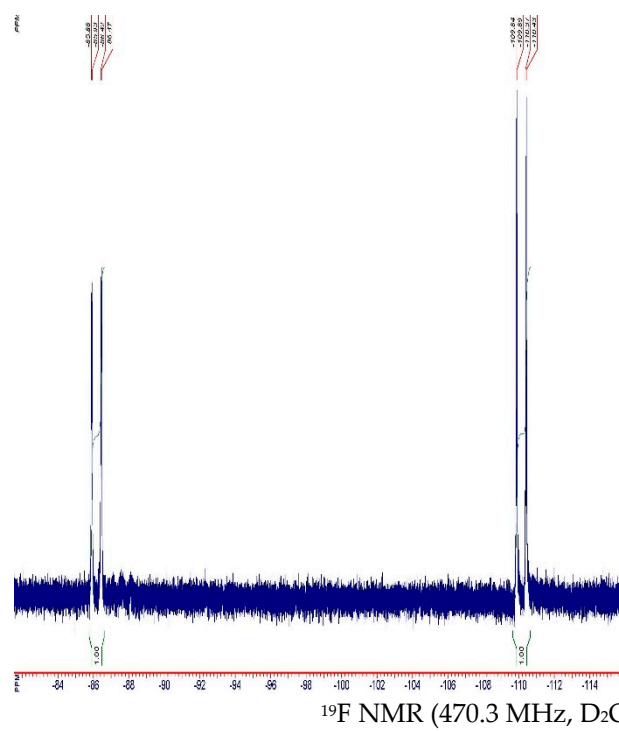


1. -Amino-2,2-difluoro-2-(pyridin-2-yl)ethyl)phosphonic acid **8a**

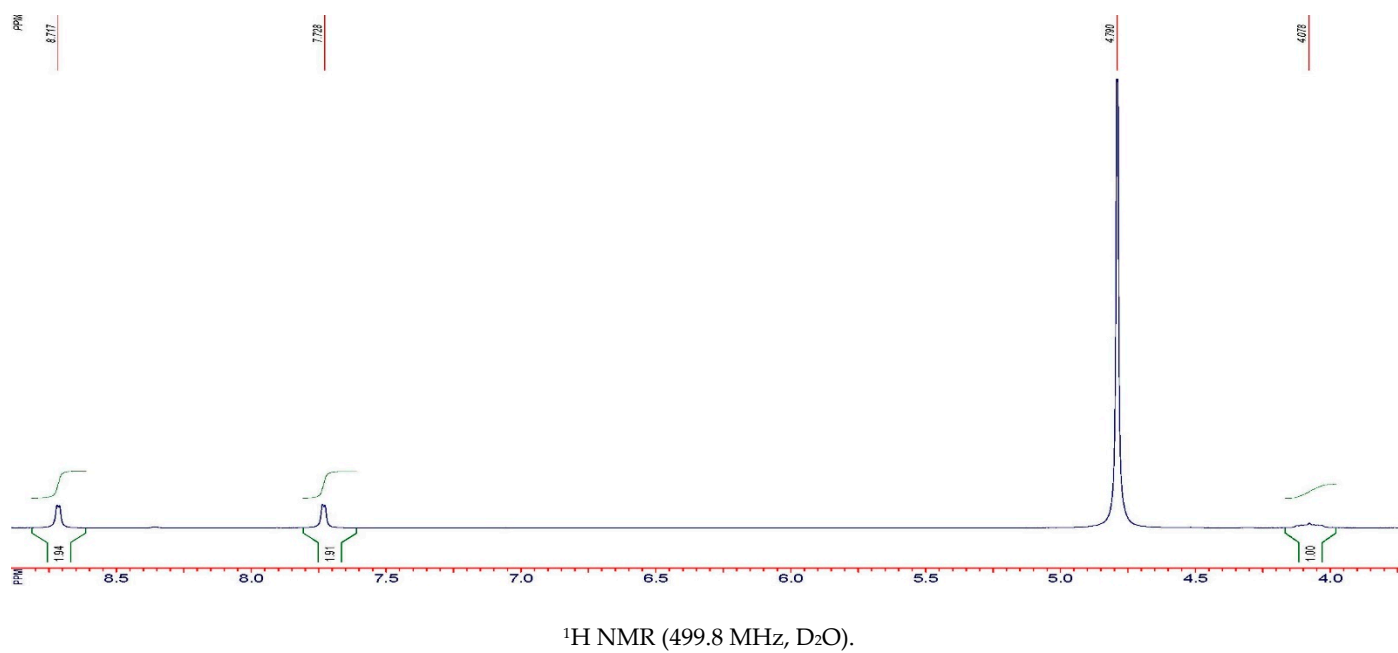


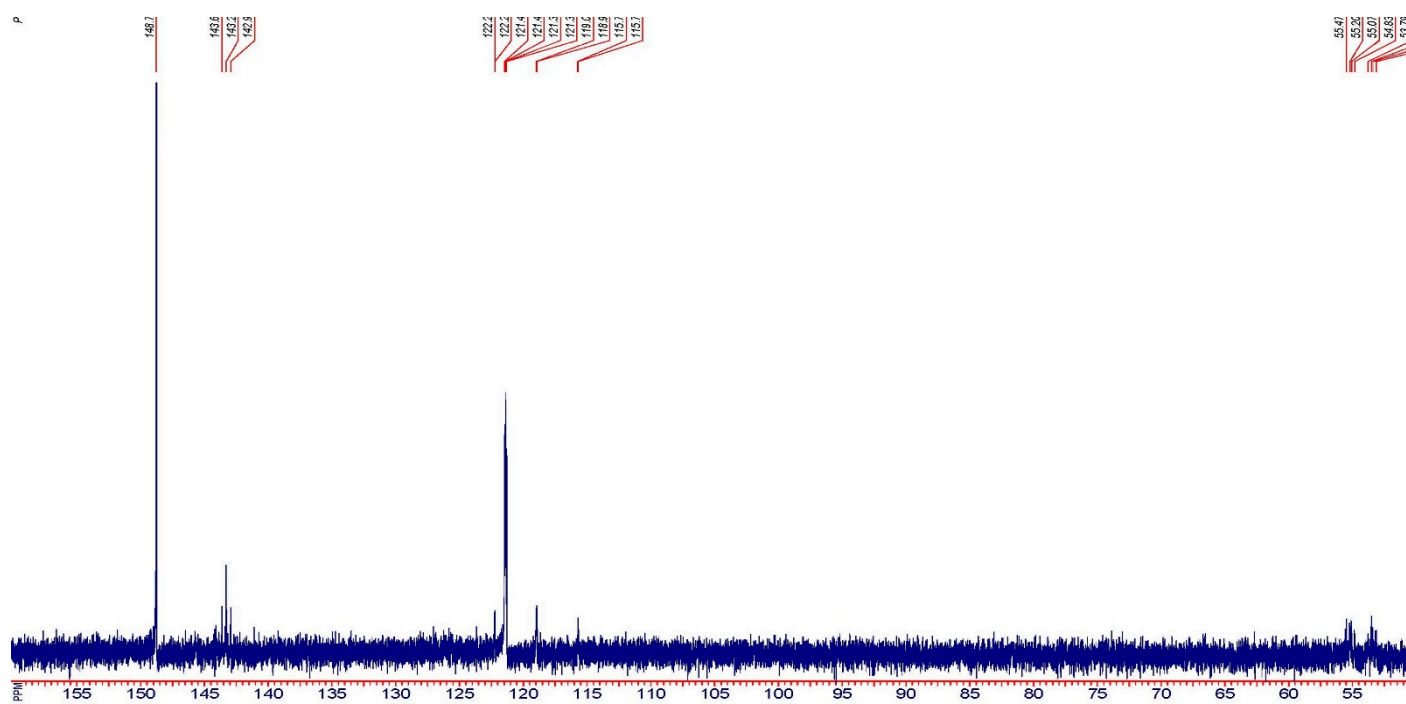


(1-Amino-2,2-difluoro-2-(pyridin-3-yl)ethyl)phosphonic acid 8b¹H NMR (499.8 MHz, D₂O).¹³C NMR (75.8 MHz, D₂O).

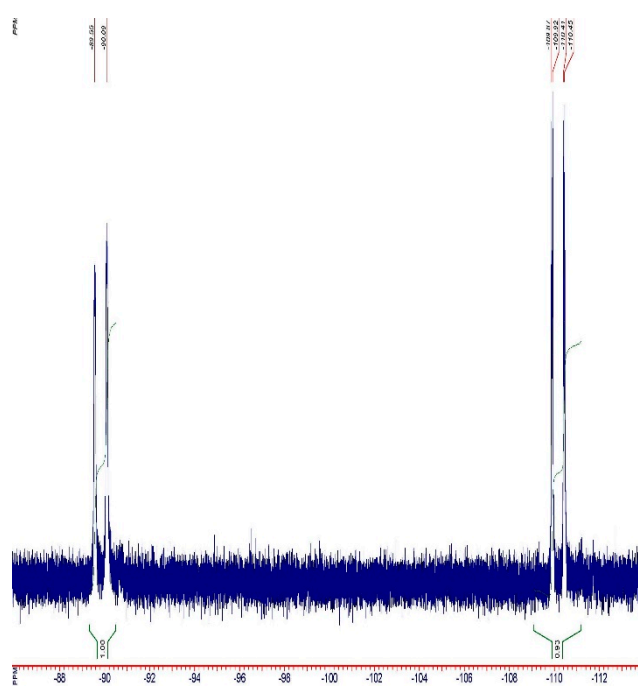


(1-Amino-2,2-difluoro-2-(pyridin-4-yl)ethyl)phosphonic acid **8c**

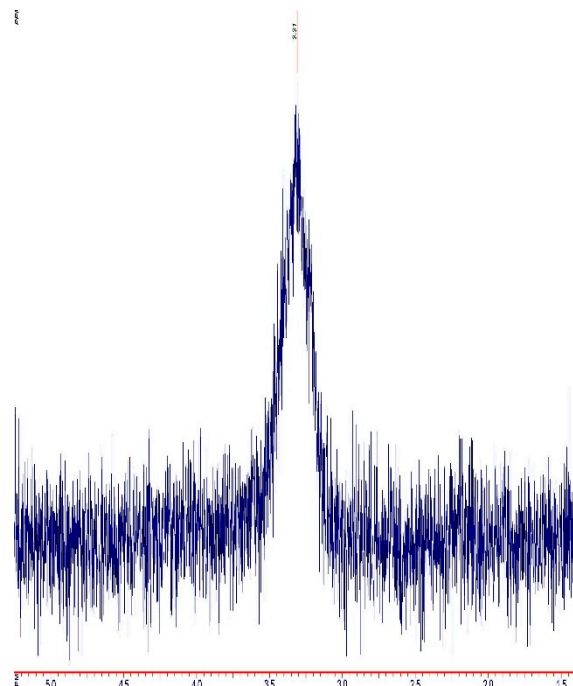




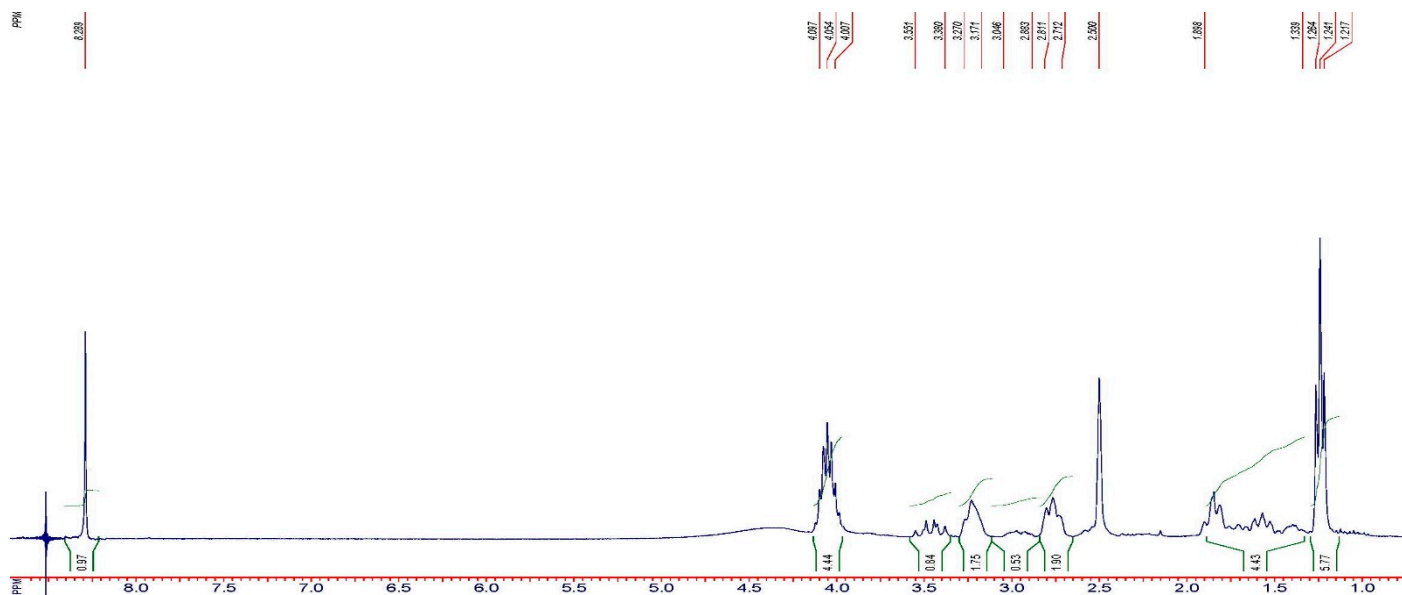
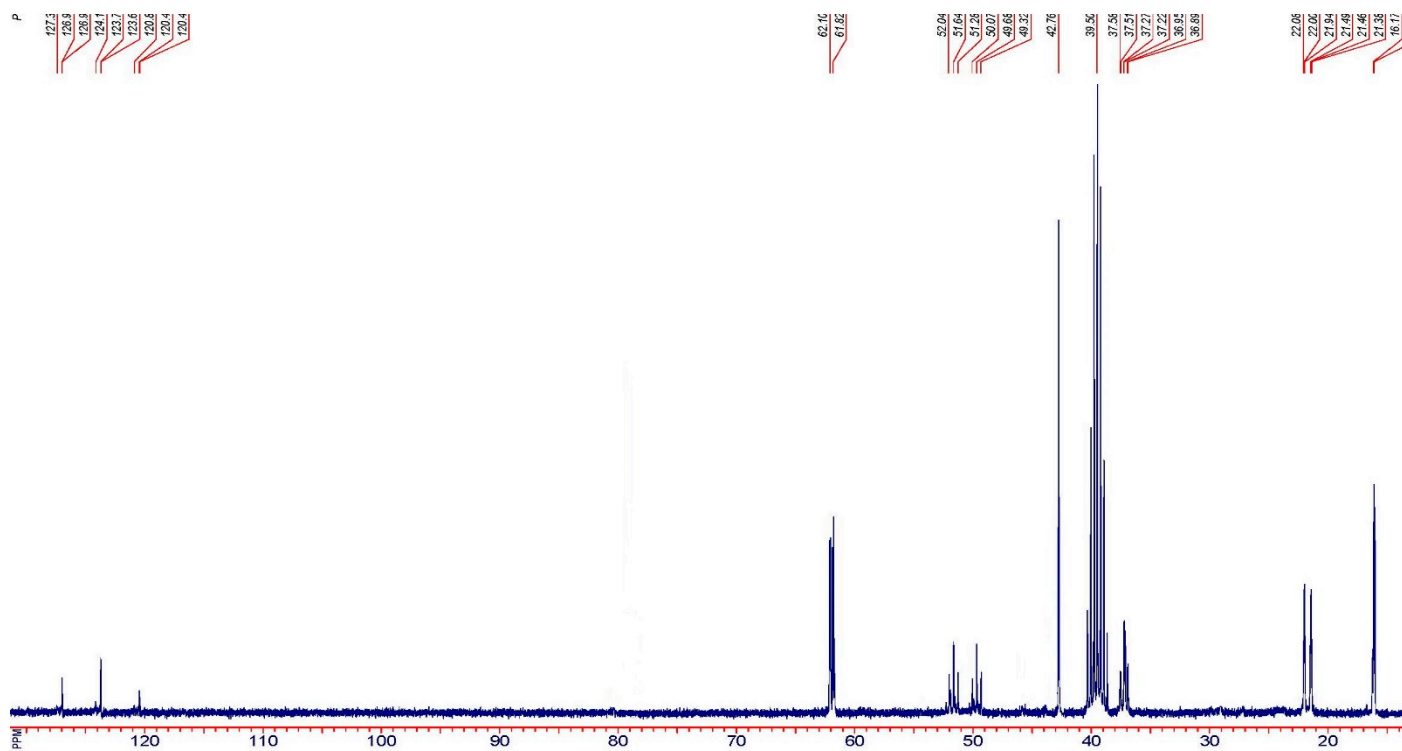
¹³C NMR (75.8 MHz, D₂O).

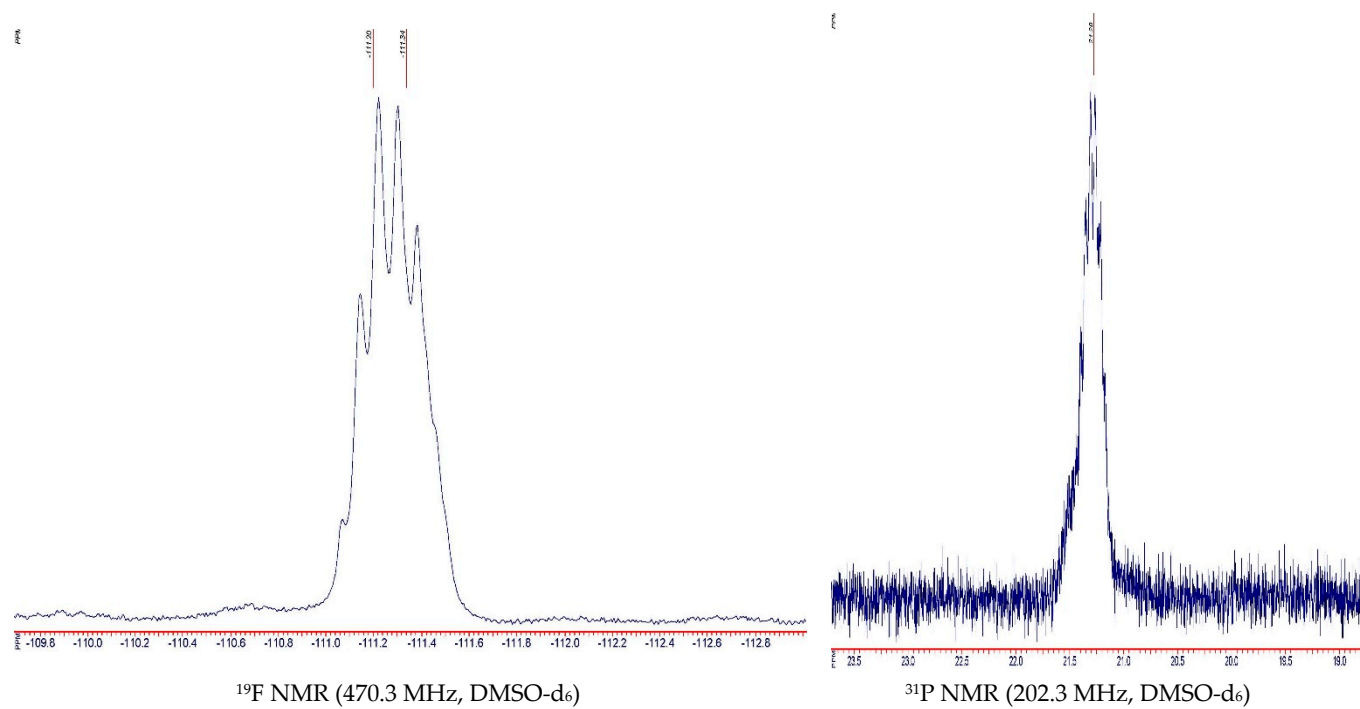


¹⁹F NMR (470.3 MHz, D₂O)

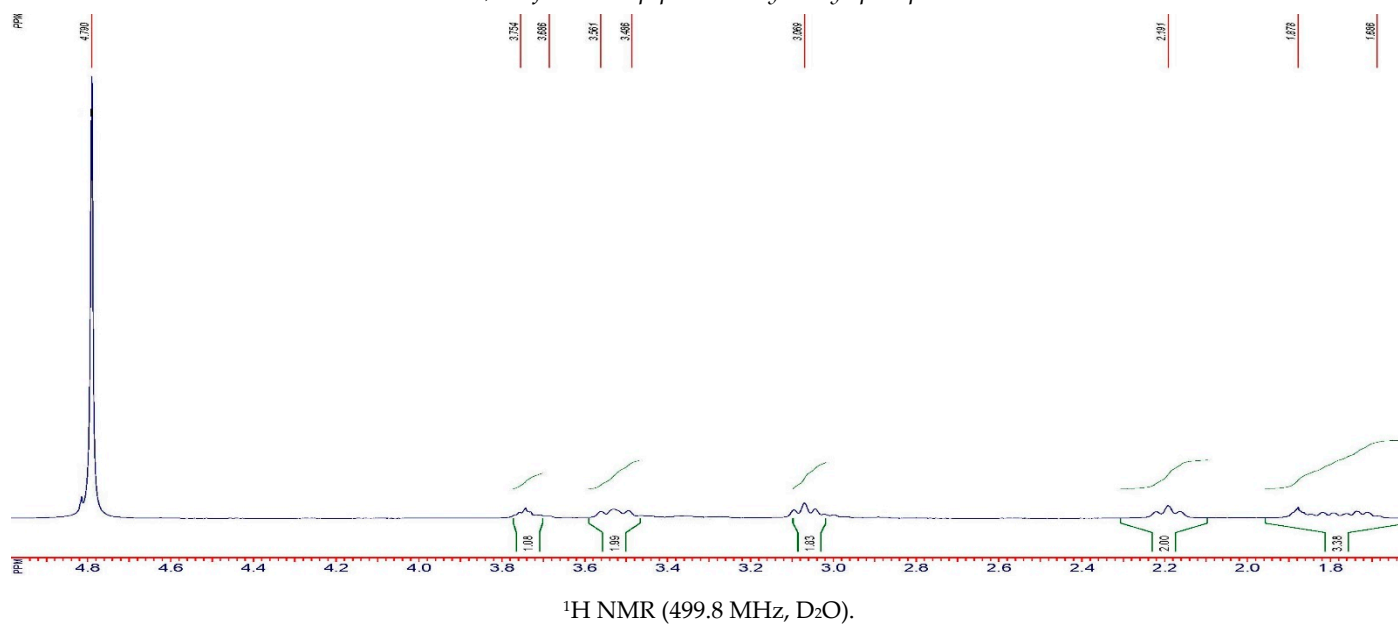


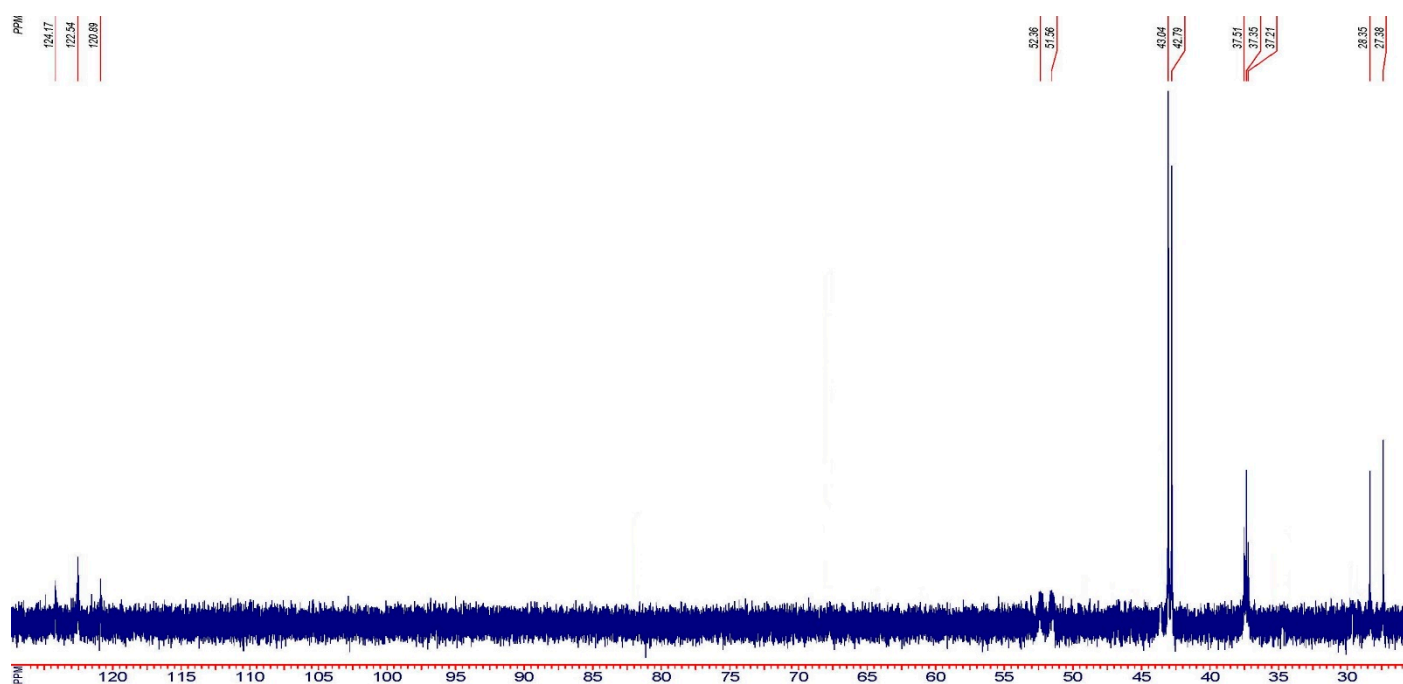
³¹P NMR (202.3 MHz, D₂O)

Diethyl (1-amino-2,2-difluoro-2-(piperidin-4-yl)ethyl)phosphonate 9¹H NMR (302 MHz, DMSO-d₆).¹³C NMR (75.8 MHz, DMSO-d₆).

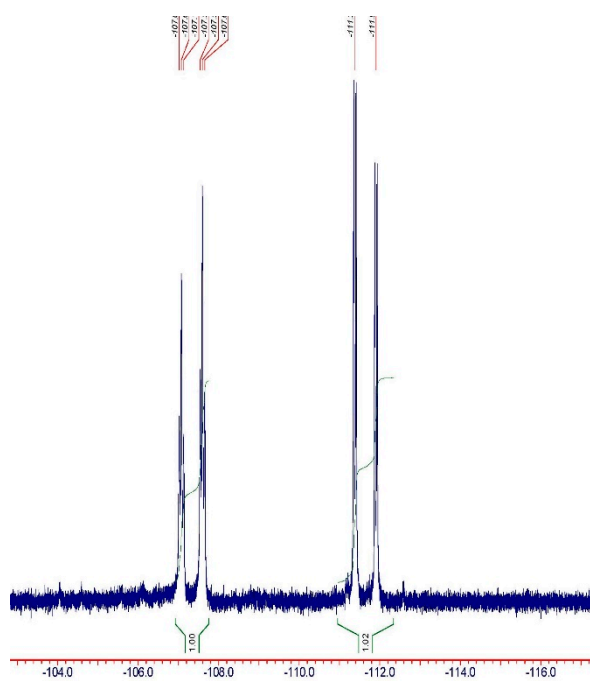


(1-Amino-2,2-difluoro-2-(piperidin-4-yl)ethyl)phosphonic acid **10**

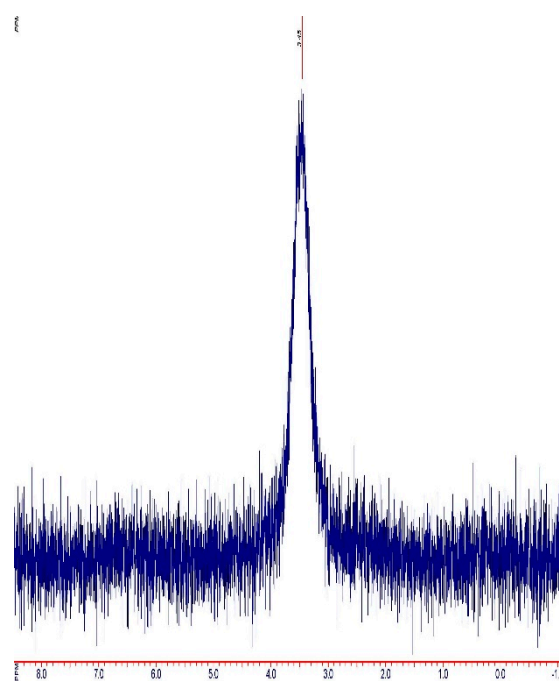




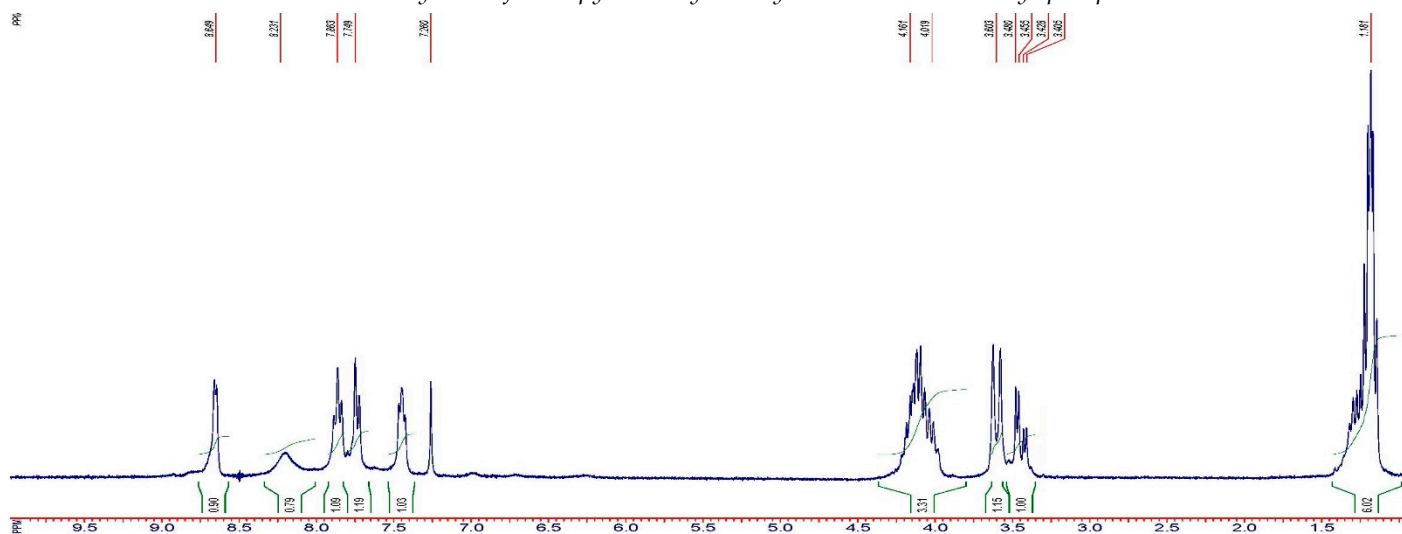
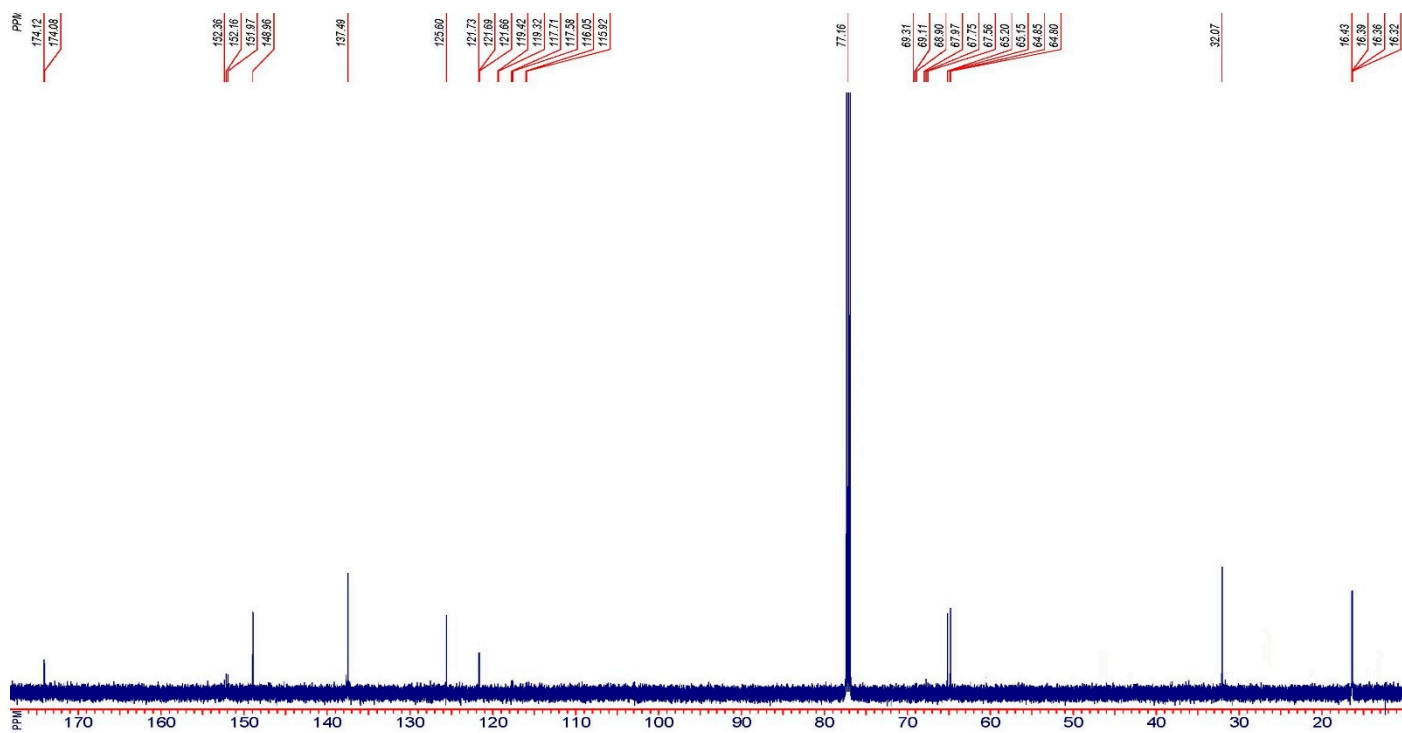
¹³C NMR (150.8 MHz, D₂O).

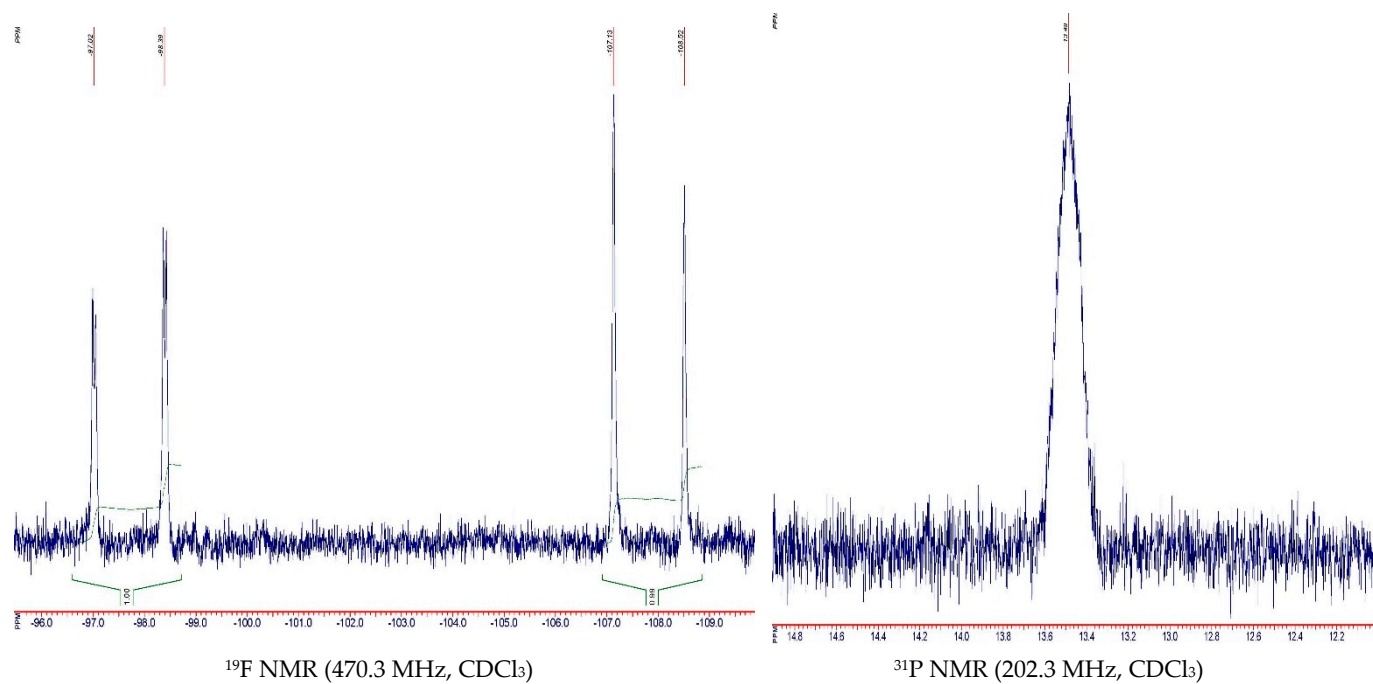


¹⁹F NMR (470.3 MHz, D₂O)

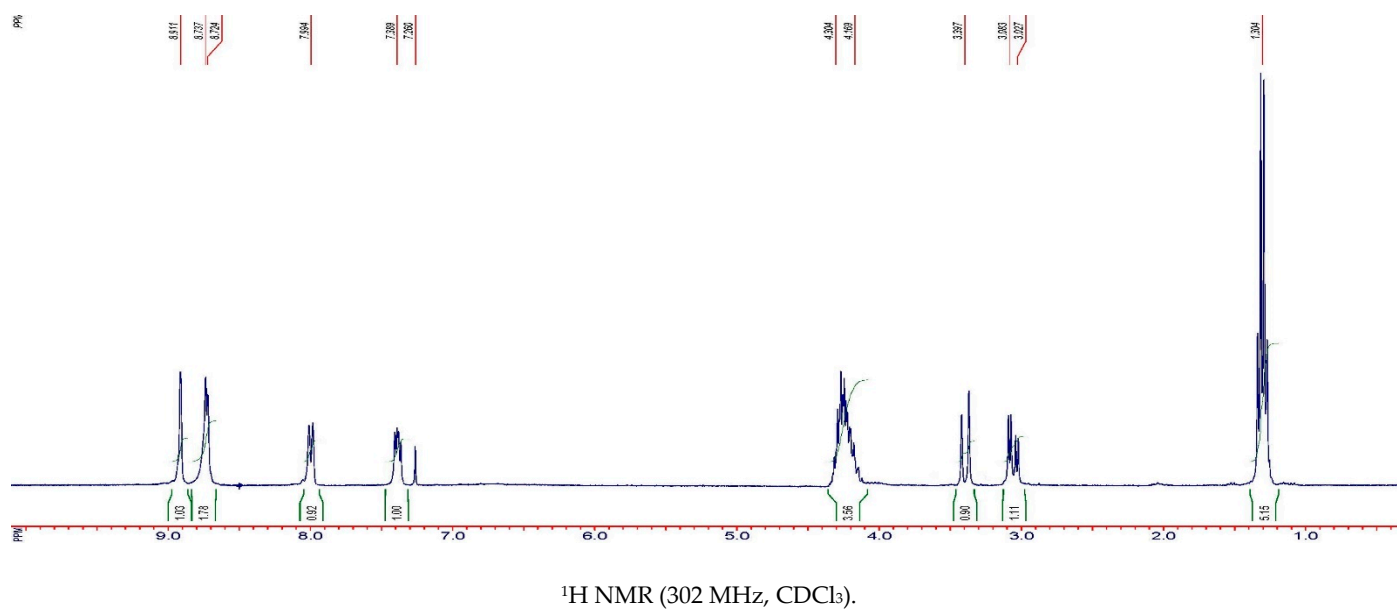


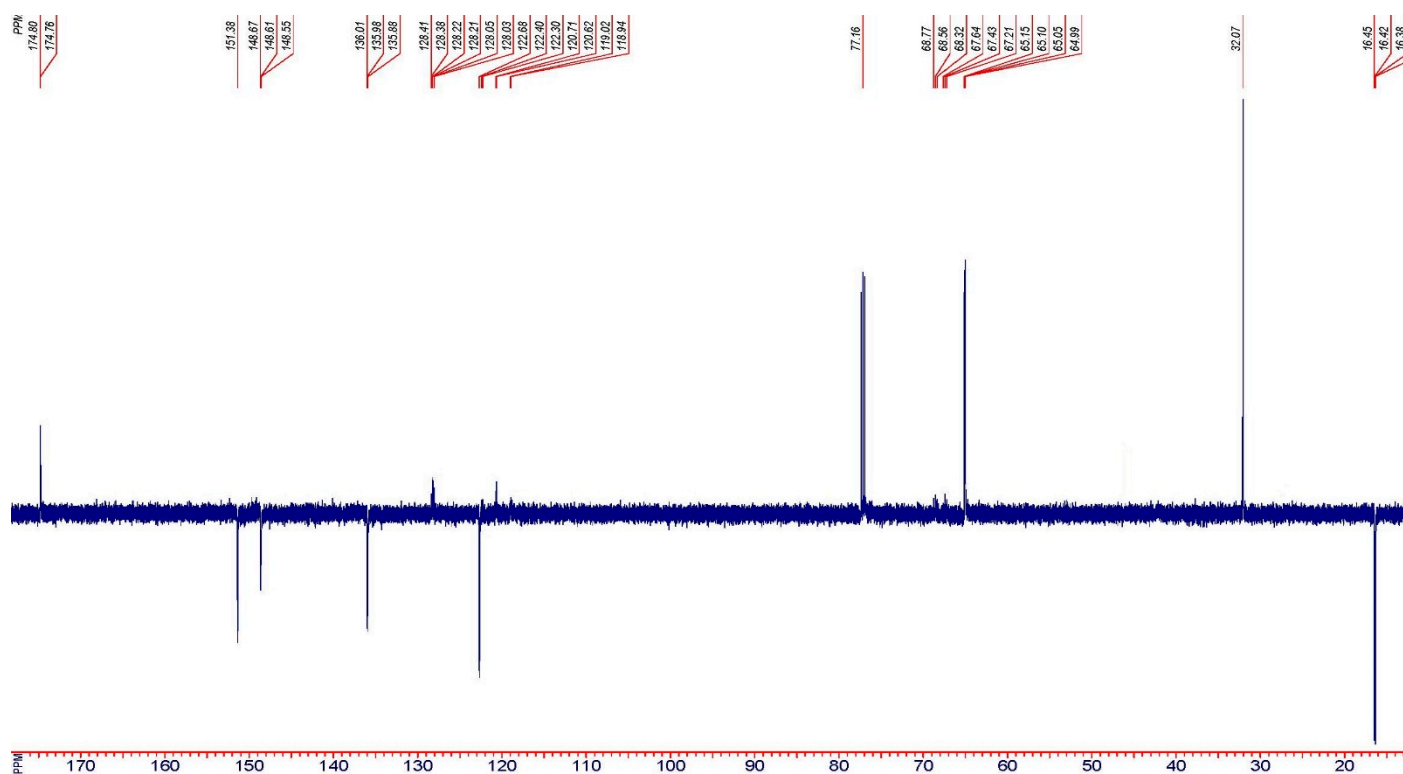
³¹P NMR (202.3 MHz, D₂O)

Diethyl (2-(difluoro(pyridin-2-yl)methyl)-4-oxothiazolidin-2-yl)phosphonate 11a¹H NMR (302 MHz, CDCl₃).¹³C NMR (150.8 MHz, CDCl₃).

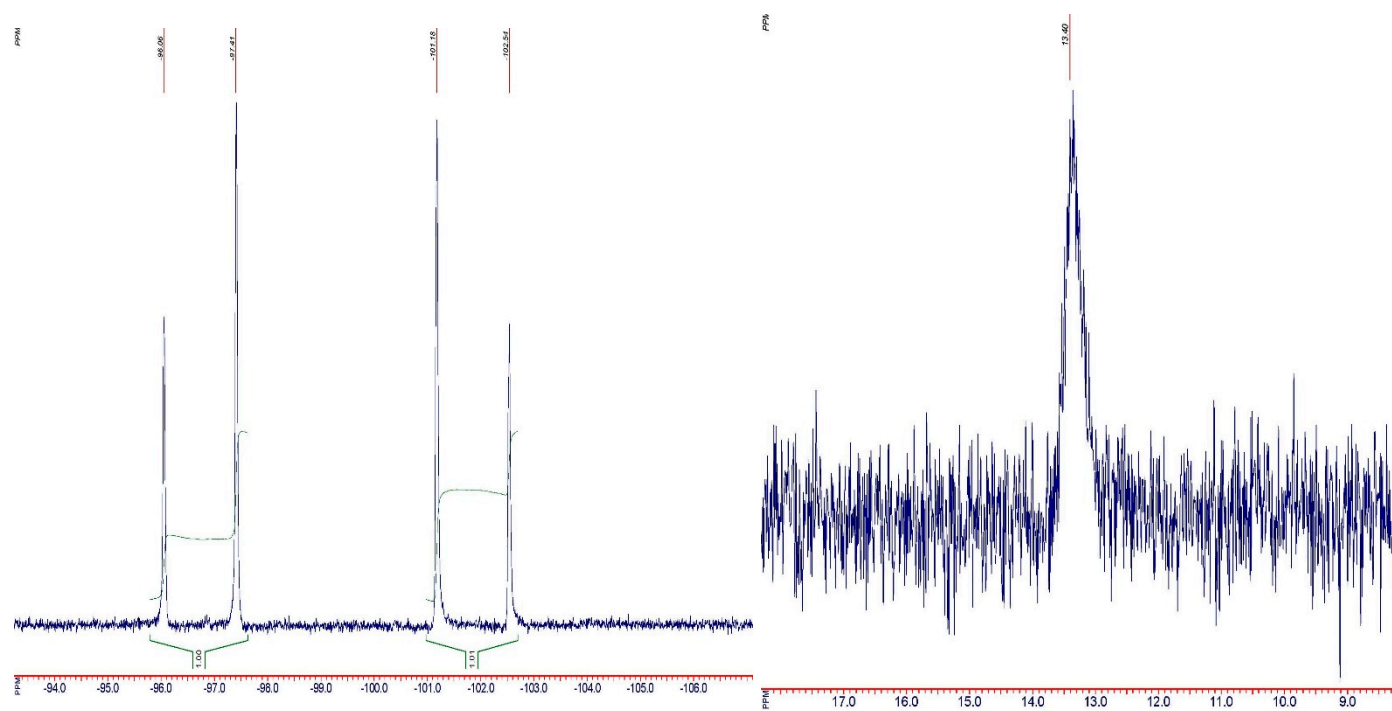


Diethyl (2-(difluoro(pyridin-3-yl)methyl)-4-oxothiazolidin-2-yl)phosphonate 11b



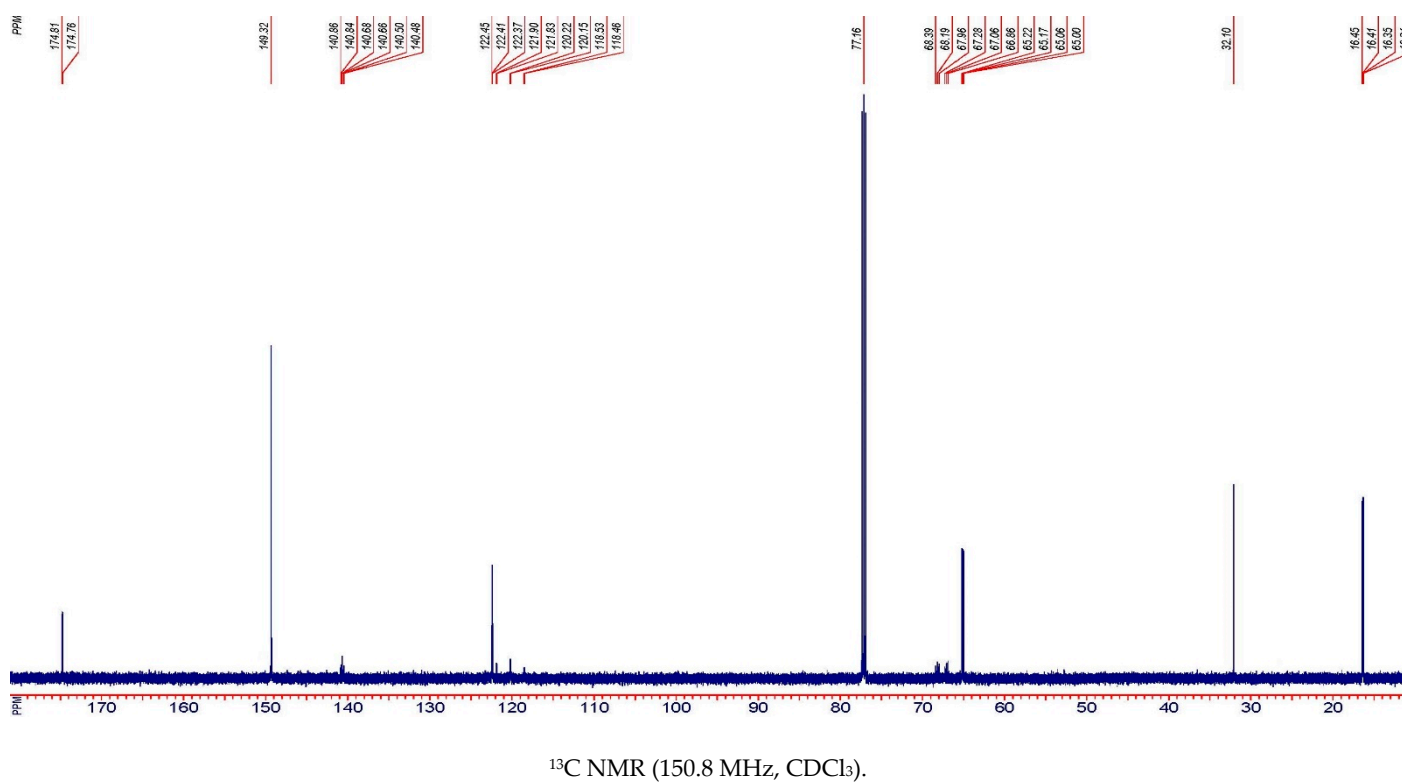
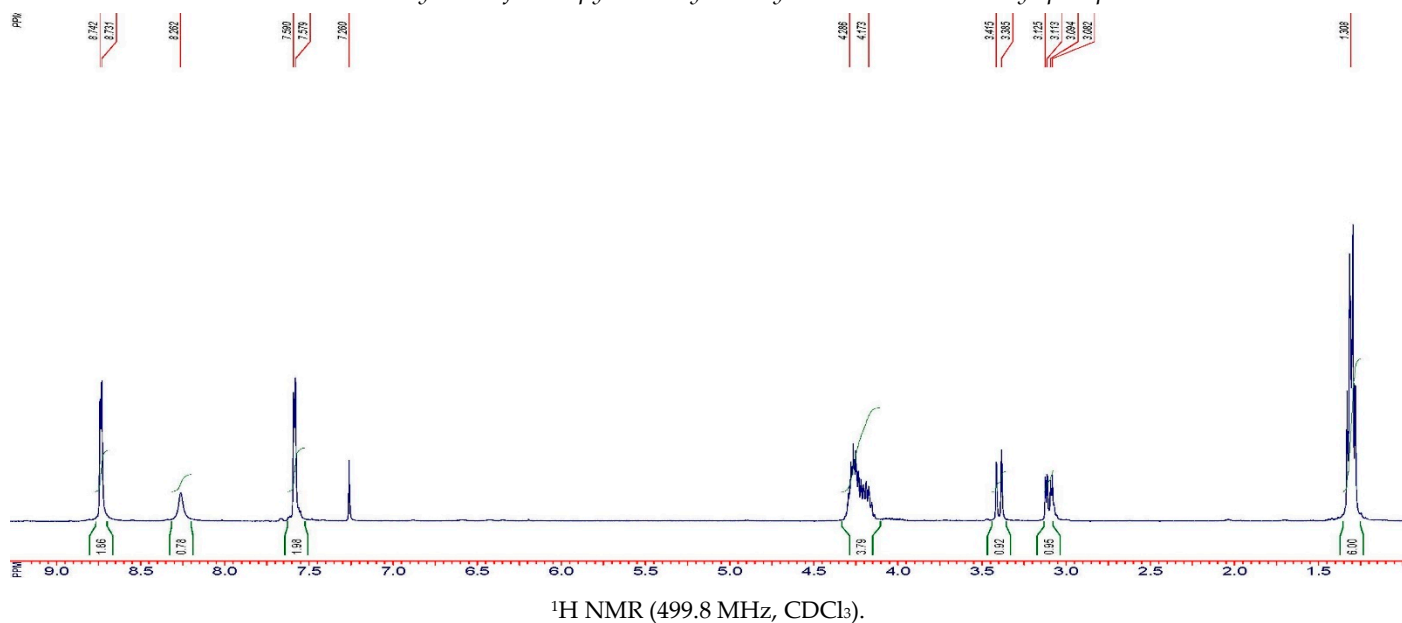


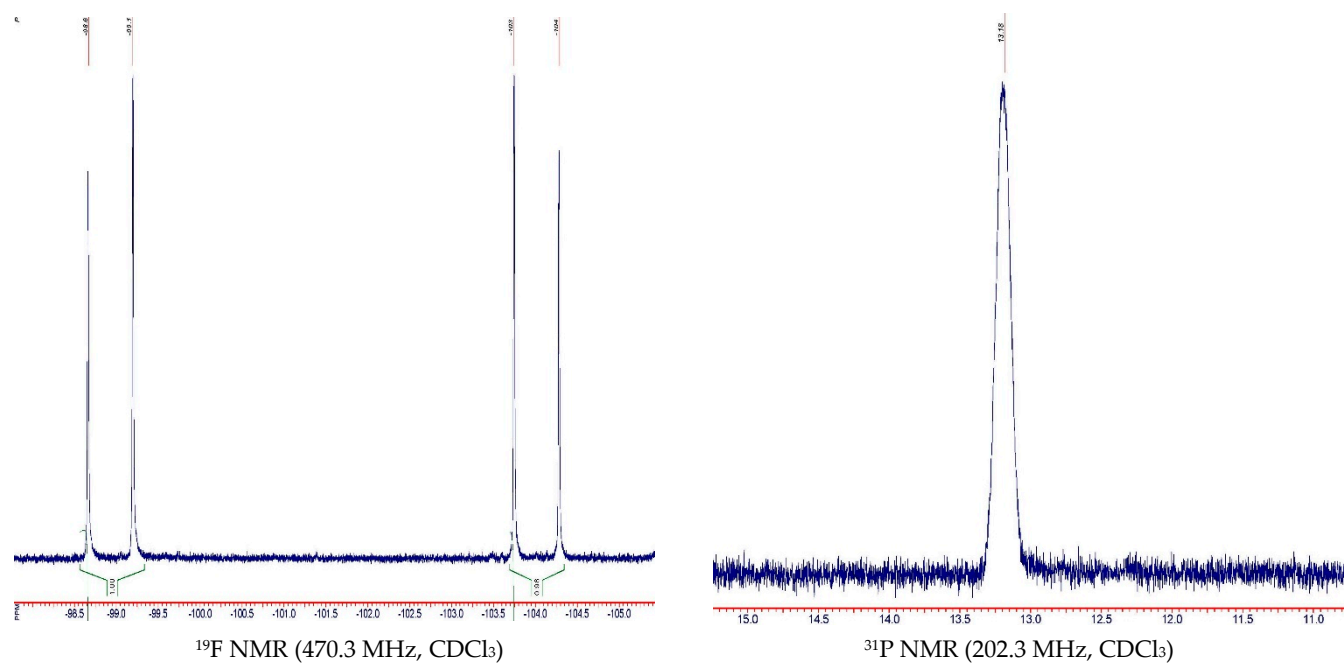
¹³C NMR_APT (150.8 MHz, CDCl₃).



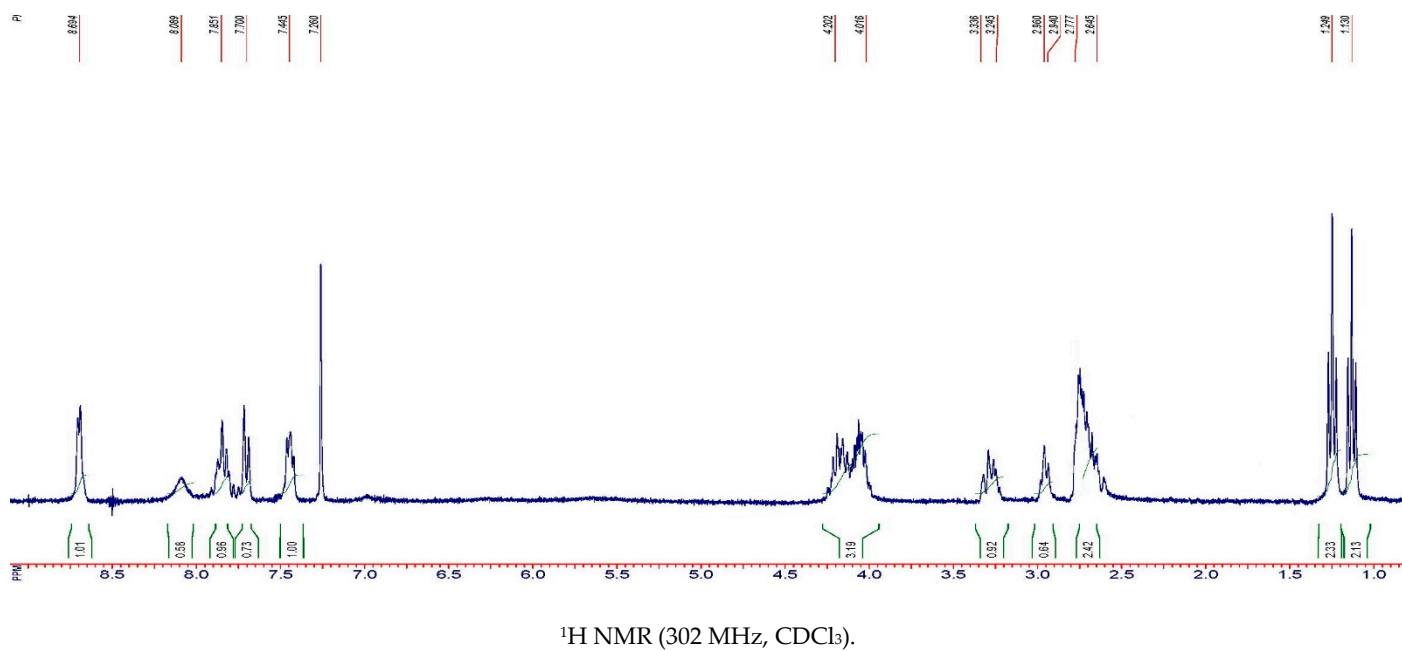
¹⁹F NMR (188 MHz, CDCl₃)

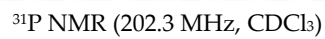
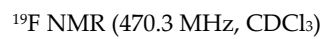
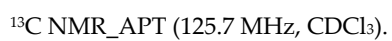
³¹P NMR (202.3 MHz, CDCl₃)

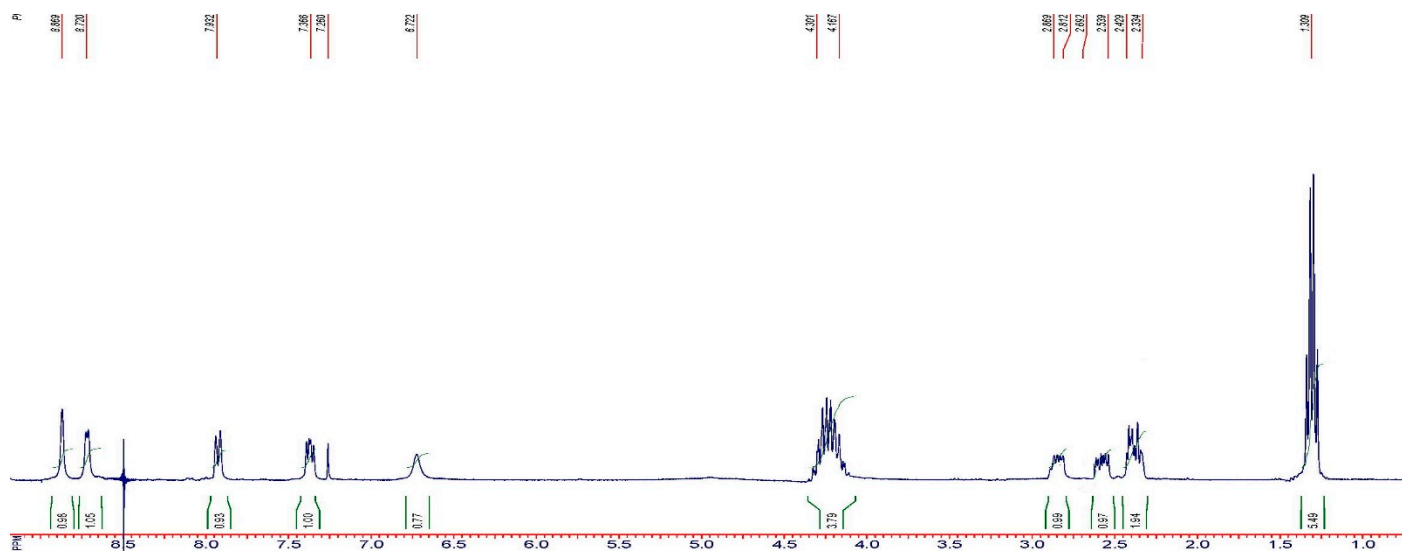
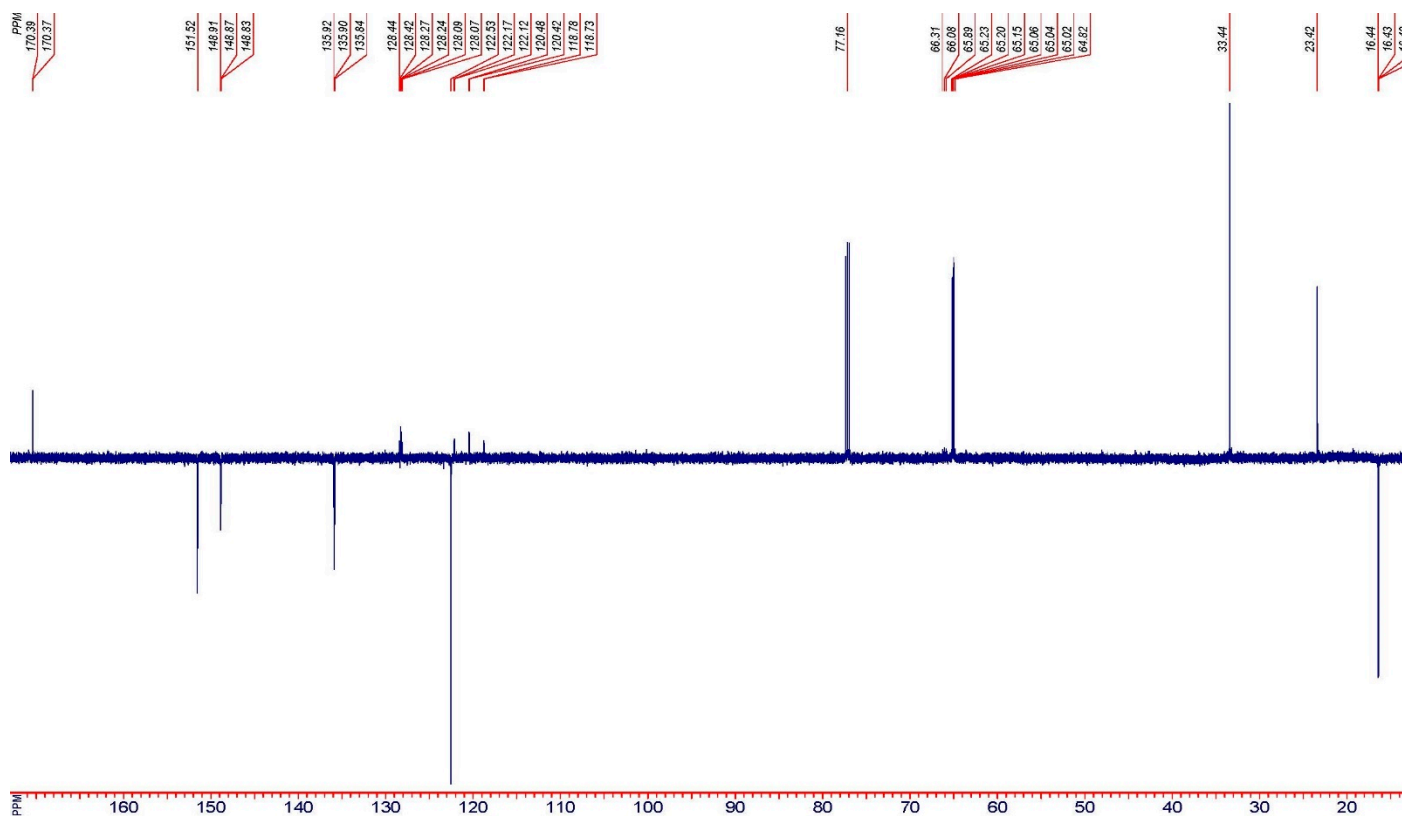
Diethyl (2-(difluoro(pyridin-4-yl)methyl)-4-oxothiazolidin-2-yl)phosphonate 11c

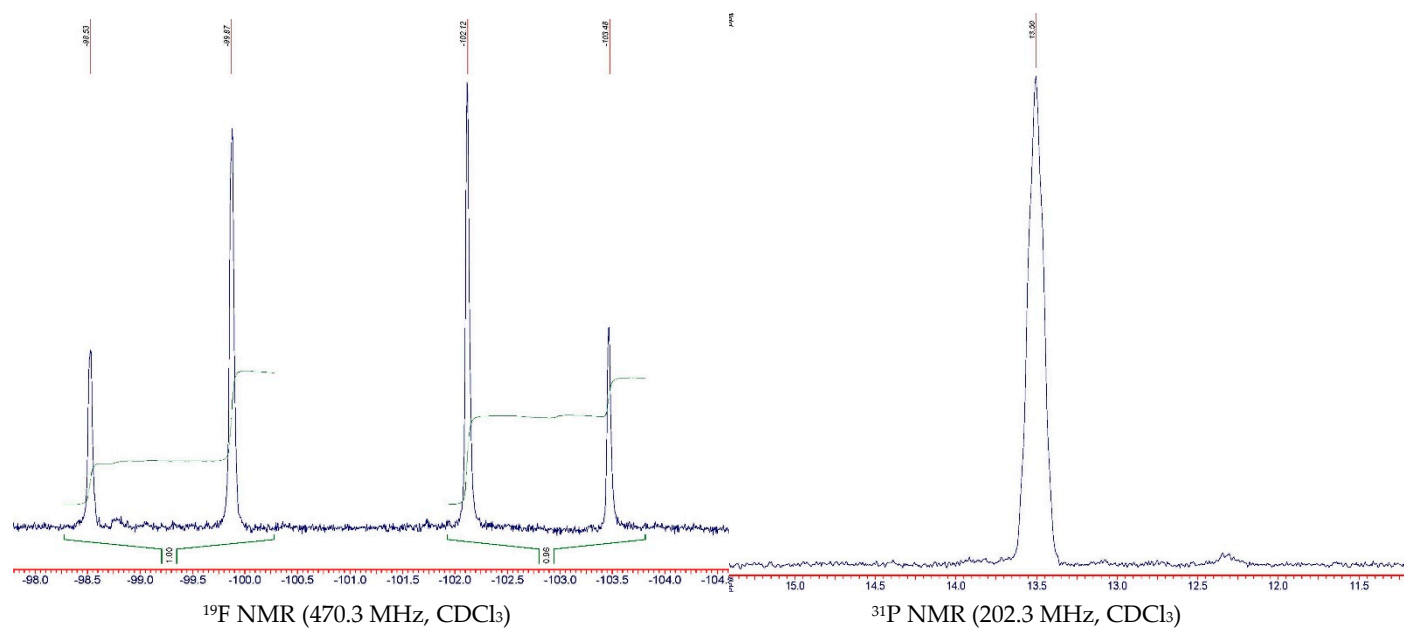


Diethyl (2-(difluoro(pyridine-2-yl)methyl)-4-oxo-1,3-thiazinan-2-yl)phosphonate **12a**

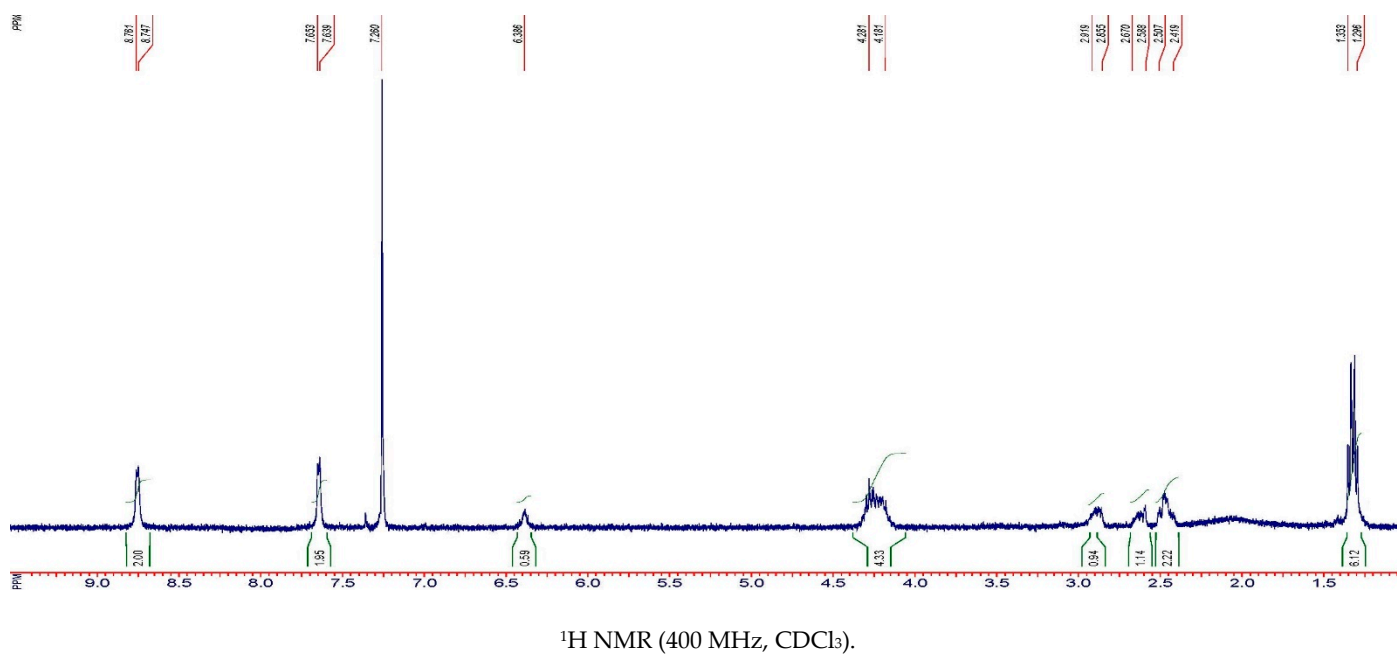


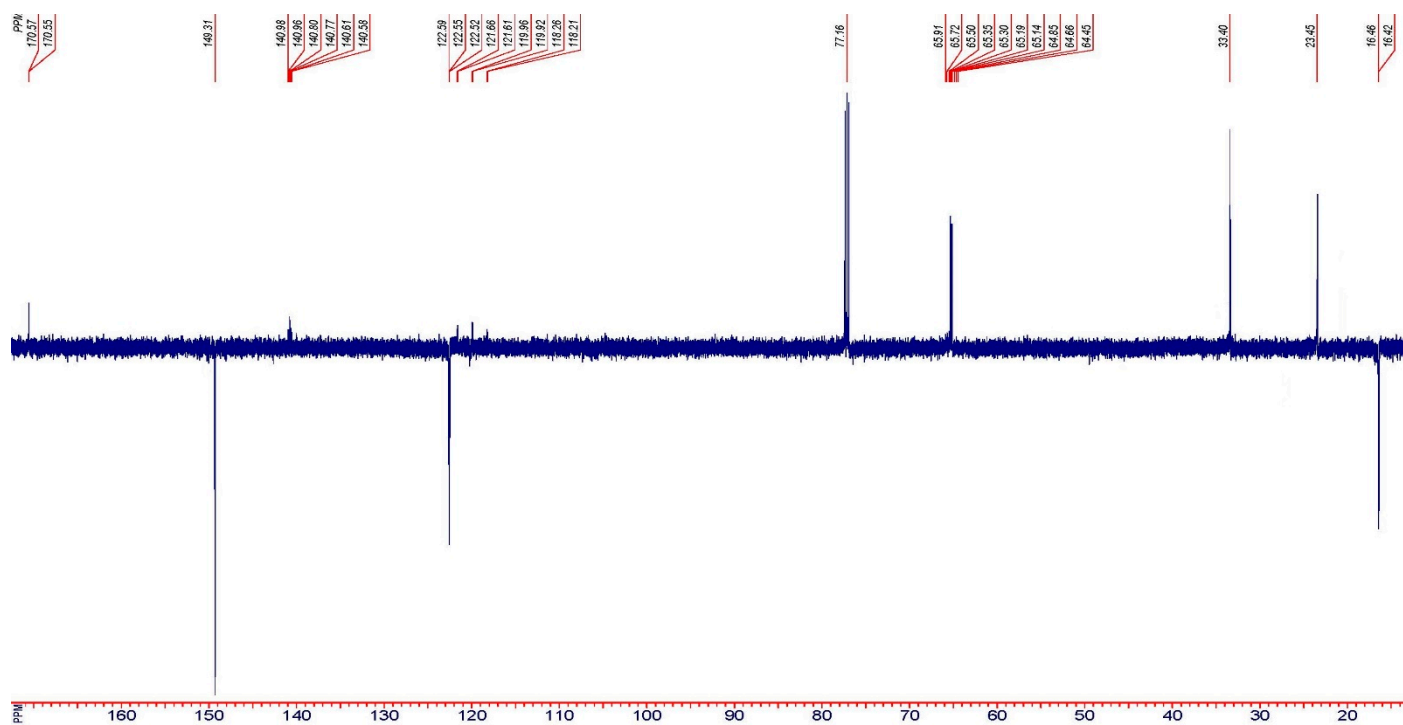


Diethyl (2-(difluoro(pyridine-3-yl)methyl)-4-oxo-1,3-thiazinan-2-yl)phosphonate 12b¹H NMR (400 MHz, CDCl₃).¹³C NMR APT (150.8 MHz, CDCl₃).

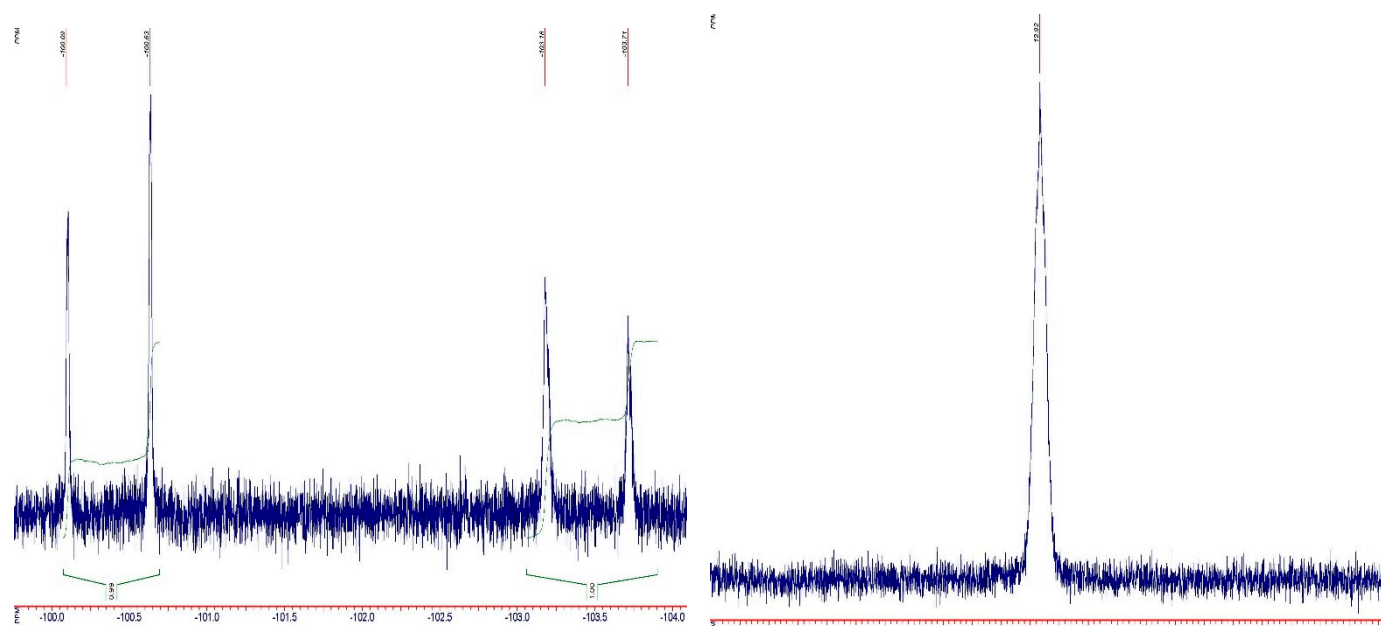


Diethyl (2-(difluoro(pyridine-4-yl)methyl)-4-oxo-1,3-thiazinan-2-yl)phosphonate **12c**





¹³C NMR_APT (150.8 MHz, CDCl₃).



¹⁹F NMR (470.3 MHz, CDCl₃)

³¹P NMR (202.3 MHz, CDCl₃)