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Enantioselective Conjugate Addition to 2-Alkylpyridines

A Thesis submitted in partial satisfaction of the

requirements for the degree Master of Science

in Chemistry

by

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September 2025

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ABSTRACT

Enantioselective Conjugate Addition to 2-Alkylpyridines

by

Priya Kandiyal

The stereoselective functionalization of pyridines remains a powerful strategy for the synthesis of biologically and synthetically valuable heterocycles. In this work, we have developed an efficient method for the direct enantio- and diastereoselective conjugate addition of 2-alkylpyridines to *α-, β*-unsaturated esters, mediated by chiral lithium amides. Under optimized conditions, this transformation delivers products bearing two adjacent stereocenters with excellent levels of both enantioselectivity and diastereoselectivity. Notably, the methodology also enables the independent installation of either the *α*- or *β*-stereocenter with high enantiomeric control, demonstrating its flexibility in accessing stereochemically diverse pyridine derivatives.

The absolute configuration of the *α*- and *β*-stereocenters was confirmed by single-crystal X-ray diffraction of a representative N-methylated salt, providing a reference for the stereochemical assignment of the substrates. The synthetic utility of the method was further showcased through one-pot applications that exploit the in situ-generated enolate for secondary transformations, including alkylation, aldol condensation, and α-oxidation, thereby enabling the construction of up to four stereocenters in a single sequence.

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List of Abbreviations

Abbreviation, Symbol, or Chemical Formula	Term
α	alpha
β	beta
Bn	benzyl
br	broad
Bu	butyl
°C	degrees Celsius
^{13}C	carbon 13
CLA	chiral lithium amide
δ	chemical shift
dr	diastereomeric ratio
ee	enantiomeric excess
equiv	equivalent(s)
Et	ethyl
g	gram(s)
HMPA	hexamethylphosphoramide
HPLC	high performance liquid chromatography
HRMS	high resolution mass spectrometry
Hz	hertz
i	iso

J	coupling constant
L	liter(s)
m	multiplet
Me	methyl
mg	milligram(s)
MHz	megahertz
µL	microliter(s)
min	minute(s)
mL	milliliter(s)
mmol	millimole
NMR	nuclear magnetic resonance
Ph	phenyl
ppm	parts per million
Py	pyridine
R	generic functional group
s	singlet
t	tert/tertiary
t	triplet
TBS	tert-butyldimethylsilyl
THF	tetrahydrofuran
TMS	trimethylsil

Chapter 1: Introduction

1.1 Introduction

Pyridines are among the most important nitrogen heterocycles in medicinal chemistry, consistently ranking as one of the most frequently occurring heteroaromatic motifs in FDA- and EMA-approved small-molecule drugs.[1-2] In the most recent analysis of U.S. FDA approvals from 2013–2023, 54 newly approved drugs contain pyridine as the most common nitrogen heterocycle.[2] Substitution patterns show that pyridines are most frequently substituted at the 2-position — approximately 90% of newly approved pyridine-containing drugs have C2 substitution being most prevalent.[2] Functionalization at the α-position provides a powerful handle for tuning electronic properties, basicity, and metabolic stability, making enantioenriched C2-substituted pyridines important building blocks for drug discovery and asymmetric catalysis.[3] The ability to form stereogenic centers adjacent to pyridine rings opens new opportunities for accessing enantioenriched heteroaromatic scaffolds that can serve as advanced intermediates, ligands, and pharmacophores. Achieving such transformations directly and with high enantioselectivity is an area of continued interest in synthetic methodology.

Chiral lithium amides (CLAs) have emerged as powerful noncovalent stereodirecting reagents, enabling highly enantioselective transformations via mixed aggregation with organolithium intermediates.[4-12] These reagents offer a complementary strategy to covalently attached chiral auxiliaries by providing a tunable chiral environment through aggregation. While α-alkylation of 2-alkylpyridines using CLAs[9] has recently been demonstrated with excellent enantioselectivity, no enantioselective conjugate addition of 2-alkylpyridines using CLAs has been reported to date.

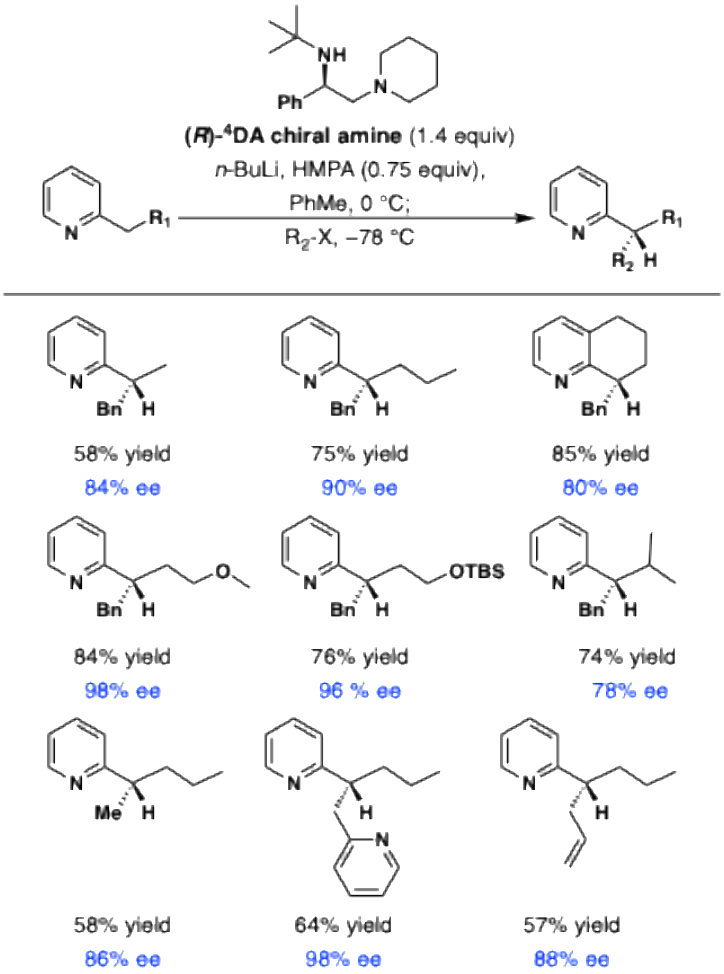
Herein, we report a general procedure for enantioselective conjugate addition to 2-alkylpyridines. This methodology achieves direct C–C bond formation while installing stereogenic centers in a single step, without the need for substrate prefunctionalization or pyridine activation. This work complements previously reported α-alkylation methods[9] and significantly expands the synthetic toolbox for the preparation of chiral pyridine derivatives.

1.2 Enantioselective Alkylation of 2-Alkylpyridines Using Chiral Lithium Amides

Our group previously developed a direct enantioselective α-alkylation of 2-alkylpyridines[9] that provided one-step route to chiral pyridines.[9] This protocol employs chiral lithium amides as noncovalent stereodirecting auxiliaries, creating a chiral environment for alkylation through mixed aggregation with the lithiated pyridine (Scheme 1). This strategy offered several distinct advantages compared to other prior methods. Firstly, it provided direct single-step process to chiral pyridines without requiring prefunctionalization, or preactivation of the pyridine nucleus thereby eliminating multistep process. Secondly, the approach was mechanistically guided and delivered excellent selectivity. Finally, the chiral amine is easily prepared from styrene oxide and is recovered in nearly quantitative yield by pH-controlled extraction.

The substrate scope includes 2-alkylpyridines and its derivative bearing longer alkyl chains, β-branching, γ-alkoxy substituent and tetrahydroquinoline frameworks, all of which delivered high enantioselectivity under optimized condition. Substrates bearing a γ-alkoxy

Scheme 1: Enantioselective alkylation of 2-Alkylpyridines



exhibited an exceptional increase in enantioselectivity. The electrophile scope was similarly diverse, encompassing methylation, allyl bromide alkylation and benzylation, allowing the introduction of versatile function handles. Many additional substrates and electrophile combinations were explored in this study, but only a representative et is highlighted here to illustrate the generality of the method.

1.3 Mechanistic Studies

Mechanistic investigations revealed that the aggregation state of the reactive lithium species plays a crucial role in stereocontro.[9] Crystallographic analysis of lithiated 2-alkylpyridines has a general structure of (2-Py)(R)CHLi·(*R*)-Li[4]DA·HMPA in a 1:1:1

stoichiometry.[9] The aggregate derived from 2-ethylpyridine **A** displayed a four-membered Li-N-Li-N cluster typical of many organolithium aggregates. In contrast, the aggregate formed by 2-(3-methoxy-propyl)- pyridine **B** underwent a striking reorganization: the γ-methoxy group coordinated to lithium, disrupting the four-membered ring and producing a six membered O chelated aggregate.[9]

Figure 1: Mixed aggregates structure determined by X-ray diffraction study of crystals[9]

The stability of aggregate **B** could be the reason for suppression of the background alkylation hence the ten-fold improvement in enantioselectivity of γ-alkoxy substituents. This result demonstrate that internal coordination reorganizes lithium aggregates into more ordered, stereocontrolling structures, which likely minimize competing, nonselective pathways. This understanding inspired the central hypothesis of this project: using a Michael acceptor like a with a Lewis-basic group, such as *tert*-butyl ester could similarly bias the aggregation state toward a stereocontrolling species and achieve highly selective conjugate additions to 2-alkylpyridines.

Chapter 2: Enantioselective Conjugate Addition to 2-Alkylpyridines

2.1 Introduction

Conjugate addition is one of the most reliable carbon–carbon bond-forming reactions in organic synthesis. When applied to heteroaromatic systems such as 2-alkylpyridines, this

transformation offers a direct approach to α-functionalized heteroarenes, which are valuable motifs in medicinal chemistry, catalysis, and materials science. Despite their utility, conjugate additions to 2-alkylpyridines remain challenging due to competing reactivity pathways and difficulty achieving high levels of stereocontrol.

Motivated by the mechanistic insights described above, we hypothesized that using an electrophile capable of internal coordination — such as a *tert*-butyl crotonate — would stabilize a well-defined lithium aggregate and enforce a stereocontrolling transition state. By leveraging this strategy, we sought to develop a general, reproducible, and highly enantioselective methodology for conjugate addition to 2-alkylpyridines.

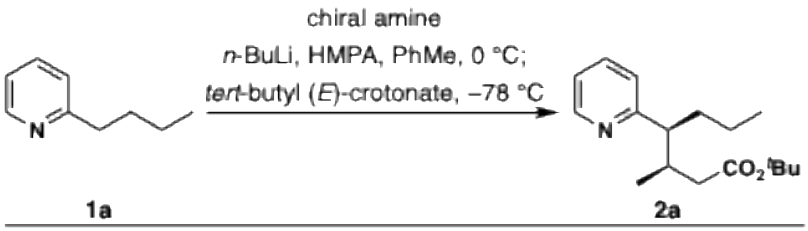
Although the project began as an enantioselective conjugate addition study, its scope expanded significantly as new discoveries emerged. We found that this strategy could be applied to construct up to four stereocenters in a single transformation, enabling access to densely substituted pyridine derivatives with exceptional levels of selectivity. This evolution transformed the project from a single-step optimization effort into a platform for multi-stereocenter synthesis, highlighting the versatility and potential impact of the methodology developed herein.

2.2 Optimization of Reaction Conditions

Our investigation into conjugate addition started with 2-butylpyridine and *tert*-butyl *(E)*-crotonate as an electrophile to evaluate the viability of this method. Initial efforts focused on screening of chiral lithium amides to identify optimal conditions (Table 1). Given the established role of toluene and HMPA in the alkylation of 2-alkylpyridines in the previous

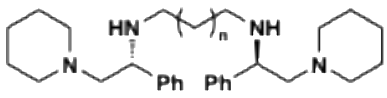
work from our laboratory,[9] 0.5 equivalent of HMPA was selected as the initial stoichiometric ratio for HMPA study, serving as the baseline for subsequent optimization.

Table 1. Identification of the optimal CLA for Enantioselective Conjugate addition



1a **2a**

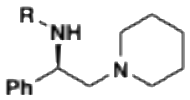
chiral amine:



tetramines (TA)

(R)-^{1}**TA**: n = 0

(R)-^{2}**TA**: n = 1



diamines (DA)

(R)-^{1}**DA**: R = *i*-Ph

(R)-^{2}**DA**: R = *i*-Pr

(R)-^{3}**DA**: R = $MeOCH_2CH_2CH_2$

(R)-^{4}**DA**: R = *t*-Bu

entry	chiral amine	yield (%)	ee (%)
1	(R)-^{1}**TA**	20	80
2	(R)-^{2}**TA**	15	93
3	(R)-^{1}**DA**	25	76
4	(R)-^{2}**DA**	30	92
5	(R)-^{3}**DA**	27	82
6	(R)-^{4}**DA**	37	99
7	(R)-^{4}**DA**^{b}	76	99
8	(R)-^{4}**DA**	52	99

All reactions were carried out using 0.44 mmol of 2-butylpyridine (**1a**), 0.45 mmol of chiral amine (1.03 equiv **DA**, unless otherwise noted) or 1.35 mmol of chiral amine (3.03 equiv, **TA**), 0.90 mmol of *n*-BuLi (2.03 equiv), and 0.53 mmol of *tert*-butyl *(E)*-crotonate (1.2 equiv) in 4.63 mL of toluene. 2-butylpyridine and *tert*-butyl *(E)*-crotonate were distilled over CaH_2 and stored in a desiccator. HMPA was distilled over CaH_2 and stored in a Schlenk flask as a solution with toluene under an atmosphere of argon. Toluene was distilled over Na and stored in a Schlenk flask under an atmosphere of argon. Chiral amines were prepared according to

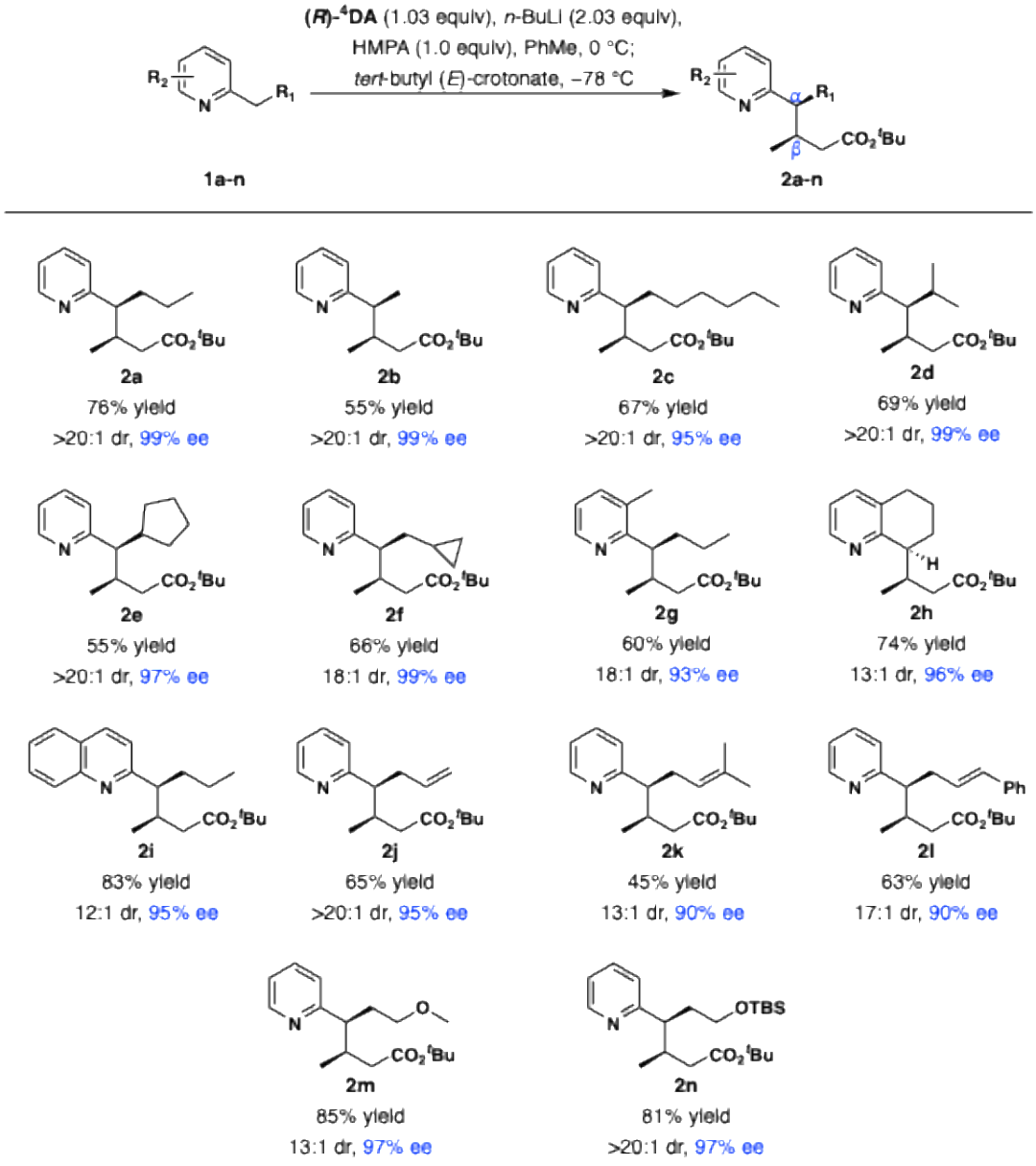
published procedures and dried for 12 h prior to use and stored in a desiccator. [b]Reaction condition: 0.44 mmol HMPA (1.0 equiv) was used.

From the outset, the reaction afforded good enantiomeric excess (ee) with (*R*)-**[1]TA** and (*R*)-**[2]TA** (80% and 93%, respectively). However, the yields were low, prompting further screening of chiral amines. A comparable enantiomeric control was observed with diamine (*R*)-**[1]DA**-**[3]DA** with a slightly better conversion of up to 30%. *tert*-butyl diamine (*R*)-**[4]DA**, which was previously shown to be highly effective in enantioselective alkylation of 2-butylpyridine,[9] once again provided to be most optimal among chiral amines with an ee of 98% and 37% yield (entry 6). Additive HMPA plays an important role in organolithium aggregation,[9] hence accordingly a range of HMPA loading (0 – 2.0 equivalent) were screened. Optimal results were obtained with 1.0 equivalent of HMPA, which doubled the yield from 37% to 76% without affecting the enantiomeric excess (entry 7). It is also interesting to note that 2.0 equivalent of HMPA decreased the ee from 99% to 86% while affording the comparable yield. Furthermore, increasing the amount of chiral diamine (*R*)-**[4]DA** from 1.03 equiv to 1.4 equiv did not lead any significant changes in the reaction outcome.

2.3 Substrate Scope

The scope of 2-alkylpyridines was investigated by employing optimized reaction conditions using *tert*-butyl *(E)*-crotonate (Table 2). The use of *tert*-butyl *(E)*-crotonate as the Michael acceptor is noteworthy, as the conjugate addition generates two stereocenters (α and β) in a single transformation, thereby presenting an additional stereochemical challenge and opportunity for control. Achieving high level of both diastereo- and enantioselectivity highlights the importance of this study.

Table 2. Scope of 2-alkylpyridines



Reaction conditions: All reactions were performed on a 0.44 mmol scale and 1.2 equivalent of Michael acceptor was used unless specified otherwise. Isolated yields are shown. Results are normalized to bases with the *R* configuration; enantiomeric excess (ee) values were determined by HPLC analyses. Diastereomeric ratio (dr) is determined through ^{1}H NMR spectroscopy.

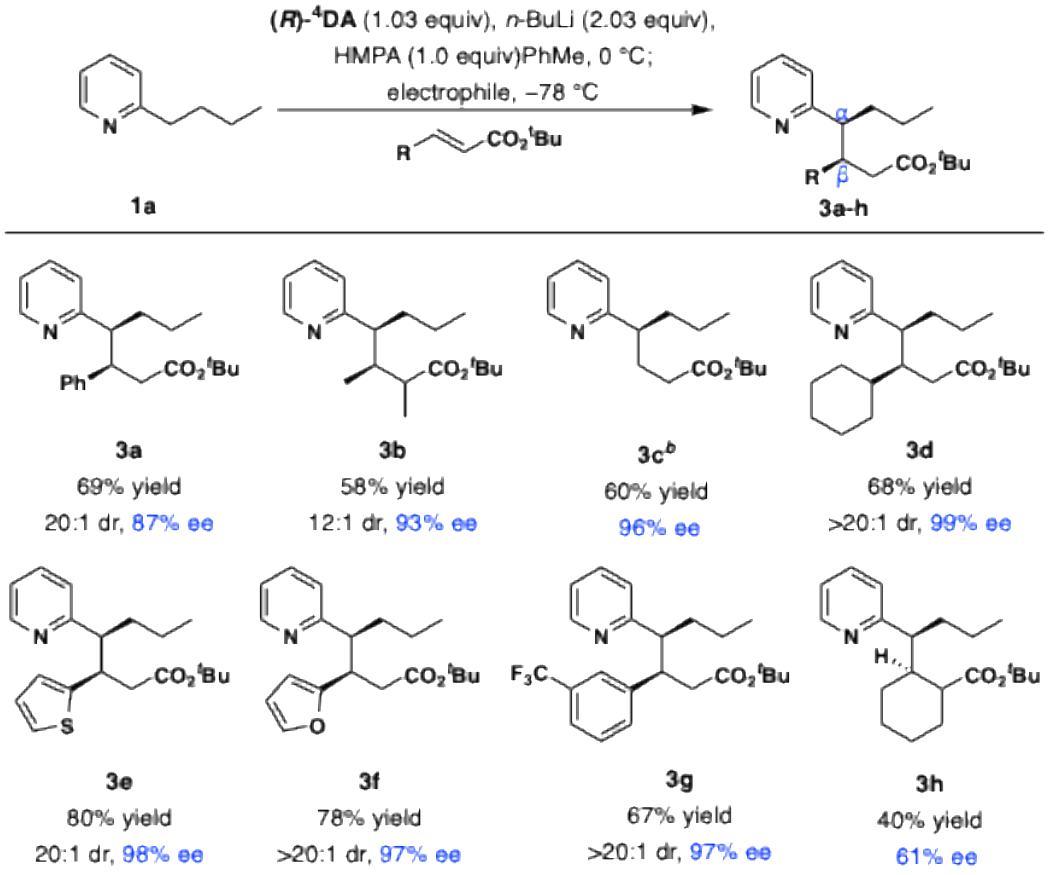
The conjugate addition of 2-butylpyridine afforded product **2a** with excellent diastereoselectivity (>20:1) and outstanding enantioselectivity (99% ee). Decreasing the

length of the alkyl chain **2b** produced similar results to those observed for **2a** with substantial decrease in the yield to 55%. In contrast, product **2c,** which incorporates and longer alkyl chain, displayed a reduced ee of 95% and slightly diminished yield. However, both **2b** and **2c** showed high levels of diastereoselectivity (>20:1). The *β*-branched substrates **2d** and **2e** also exhibited excellent stereoselectivity, accompanied by decent yields. The *γ*-branched substrate **2f** delivered excellent ee while C3-substituted **2g** showed slightly diminished ee of 93% while both substrates displayed a slight decrease in diastereomeric ratio (18:1). Next, we investigated tetrahydroquinoline substrate **2h** and it worked smoothly delivering an ee of 96% but a comparatively lower a lower diastereomeric ratio of 13:1. Quinolines **2i** also performed well with this protocol, affording high yield of 85%, 95% ee, but a diminished dr of 12:1 dr. The *γ-, δ*-unsaturation **2j** was also tolerated well however unsaturation with bulkier terminal **2k**, and **2l** exhibited a slight erosion in ee to 90% although cinnamate **2l** still delivered a higher yield of 85%. The pyridine derivative consisting of ether **2m** and TBS protected alcohol **2n** yielded both excellent enantiomeric excess and high yield in 80s. Notably, **2m** exhibited a lower dr of 13:1.

2.4 Electrophile Scope

Next, the scope of *tert*-butyl esters was explored (Table 3). The reaction with *tert*-butyl (*E*)-cinnamate **3a** afforded the desired product with an ee of 87%, indicating that this system tolerates aryl-substituted Michael acceptors reasonably well. Notably, compound **3b**, which contains three stereocenters, was obtained in 93% ee with good diastereoselectivity at the β-position (12:1) and exclusive formation of a single stereoisomer at the γ-position. This result highlights the excellent level of stereo control achievable with this methodology.

Table 3. Scope of *α, β*-unsaturated esters



[a]Reaction conditions: All reactions were performed on a 0.44 mmol scale and 1.2 equivalent of Michael acceptor was used unless specified otherwise. Isolated yields are shown. Results are normalized to bases with the *R* configuration; enantiomeric excess (ee) values were determined by HPLC analyses. Diastereomeric ratio (dr) is determined through ^{1}H NMR spectroscopy. [b]4.8 equivalent of Michael acceptor was used.

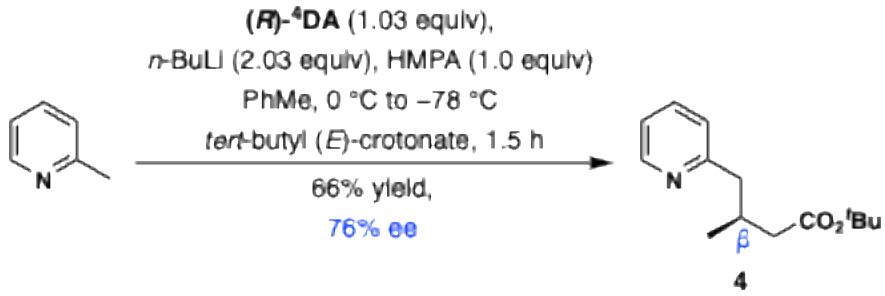
The use of *tert*-butyl acrylate **3c** initially resulted in poor conversion, although the enantiomeric excess remained high. Increasing the loading of acrylate improved the conversion to approximately 60% while maintaining excellent enantioselectivity (98% ee). This finding is particularly significant, as it demonstrates that even in the absence of a *β*-stereocenter, the reaction proceeds with outstanding enantiocontrol. The excellent stereoselectivity observed for **3d** (99% ee, >20:1 dr) is due to increased steric differentiation and conformational bias of the electrophile which likely favor a single well-defined transition state in the conjugate addition. *tert*-butyl heterocyclic acceptors were also well tolerated: **3e**

and **3f** were formed rapidly and in high yields, with enantiomeric excesses of 98% and 97%, respectively. Compound **3g** was likewise obtained with excellent enantioselectivity and high diastereoselectivity. In contrast, substrate **3h** exhibited the lowest level of enantiocontrol observed in this study (61% ee), suggesting that specific electronic or steric features of this substrate may interfere with effective stereo control.

2.5 Conjugate Addition to 2-Methylpyridine

Encouraged by the results obtained for **2a**, in which both the α- and β-stereocenters were introduced simultaneously with excellent stereoselectivity, and for **3c**, in which the α-stereocenter was installed independently of the β-position, we questioned whether the β-stereocenter could likewise be generated independently with a meaningful level of stereoselectivity. To evaluate this hypothesis, 2-methylpyridine was selected as the substrate and *tert*-butyl (*E*)-crotonate as the electrophile (Scheme 2).

Scheme 2: Conjugate addition to 2-methylpyridine



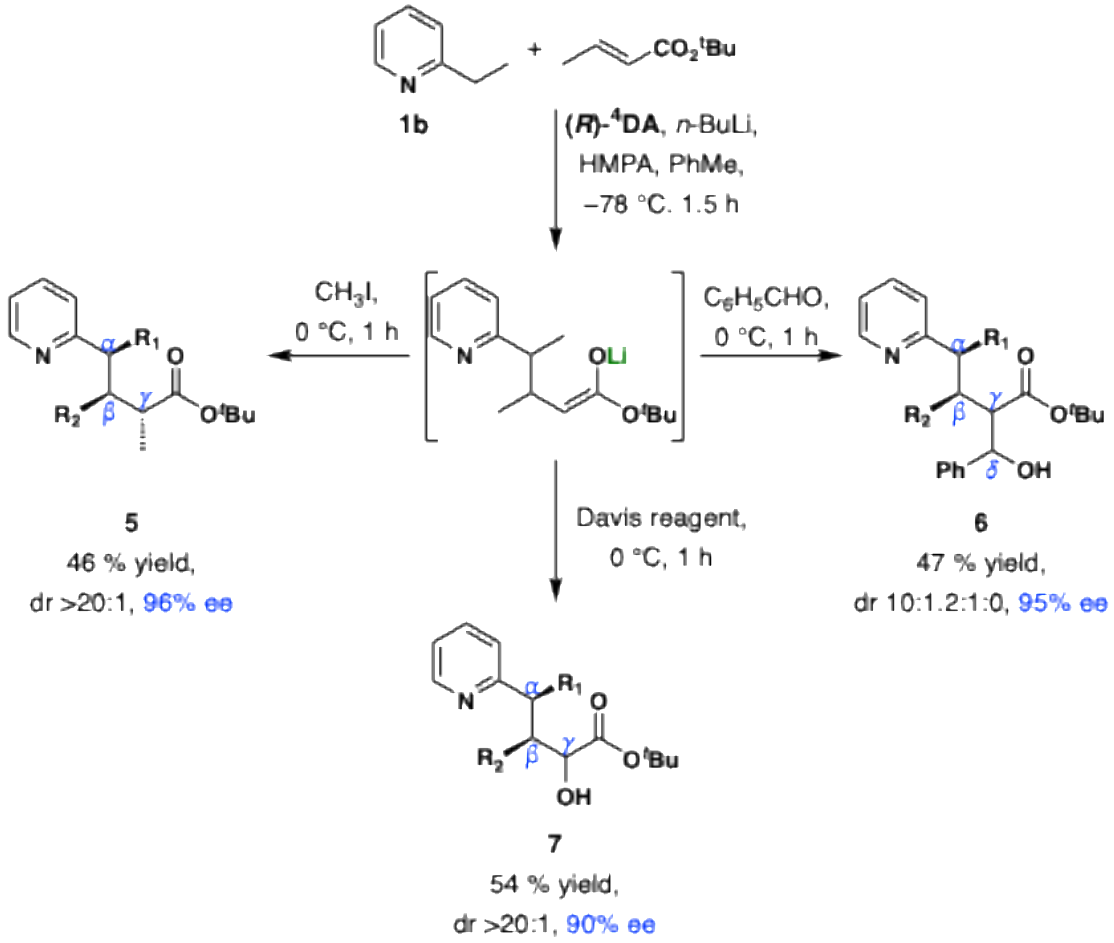
This reaction allows for the selective installation of a single β-stereocenter, and, to our satisfaction, product **4** was obtained with a respectable 76% enantiomeric excess and 66% yield. This outcome demonstrates that enantioselective induction at the β-position can be achieved independently, likely through a similar chiral lithium amide–controlled transition state as in the disubstituted systems. These findings broaden the scope of this methodology,

establishing a foundation for future development of selective β-functionalization to access a variety of chiral pyridine derivatives.

2.6 Application

Scheme 3 highlights the versatility of this Michael addition methodology through several one-pot applications. These studies, performed by Dyllan Ly as part of the collaborative efforts on this project, capitalize on the reactivity of the initially formed enolate and exploit it for subsequent transformations in a single operation. In all three applications, a new stereocenter was introduced with high levels of stereoselectivity.

Scheme 3: One-pot synthesis of multiple stereocenters

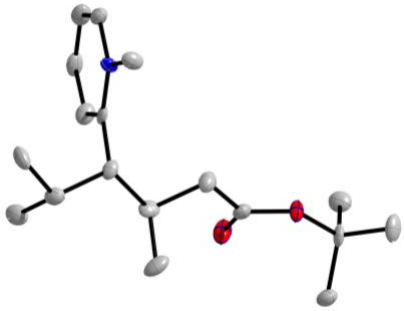


Compound **5** was synthesized by in situ secondary alkylation with methyl iodide following the conjugate addition step. This transformation introduced a third stereocenter at the γ-position with excellent enantiomeric excess (96% ee) and diastereoselectivity (>20:1). In a related transformation, in situ aldol condensation of the enolate with benzaldehyde produced compound **6** in 95% ee, introducing a fourth stereocenter with excellent selectivity. Finally, treatment with Davis reagent effected α-oxidation of the conjugate addition product, furnishing compound **7** in 90% ee with high diastereoselectivity at both the β- and newly formed γ-stereocenters. These results collectively demonstrate the synthetic utility of the methodology for constructing densely functionalized, stereochemically rich pyridine derivatives.

2.7 Stereochemical assignment

The absolute configurations of the α- and β-stereocenters were unambiguously established by single-crystal X-ray diffraction analysis of the N-methylated salt of compound **2d**. These experimentally determined configurations provide a firm stereochemical reference for this series of compounds.

Figure 2: Crystal structure of methylate N-2d



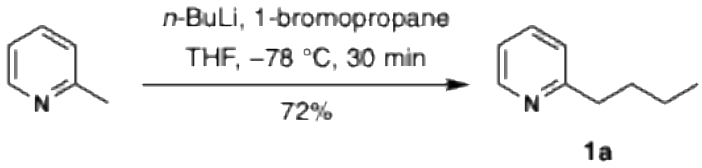
2.8 Conclusion

In conclusion, we have developed a method for the direct enantio- and diastereoselective conjugate addition of *α-, β*-unsaturated esters to 2-alkylpyridines. This transformation enables a one-pot synthesis of chiral 2-alkylpyridines mediated by chiral lithium amides, providing an efficient and operationally simple route to stereochemically rich pyridine derivatives. Notably, this methodology allows for the simultaneous introduction of adjacent stereocenters with excellent levels of both diastereo- and enantioselectivity, as well as the independent generation of *α*- or *β*-stereocenters with high enantiomeric control. The one-pot application studies further demonstrate the synthetic utility of this approach, as multiple C–C and C–X bonds and up to four stereocenters can be constructed in a single sequence. Taken together, these results highlight the potential of this methodology to serve as a versatile platform for the synthesis of complex, chiral pyridine scaffolds that can function as valuable building blocks in organic synthesis.

2.9 Supporting Information

All reactions were carried out under an inert atmosphere of dry argon in flame-dried glassware, unless the reaction procedure states otherwise. Tetrahydrofuran (THF) and diethyl ether (Et_2O) were distilled from sodium-benzophenone in a continuous still under an atmosphere of argon. Toluene was distilled over sodium under an inert atmosphere of argon. Diisopropylamine and triethylamine were distilled from calcium hydride in a continuous still under an atmosphere of argon. Reaction temperatures were controlled by IKA ETS-D4 fuzzy thermo couples. Analytical thin-layer chromatography (TLC) was performed using pre-coated TLC plates with Silica Gel 60 F_{254} (EMD no. 5715-7) and visualized using combinations of UV, anisaldehyde, ceric ammonium molybdate (CAM), potassium

permanganate, and iodine staining. Flash column chromatography was performed using 4063 μm silica gel (Merck, Geduran, no. 11567-1) as the stationary phase. Proton nuclear magnetic resonance spectra were recorded at 400, 500, and 600 MHz on Varian Unity Inova spectrometers and Bruker Avance NEO spectrometer. Carbon nuclear magnetic resonance spectra were recorded at 100 MHz, 125 MHz, and 150 MHz on Varian Unity Inova spectrometers and Bruker Avance NEO spectrometer. All chemical shifts were reported in δ units relative to tetramethylsilane. High resolution mass spectra were obtained by the Mass Spectrometry Facility at the University of California, Santa Barbara.

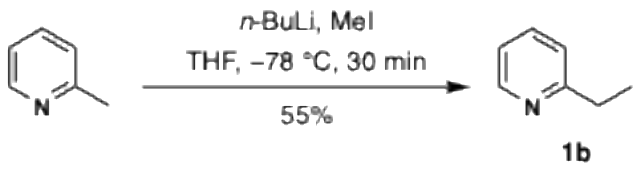


1a

General procedure I:

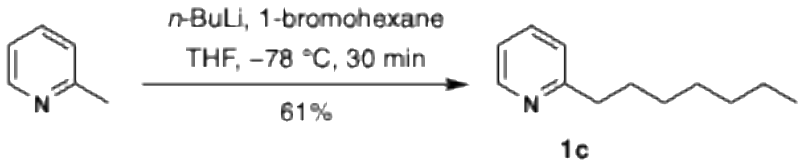
2-Butylpyridine (1a). The following procedure was adapted from a literature preparation.[9] To a solution of 2-methylpyridine (1.0 g, 10.7 mmol) in THF (0.52 mL) at −78 °C, *n*-BuLi (4.5 mL, 2.5 M in hexane, 11.2 mmol, 1.05 equiv) was added dropwise and stirred at this temperature for 15 min, followed by an additional 15 min of stirring at 0 °C. After cooling the mixture back down to −78 °C, 1-bromopropane (0.98 mL, 10.7 mmol, 1.0 equiv) was added. The resultant mixture was stirred for another 30 min at −78 °C. Thereafter, the reaction mixture was quenched with MeOH (0.2 mL), brought to rt, and diluted with H_2O (5 mL) and EtOAc (5 mL). The organics were extracted with EtOAc, washed with brine, dried over Na_2SO_4, concentrated, and the residue was purified by column chromatography on silica gel (5-10% EtOAc in hexanes) to afford the product **1a** (1.04 g,

1.04 mmol, 72% yield). The NMR spectroscopy data were consistent with previously reported values in the literature.[9]



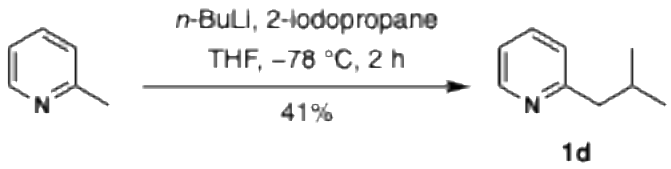
1b

2-Ethylpyridine (1b). The title compound was prepared according to **general procedure I,** using 2-methylpyridine (1.0 g, 10.7 mmol), *n*-BuLi (5.2 mL, 2.08 M in hexane, 10.7 mmol, 1.0 equiv) in THF (0.52 mL), followed by the addition of methyl iodide (0.8 mL, 12.9 mmol, 1.2 equiv), at –78 °C. The reaction mixture was quenched after 30 min, and product **1b** (631 mg, 5.89 mmol, 55% yield) was obtained after purification by column chromatography on silica gel (2-6% EtOAc in hexanes). The NMR spectroscopy data were consistent with previously reported values in the literature.[9]



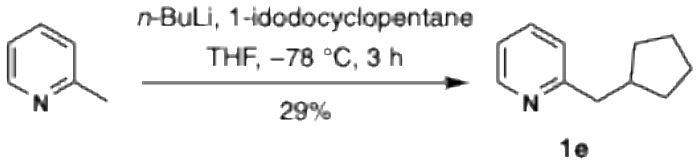
1c

2-Heptylpyridine (1c). The title compound was prepared according to **general procedure I,** using 2-methylpyridine (1.0 g, 10.7 mmol), *n*-BuLi (4.5 mL, 2.5 M in hexane, 11.27 mmol, 1.05 equiv) in THF (0.52 mL), followed by the addition of 1-bromohexane (1.58 mL, 11.27 mmol, 1.05 equiv), at –78 °C. The reaction mixture was quenched after 30 min, and product **1c** (1.15 g, 6.49 mmol, 61% yield) was obtained after purification by column chromatography on silica gel (2-6% EtOAc in hexanes). The NMR spectroscopy data were consistent with previously reported values in the literature.[9]



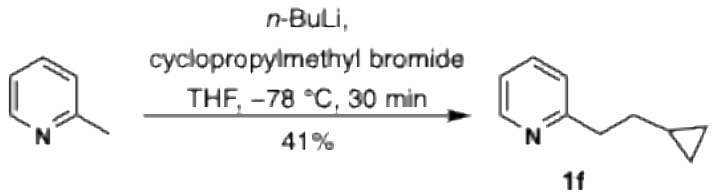
1d

2-Isobutylpyridine (1d). The title compound was prepared according to **general procedure I,** using 2-methylpyridine (0.5 g, 5.37 mmol), *n*-BuLi (2.2 mL, 2.5 M in hexane, 5.53 mmol, 1.03 equiv) in THF (20 mL), followed by the addition of 2-iodopropane (0.54 mL, 5.37 mmol, 1.0 equiv), at –78 °C. The reaction mixture was quenched after 2 h, and product **1d** (0.30 g, 2.23 mmol, 41% yield) was obtained after purification by column chromatography on silica gel (10% EtOAc in hexane). The NMR spectroscopy data were consistent with previously reported values in the literature. [9]



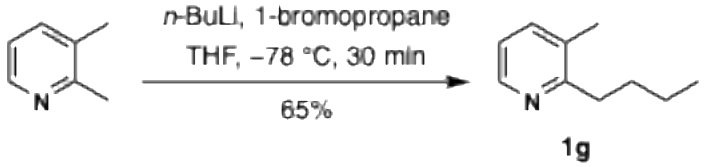
1e

2-(Cyclopentylmethyl)pyridine (1e). The title compound was prepared according to **general procedure I,** using 2-methylpyridine (0.5 g, 5.37 mmol), *n*-BuLi (2.2 mL, 2.5 M in hexane, 5.53 mmol, 1.03 equiv) in THF (20 mL), followed by the addition of 1-iodocyclopentane (0.61 mL, 5.37 mmol, 1.0 equiv), at –78 °C. The reaction mixture was quenched after 3 h, and product **1e** (0.25 g, 1.55 mmol, 29% yield) was obtained after purification by column chromatography on silica gel (10% EtOAc in hexane). The NMR spectroscopy data were consistent with previously reported values in the literature. [9]



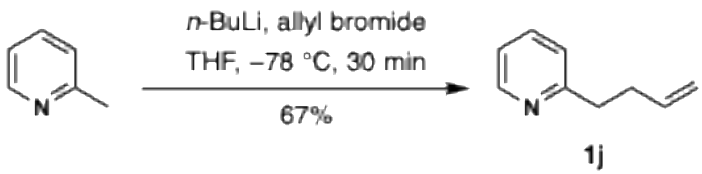
1f

2-(2-Cyclopropylethyl)pyridine (1f). The title compound was prepared according to **general procedure I,** using 2-methylpyridine (0.5 g, 5.37 mmol), *n*-BuLi (2.2 mL, 2.5 M in hexane, 5.53 mmol, 1.03 equiv) in THF (12.5 mL), followed by the addition of cyclopropylmethyl bromide (0.52 mL, 5.37 mmol, 1.0 equiv), at −78 °C. The reaction mixture was quenched after 30 min, and product **1f** (0.32 g, 2.17 mmol, 41% yield) was obtained after purification by column chromatography on silica gel (5% EtOAc in hexane). The NMR spectroscopy data were consistent with previously reported values in the literature. [9]



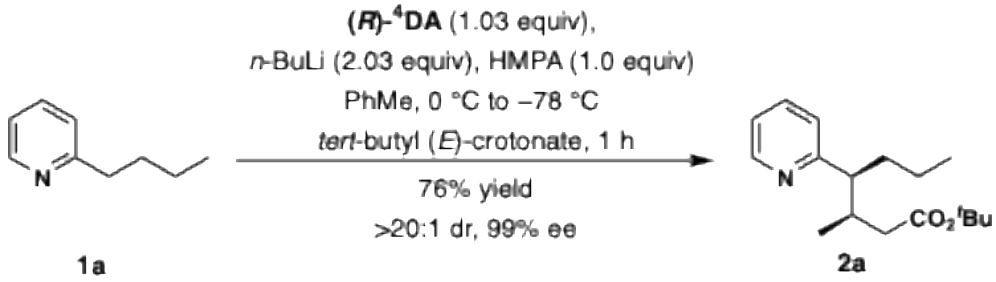
1g

2-butyl-3-methylpyridine (1g). The title compound was prepared according to **general procedure I,** using 2,3-dimethylpyridine (0.5 g, 3.49 mmol), *n*-BuLi (1.5 mL, 2.5 M in hexane, 3.67 mmol, 1.05 equiv) in THF (6.7 mL), followed by the addition of 1-bromopropane (0.34 mL, 3.67 mmol, 1.05 equiv), at −78 °C. The reaction mixture was quenched after 30 min, and product **1g** (0.339 g, 2.27 mmol, 65% yield) was obtained after purification by column chromatography on silica gel (5% EtOAc in hexane). The NMR spectroscopy data were consistent with previously reported values in the literature. [9]



1j

2-(But-3-en-yl)pyridine (1j). The title compound was prepared according to **general procedure I,** using 2-methylpyridine (0.5 g, 5.37 mmol), *n*-BuLi (2.26 mL, 2.5 M in hexane, 5.64 mmol, 1.05 equiv) in THF (14 mL), followed by the addition of allyl bromide (0.49 mL, 5.64 mmol, 1.05 equiv), at −78 °C. The reaction mixture was quenched after 1 h, and product **1j** (0.475 g, 3.57 mmol, 67% yield) was obtained after purification by column chromatography on silica gel (5-10% EtOAc in hexane). The NMR spectroscopy data were consistent with previously reported values in the literature. [9]

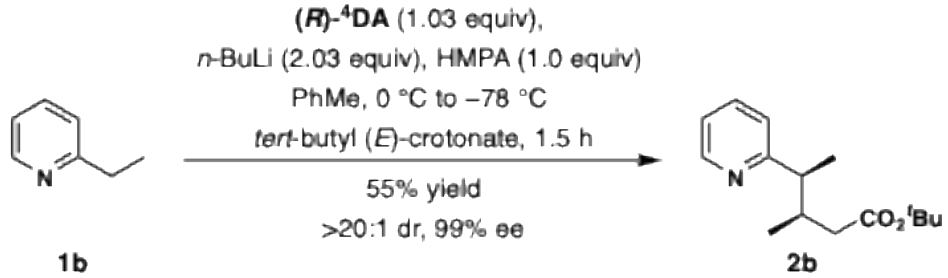


1a 2a

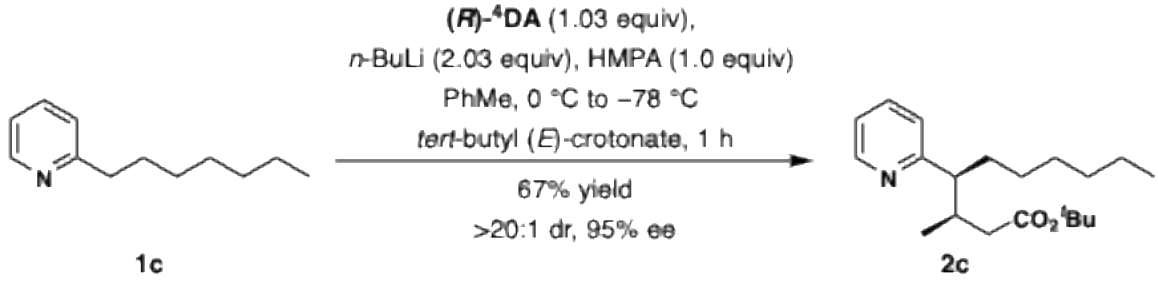
General procedure II:

tert*-butyl (3*R*,4*S*)-3-methyl-4-(pyridin-2-yl)heptanoate (2a).** A 25 mL round-bottom flask equipped with a stir bar is flame-dried under vacuum and cooled under an atmosphere of dry argon. **(*R*)-[1]DA** (0.119 g, 0.46 mmol, 1.03 equiv) is added, and the flask is backfilled with argon three times. Using a syringe, HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv) (caution****: possible carcinogen*) was added to 2-butylpyridine (60 mg, 0.44 mmol) dissolved in toluene (4.63 mL). The solution is cooled to 0 °C for 15 min, and *n*-BuLi (0.39 mL, 2.3 M in hexane, 0.90 mmol, 2.03 equiv) was added dropwise. The resulting solution is

stirred for 15 min and cooled down to −78 °C for an additional 15 min. *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) is added dropwise at −78 °C, and the solution is stirred at this temperature for 1 h. Upon completion, 300 µL of methanol was added at −78 °C and stirred for 15 min before being brought to rt. The reaction mixture was diluted with DI H_2O (5 mL) and EtOAc (5 mL) and transferred to a separatory funnel. The aqueous layer is extracted 3 times with EtOAc (5 mL). Combined organics were rinsed with 0.46 mL of 1 M HCl (volume of 1 M HCl = mmol of (*R*)-^{4}DA) to recover **(*R*)-^{4}DA**. Organics were rinsed with brine, dried over anhydrous Na_2SO_4, concentrated, and the crude extract was purified by column chromatography on silica gel (2-10% EtOAc in hexane) to afford **2a** (94 mg, 0.339 mmol, 76% yield). Ee: 99% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 9.578 min (minor); t_2 = 13.350 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.57 – 8.52 (ddd, 1H), 7.58 (td, *J* = 7.6, 1.9 Hz, 1H), 7.09 (dd, *J* = 7.6, 3.9 Hz, 2H), 2.64 (ddd, *J* = 11.1, 7.5, 4.1 Hz, 1H), 2.29 (dtd, *J* = 9.8, 7.1, 4.1 Hz, 1H), 2.15 (dd, *J* = 14.8, 4.1 Hz, 1H), 1.85 (dd, *J* = 14.9, 9.9 Hz, 1H), 1.68 (dddd, *J* = 13.5, 10.2, 6.5, 4.1 Hz, 1H), 1.40 (s, 9H), 1.05 (tdd, *J* = 14.2, 11.5, 7.1 Hz, 2H), 0.99 (d, *J* = 6.7 Hz, 3H), 0.83 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.88, 163.80, 149.19, 136.18, 123.80, 121.32, 80.09, 52.63, 40.92, 35.43, 33.80, 28.23, 21.01, 17.61, 14.30.



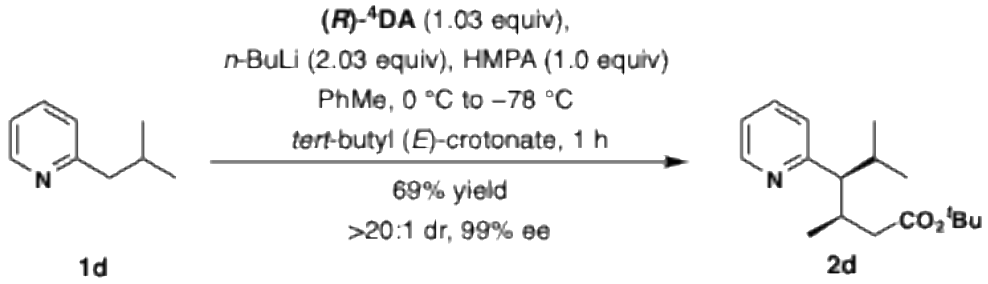
***tert*-butyl (*3R,4S*)-3-methyl-4-(pyridin-2-yl)pentanoate (2b).** The title compound was prepared according to **general procedure II** using 2-ethylpyridine (48 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.6 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at −78 °C. The reaction was quenched after 1.5 h, and product **2b** (61 mg, 0.244 mmol, 55% yield) was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 99% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 10.849 min (minor); t_2 = 11.672 min (major)]. ^{1}H NMR (600 MHz, $CDCl_3$) **δ** 8.54 (ddd, *J* = 4.9, 1.9, 1.0 Hz, 1H), 7.59 (td, *J* = 7.6, 1.7 Hz, 1H), 7.14 (dt, *J* = 7.9, 1.0 Hz, 1H), 7.12 – 7.07 (m, 1H), 2.79 (p, *J* = 7.2 Hz, 1H), 2.38 – 2.28 (m, 1H), 2.17 (dd, *J* = 14.8, 4.5 Hz, 1H), 1.92 (dd, *J* = 14.8, 9.6 Hz, 1H), 1.41 (s, 9H), 1.28 (d, *J* = 7.0 Hz, 3H), 0.96 (d, *J* = 6.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) **δ** 172.78, 165.34, 149.26, 136.32, 122.46, 121.32, 80.16, 46.60, 41.32, 35.98, 28.25, 16.74, 16.64.



1c 2c

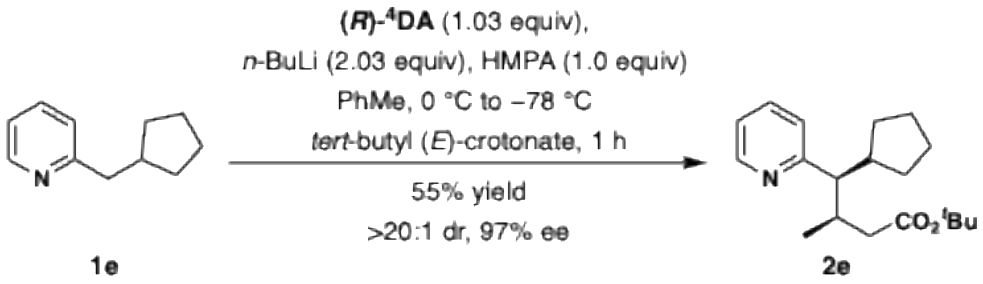
***tert*-butyl (*3R,4S*)-3-methyl-4-(pyridin-2-yl)decanoate (2c).** The title compound was prepared according to **general procedure II** using 2-heptylpyridine (78 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63

mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2c** (95 mg, 0.297 mmol, 67% yield) was obtained after purification by column chromatography (10-20% EtOAc in hexane). Ee: 95% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 11.512 min (minor); t_2 = 17.756 min (major)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.55 (dt, *J* = 4.3, 1.7 Hz, 1H), 7.58 (td, *J* = 7.7, 1.9 Hz, 1H), 7.13 – 7.05 (m, 2H), 2.61 (ddd, *J* = 10.4, 7.5, 4.4 Hz, 1H), 2.29 (dtd, *J* = 10.7, 7.0, 4.1 Hz, 1H), 2.16 (dd, *J* = 14.8, 4.1 Hz, 1H), 1.85 (dd, *J* = 14.8, 9.9 Hz, 1H), 1.81 – 1.66 (m, 2H), 1.41 (s, 9H), 1.23 – 1.10 (m, 6H), 1.09 – 1.00 (m, 2H), 0.99 (d, *J* = 6.7 Hz, 3H), 0.83 (d, *J* = 6.7 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.94, 163.88, 149.32, 136.06, 123.75, 121.28, 80.10, 52.95, 40.94, 35.46, 31.86, 31.58, 29.55, 28.24, 27.85, 22.73, 17.62, 14.18.



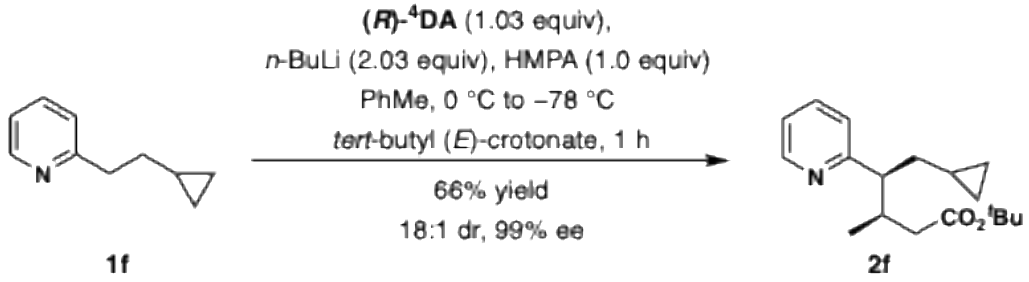
***tert*-butyl (*3R,4S)*-3,5-dimethyl-4-(pyridin-2-yl)hexanoate (2d).** The title compound was prepared according to **general procedure II** using 2-isobutylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2d** (85 mg, 0.306 mmol, 69% yield) was obtained after purification by column chromatography (5-10% EtOAc in hexane).

Ee: 99% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane with 0.05% Et_3N; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 8.373 min (minor); t_2 = 17.202 min (major)]. ^1H NMR (500 MHz, $CDCl_3$) **δ** 8.58 – 8.53 (m, 1H), 7.58 (t, *J* = 7.7 Hz, 1H), 7.14 – 7.08 (m, 1H), 7.06 (d, *J* = 7.8 Hz, 1H), 2.56 (dtp, *J* = 9.8, 6.7, 3.4 Hz, 1H), 2.44 (t, *J* = 7.6 Hz, 1H), 2.34 (dd, *J* = 14.9, 3.0 Hz, 1H), 2.31 – 2.19 (m, 1H), 1.87 – 1.78 (m, 1H), 1.41 (s, 9H), 0.94 (d, *J* = 6.7 Hz, 3H), 0.90 (d, *J* = 6.7 Hz, 3H), 0.74 (d, *J* = 6.7 Hz, 3H).^{13}C NMR (126 MHz, $CDCl_3$) **δ** 173.32, 161.93, 148.83, 135.77, 124.91, 121.34, 80.07, 59.41, 39.33, 31.60, 28.73, 28.25, 21.41, 19.81, 18.79.



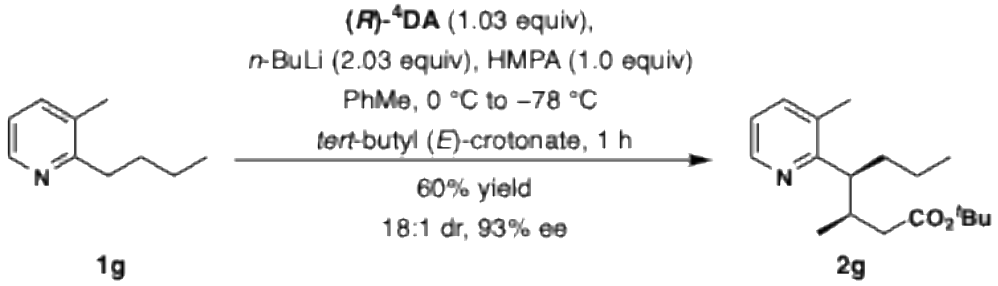
***tert*-butyl (*3R,4R)*-4-cyclopentyl-3-methyl-4-(pyridin-2-yl)butanoate (2e).** The title compound was prepared according to **general procedure II** using 2-(cyclopentylmethyl) pyridine (72 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2e** (74 mg, 0.244 mmol, 55% yield) was obtained after purification by column chromatography (5-10% EtOAc in hexane). Ee: 97% [Chiralcel® AD-H; 1% *i*-PrOH in hexane with 0.05% Et_3N; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 5.323 min (minor); t_2 = 6.567 min (major)]. ^1H NMR (500 MHz, $CDCl_3$) **δ** 8.54 (d, *J* = 4.0 Hz, 1H), 7.55 (t, *J* = 7.7 Hz, 1H),

7.09 (dd, J = 6.4, 4.8 Hz, 1H), 7.04 (d, J = 7.8 Hz, 1H), 2.59 – 2.50 (m, 2H), 2.50 – 2.38 (m, 2H), 1.98 (dtd, J = 11.0, 7.0, 3.4 Hz, 1H), 1.82 (dd, J = 14.7, 11.0 Hz, 1H), 1.62 (dddd, J = 12.4, 9.9, 8.5, 4.6 Hz, 1H), 1.53 (s, 4H), 1.42 (s, 8H), 1.26 – 1.16 (m, 1H), 1.00 – 0.90 (m, 1H), 0.87 (d, J = 6.7 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 173.52, 162.61, 148.95, 135.66, 124.58, 121.24, 80.03, 58.58, 41.95, 38.66, 33.46, 31.54, 31.50, 28.25, 25.31, 24.82, 19.19.



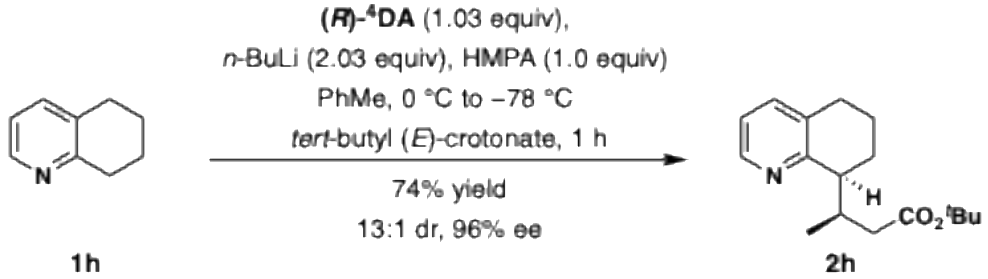
***tert*-butyl (*3R,4S)*-5-cyclopropyl-3-methyl-4-(pyridin-2-yl)pentanoate (2f).** The title compound was prepared according to **general procedure II** using 2-(2-cyclopropylethyl) pyridine (65 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2f** (85 mg, 0.293 mmol, 66% yield) was obtained after purification by column chromatography (5-10% EtOAc in hexane). Ee: 99% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane with 0.05% Et_3N; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 10.745 min (minor); t_2 = 11.649 min (major)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.57 (ddd, J = 4.9, 1.9, 1.0 Hz, 1H), 7.58 (td, J = 7.7, 1.9 Hz, 1H), 7.15 (d, J = 7.8 Hz, 1H), 7.10 (ddd, J = 7.5, 4.9, 1.2 Hz, 1H), 2.76 (ddd, J = 11.0, 7.6, 4.2 Hz, 1H), 2.34 (dtd, J = 9.6, 7.1, 4.2 Hz, 1H), 2.17 (dd, J = 14.8, 4.2 Hz, 1H),

1.97 – 1.89 (m, 1H), 1.85 (dd, *J* = 14.9, 9.8 Hz, 1H), 1.41 (s, 9H), 0.98 (d, *J* = 6.7 Hz, 3H), 0.38 (dddd, *J* = 13.1, 7.9, 5.4, 2.9 Hz, 1H), 0.34 – 0.26 (m, 1H), 0.22 (dddd, *J* = 9.2, 7.8, 5.3, 3.9 Hz, 1H), 0.00 – -0.08 (m, 1H), -0.11 – -0.18 (m, 1H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.84, 163.93, 149.16, 136.06, 124.12, 121.30, 80.09, 53.30, 40.81, 36.81, 35.00, 28.23, 17.64, 9.62, 5.10, 4.35.



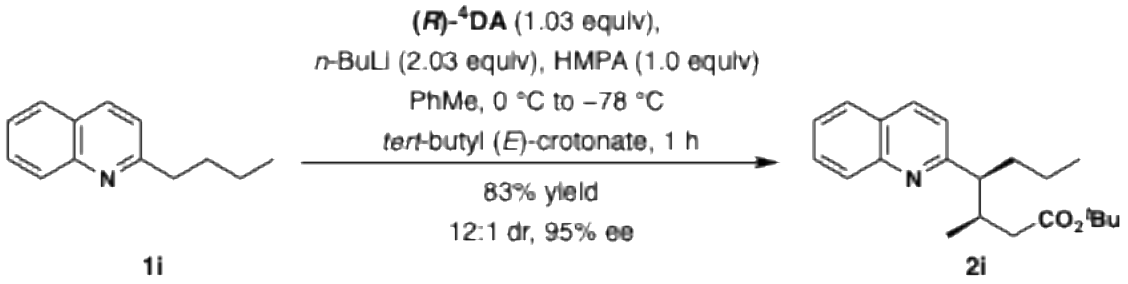
***tert*-butyl (*3R,4S)*-3-methyl-4-(3-methylpyridin-2-yl)heptanoate (2g).** The title compound was prepared according to **general procedure II** using 2-butyl-3-methylpyridine (66 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2g** (78 mg, 0.268 mmol, 60% yield) was obtained after purification by column chromatography (5-10% EtOAc in hexane). Ee: 93% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 5.774 min (major); t_2 = 6.537 min (minor)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.48 – 8.37 (m, 1H), 7.40 (s, 1H), 6.99 (s, 1H), 2.91 (s, 1H), 2.55 (dd, *J* = 14.5, 4.1 Hz, 1H), 2.30 (s, 5H), 2.10 (dd, *J* = 14.6, 9.2 Hz, 1H), 1.91 (s, 1H), 1.67 (qd, *J* = 8.4, 4.2 Hz, 1H), 1.44 (s, 9H), 1.09 – 0.89 (m, 2H), 0.84 – 0.78 (m, 6H). ^{13}C NMR (126

MHz, $CDCl_3$) **δ** 172.95, 162.56, 146.93, 137.58, 132.19, 120.72, 80.09, 46.72, 40.35, 35.38, 34.12, 28.27, 20.96, 19.59, 18.11, 14.52.

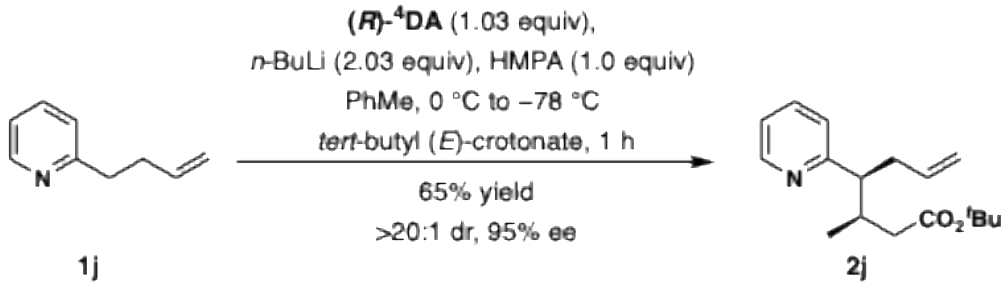


1h 2h

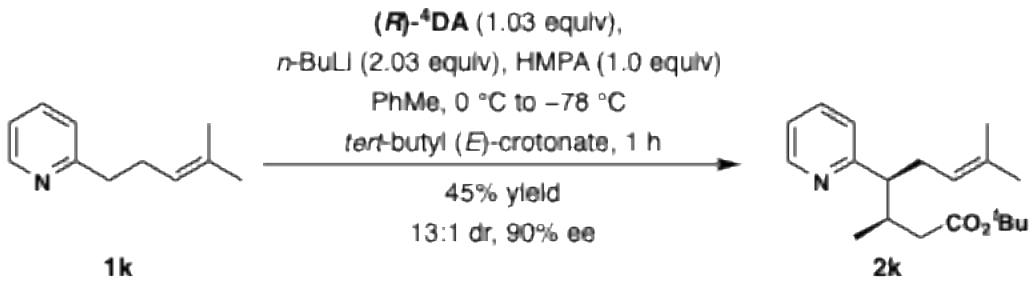
***tert*-butyl (*R*)-3-((*S*)-5,6,7,8-tetrahydroquinolin-8-yl)butanoate (2h).** The title compound was prepared according to **general procedure II** using 5,6,7,8-tetrahydroquinoline (59 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at −78 °C. The reaction was quenched after 1 h, and product **2h** (90 mg, 0.327 mmol, 74% yield) was obtained after purification by column chromatography (5-10% EtOAc in hexane). Ee: 93% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 12.465 min (major); t_2 = 13.440 min (minor)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.44 – 8.39 (m, 1H), 7.33 (d, *J* = 7.6 Hz, 1H), 7.00 (dd, *J* = 7.6, 4.7 Hz, 1H), 3.09 (dtd, *J* = 9.2, 6.6, 4.7 Hz, 1H), 2.93 (q, *J* = 6.6 Hz, 1H), 2.80 – 2.65 (m, 2H), 2.38 (dd, *J* = 14.5, 6.2 Hz, 1H), 2.21 (dd, *J* = 14.5, 9.1 Hz, 1H), 2.02 – 1.87 (m, 2H), 1.71 – 1.58 (m, 2H), 1.44 (s, 9H), 0.73 (d, *J* = 6.8 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.86, 159.16, 146.80, 136.75, 133.46, 120.84, 80.09, 44.73, 41.37, 33.00, 29.47, 28.28, 23.41, 21.53, 15.21.



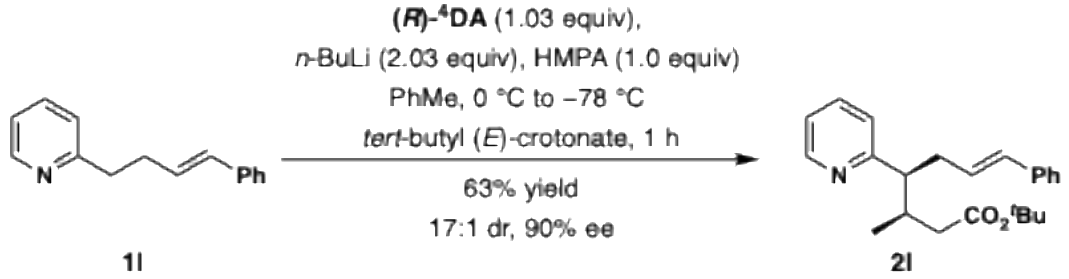
***tert*-butyl (*3R,4S*)-3-methyl-4-(quinolin-2-yl)heptanoate (2i).** The title compound was prepared according to **general procedure II** using 2-butylquinoline (82 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at −78 °C. The reaction was quenched after 1 h, and product **2i** (120 mg, 0.366 mmol, 83% yield) was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 96% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 5.348 min (minor); t_2 = 6.448 min (major)]. ^{1}H NMR (500 MHz, cdcl$_3$) **δ** 8.09 – 8.04 (m, 2H), 7.78 (dd, *J* = 8.2, 1.5 Hz, 1H), 7.68 (ddd, *J* = 8.4, 6.9, 1.4 Hz, 1H), 7.49 (ddd, *J* = 8.1, 6.9, 1.2 Hz, 1H), 7.28 (d, *J* = 8.5 Hz, 1H), 2.83 (ddd, *J* = 10.5, 8.1, 4.3 Hz, 1H), 2.39 (dddd, *J* = 10.4, 7.9, 6.7, 4.0 Hz, 1H), 2.14 (dd, *J* = 15.0, 4.0 Hz, 1H), 1.93 (dd, *J* = 15.0, 10.0 Hz, 1H), 1.89 – 1.77 (m, 2H), 1.38 (s, 9H), 1.18 – 1.09 (m, 1H), 1.06 (d, *J* = 6.7 Hz, 3H), 0.84 (t, *J* = 7.4 Hz, 4H). ^{13}C NMR (126 MHz, CDCl$_3$) **δ** 172.92, 164.65, 147.96, 136.10, 129.39, 129.28, 127.58, 127.09, 125.87, 121.18, 80.13, 53.76, 41.21, 35.49, 34.06, 28.21, 21.08, 17.81, 14.39.



***tert*-butyl (*3R,4S*)-3-methyl-4-(pyridin-2-yl)hept-6-enoate (2j).** The title compound was prepared according to **general procedure II** using 2-(but-3-en-yl)pyridine (59 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2j** (80 mg, 0.289 mmol, 65% yield) was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 95% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane with 0.05% Et_3N; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 11.044 min (minor); t_2 = 13.541 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.59 – 8.52 (m, 1H), 7.59 (t, *J* = 7.5 Hz, 1H), 7.10 (d, *J* = 5.4 Hz, 2H), 5.58 (ddt, *J* = 17.1, 10.2, 7.0 Hz, 1H), 4.91 (dq, *J* = 17.1, 1.7 Hz, 1H), 4.84 (dd, *J* = 10.2, 2.0 Hz, 1H), 2.76 (s, 1H), 2.63 – 2.47 (m, 2H), 2.36 (dtd, *J* = 10.9, 7.0, 4.0 Hz, 1H), 2.20 (dd, *J* = 14.9, 4.1 Hz, 1H), 1.91 – 1.82 (m, 1H), 1.41 (s, 9H), 1.02 (d, *J* = 6.7 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.71, 162.86, 149.17, 136.89, 136.20, 124.08, 121.49, 116.13, 80.20, 52.54, 40.71, 35.96, 34.96, 28.25, 17.57.



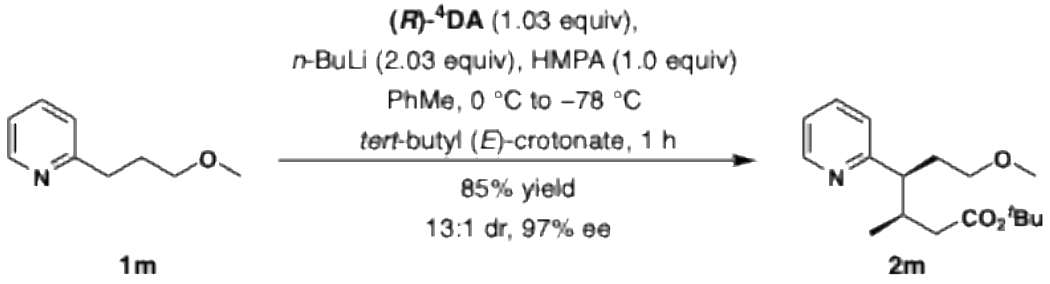
***tert*-butyl (*3R,4S*)-3,7-dimethyl-4-(pyridin-2-yl)oct-6-enoate (2k).** The title compound was prepared according to **general procedure II** using 2-(4-methylpent-3-en-1-yl)pyridine (72 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at −78 °C. The reaction was quenched after 1 h, and product **2k** (61 mg, 0.200 mmol, 45% yield) was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 90% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 20.032 min (minor); t_2 = 21.215 min (major)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.54 (ddd, *J* = 4.8, 1.9, 0.9 Hz, 1H), 7.55 (td, *J* = 7.7, 1.9 Hz, 1H), 7.15 – 7.01 (m, 2H), 4.91 (tp, *J* = 7.2, 1.4 Hz, 1H), 2.65 (ddd, *J* = 8.5, 7.5, 6.0 Hz, 1H), 2.45 (t, *J* = 7.0 Hz, 2H), 2.42 – 2.29 (m, 1H), 2.21 (dd, *J* = 14.8, 4.0 Hz, 1H), 1.85 (dd, *J* = 14.8, 9.9 Hz, 1H), 1.60 – 1.45 (m, 8H), 1.40 (s, 8H), 1.01 (d, *J* = 6.7 Hz, 3H).



1l 2l

***tert*-butyl (*3R,4S,E*)-3-methyl-7-phenyl-4-(pyridin-2-yl)hept-6-enoate (2l).** The title compound was prepared according to **general procedure II** using 2-(4-phenylbut-3-en-1-yl)pyridine (93 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81

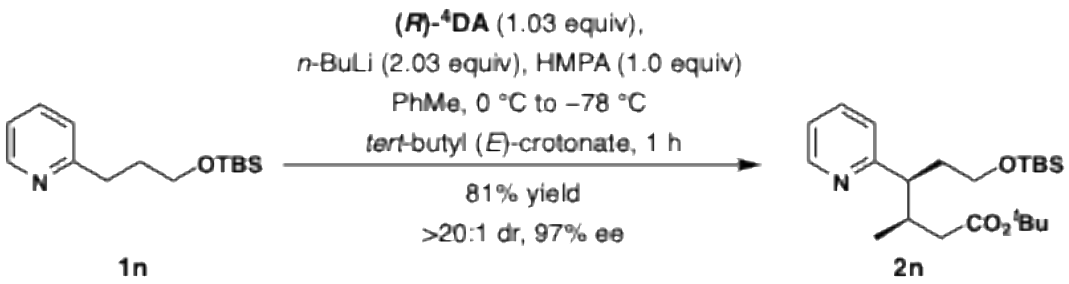
µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2l** (98 mg, 0.279 mmol, 63% yield) was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 90% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 9.703 min (minor); t_2 = 10.801 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.58 (dt, *J* = 7.8, 3.9 Hz, 1H), 7.59 (qd, *J* = 9.3, 4.6 Hz, 1H), 7.24 – 7.16 (m, 4H), 7.16 – 7.09 (m, 3H), 6.29 (d, *J* = 15.8 Hz, 1H), 5.98 (dt, *J* = 15.7, 7.1 Hz, 1H), 2.85 (ddd, *J* = 11.5, 7.4, 4.4 Hz, 1H), 2.75 (td, *J* = 11.9, 7.1 Hz, 1H), 2.71 – 2.62 (m, 1H), 2.42 (dtd, *J* = 10.9, 7.0, 4.1 Hz, 1H), 2.24 (dd, *J* = 15.0, 4.2 Hz, 1H), 1.90 (dd, *J* = 14.9, 9.7 Hz, 1H), 1.41 (s, 9H), 1.06 (d, *J* = 6.8 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.67, 162.75, 149.17, 137.79, 136.30, 131.39, 128.82, 128.47, 126.95, 126.06, 124.15, 121.56, 80.18, 52.84, 40.72, 35.11, 35.03, 35.00, 29.82, 28.24, 17.59.



1m 2m

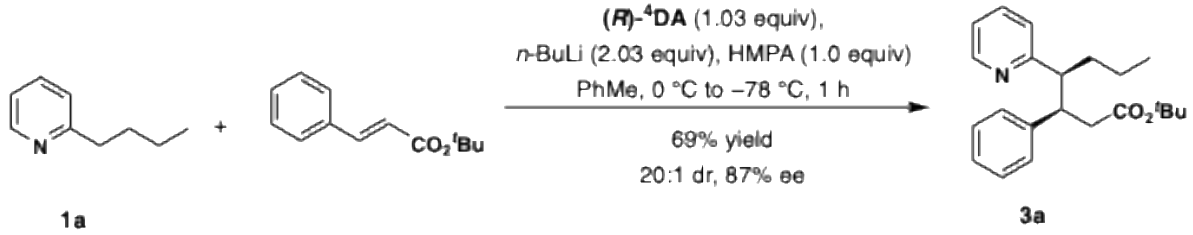
***tert*-butyl (*3R,4S*)-6-methoxy-3-methyl-4-(pyridin-2-yl)hexanoate (2m).** The title compound was prepared according to **general procedure II** using 2-(3-methoxypropyl)pyridine (66 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2m** (111 mg, 0.378 mmol, 85% yield) was obtained after purification by column

chromatography (30% EtOAc in hexane). Ee: 97% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 12.298 min (major); t_2 = 14.687 min (minor)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.56 (ddd, *J* = 4.9, 2.0, 1.0 Hz, 1H), 7.58 (td, *J* = 7.7, 1.9 Hz, 1H), 7.15 – 7.07 (m, 2H), 3.24 – 3.13 (m, 4H), 3.05 (dt, *J* = 9.5, 7.4 Hz, 1H), 2.78 (p, *J* = 7.0 Hz, 1H), 2.32 (dtd, *J* = 9.7, 7.1, 4.1 Hz, 1H), 2.16 (dt, *J* = 14.8, 4.1 Hz, 1H), 2.10 – 2.01 (m, 2H), 1.90 – 1.80 (m, 1H), 1.41 (s, 9H), 1.26 (td, *J* = 9.3, 3.1 Hz, 1H), 1.01 (d, *J* = 6.7 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.70, 162.98, 149.29, 136.21, 124.16, 121.47, 80.13, 71.00, 58.56, 49.04, 40.80, 35.31, 31.39, 28.19, 17.49.



***tert*-butyl (*3R,4S*)-6-((tert-butyldimethylsilyl)oxy)-3-methyl-4-(pyridin-2-yl)hexanoate (2n).** The title compound was prepared according to **general procedure II** using tert-butyl-dimethyl-(3-pyridin-2-ylpropoxy)silane (111 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-4DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at –78 °C. The reaction was quenched after 1 h, and product **2n** (141 mg, 0.358 mmol, 81% yield) was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 97% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 8.774 min (minor); t_2 = 11.899 min (major)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.55 (ddd, *J* =

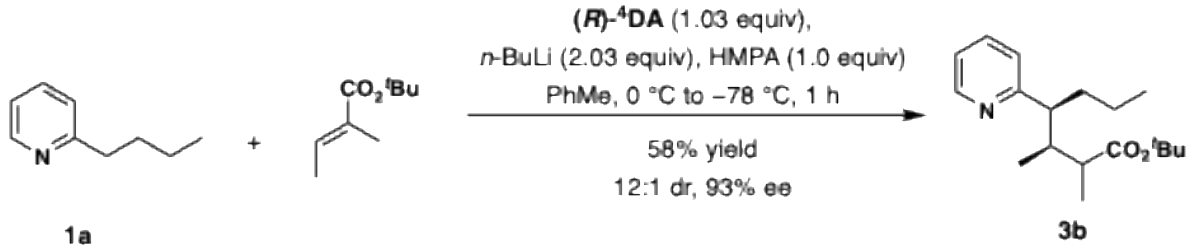
4.8, 1.9, 0.9 Hz, 1H), 7.57 (td, *J* = 7.7, 1.9 Hz, 1H), 7.14 – 7.05 (m, 2H), 3.44 (ddd, *J* = 10.1, 7.4, 4.6 Hz, 1H), 3.31 (ddd, *J* = 10.1, 8.1, 6.5 Hz, 1H), 2.80 (ddd, *J* = 10.9, 7.2, 3.9 Hz, 1H), 2.31 (dtd, *J* = 9.7, 6.9, 4.2 Hz, 1H), 2.18 (dd, *J* = 14.8, 4.2 Hz, 1H), 2.10 – 2.01 (m, 1H), 1.96 (dtd, *J* = 13.3, 7.7, 3.9 Hz, 1H), 1.86 (dd, *J* = 14.9, 9.8 Hz, 1H), 0.99 (d, *J* = 6.7 Hz, 3H), 0.83 (s, 9H), -0.07 (d, *J* = 7.3 Hz, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 172.81, 163.19, 149.35, 136.00, 124.29, 121.37, 80.13, 61.46, 48.82, 40.87, 35.33, 34.33, 28.25, 26.06, 18.39, 17.46, -5.26, -5.31.



General procedure III:

tert*-butyl (3*R*,4*S*)-3-phenyl-4-(pyridin-2-yl)heptanoate (3a).** A 25 mL round-bottom flask equipped with a stir bar is flame-dried under vacuum and cooled under an atmosphere of dry argon. **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv) is added, and the flask is backfilled with argon three times. Using a syringe, HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv) (caution**: possible carcinogen*) was added to 2-butylpyridine (60 mg, 0.44 mmol) dissolved in toluene (4.13 mL). The solution is cooled to 0 °C for 15 min, and *n*-BuLi (0.36 mL, 2.5 M in hexane, 0.90 mmol, 2.03 equiv) was added dropwise. The resulting solution is stirred for 15 min and cooled down to –78 °C for an additional 15 min. Solution of (*E*)-*tert*-butyl-cinnamate (107 µL, 0.53 mmol, 1.2 equiv) in toluene (0.5 mL) is added dropwise at –78 °C, and the solution is stirred at this temperature for 1 h. Upon completion, 300 µL of

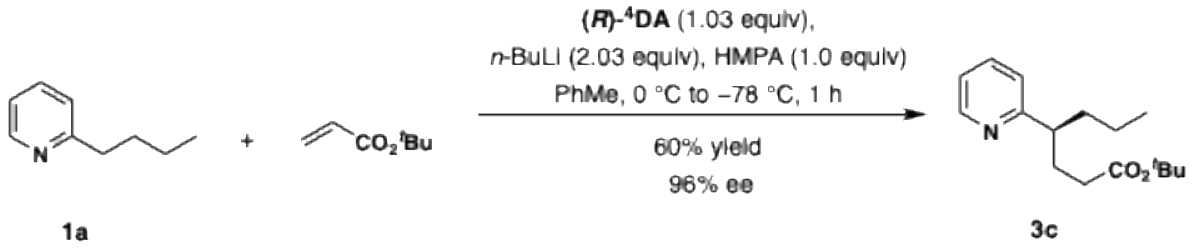
methanol was added at −78 °C and stirred for 15 min before being brought to rt. The reaction mixture was diluted with DI H_2O (5 mL) and EtOAc (5 mL) and transferred to a separatory funnel. The aqueous layer is extracted 3 times with EtOAc (5 mL). Combined organics were rinsed with 0.46 mL of 1 M HCl (volume of 1 M HCl = mmol of (*R*)-^{4}DA) to recover **((*R*)-^{4}DA**. Organics were rinsed with brine, dried over anhydrous Na_2SO_4, concentrated, and the crude extract was purified by column chromatography on silica gel (2-10% EtOAc in hexane) to afford **3a** (104 mg, 0.306 mmol, 69% yield). Ee: 87% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 22.733 min (minor); t_2 = 32.648 min (major)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.65 – 8.59 (m, 1H), 7.61 (td, *J* = 7.6, 1.8 Hz, 1H), 7.32 – 7.27 (m, 2H), 7.24 – 7.19 (m, 1H), 7.16 – 7.13 (m, 1H), 3.39 (td, *J* = 11.0, 4.6 Hz, 1H), 2.90 (td, *J* = 10.9, 3.5 Hz, 1H), 2.35 (dd, *J* = 14.7, 11.4 Hz, 1H), 2.14 (dd, *J* = 14.7, 4.5 Hz, 1H), 1.61 (s, 2H), 1.38 – 1.23 (m, 2H), 1.10 (s, 9H), 0.66 (t, *J* = 7.3 Hz, 3H).



1a 3b

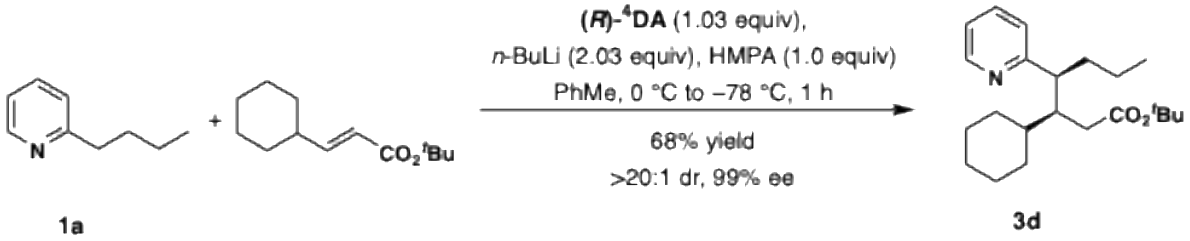
***tert*-butyl (*2R,3S,4S*)-2,3-dimethyl-4-(pyridin-2-yl)heptanoate (3b).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-2-methylbut-2-enoate (90 µL, 0.53 mmol, 1.2 equiv) at −78 °C. The reaction was

quenched after 1 h, and product **3b** (75 mg, 0.257 mmol, 58% yield) was obtained after purification by column chromatography (5% EtOAc in CH_2Cl_2). Ee: 93% [Chiralcel® AD-H; 0.3% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 6.398 min (minor); t_2 = 8.002 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.58 (dd, *J* = 5.0, 1.8 Hz, 1H), 7.57 (td, *J* = 7.6, 1.8 Hz, 1H), 7.17 – 7.04 (m, 2H), 2.92 (ddd, *J* = 11.4, 8.1, 3.4 Hz, 1H), 2.15 – 2.06 (m, 1H), 2.06 – 1.95 (m, 1H), 1.74 (dddd, *J* = 13.3, 11.4, 8.8, 5.7 Hz, 1H), 1.61 – 1.56 (m, 1H), 1.45 (s, 8H), 1.06 (d, *J* = 7.0 Hz, 3H), 1.04 – 0.98 (m, 2H), 0.95 (d, *J* = 7.0 Hz, 3H), 0.83 (t, *J* = 7.3 Hz, 3H).

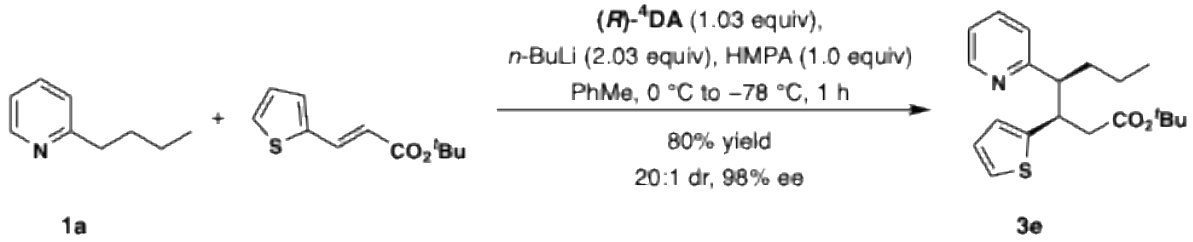


***tert*-butyl (*S*)-4-(pyridin-2-yl)heptanoate (3c).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.63 mL) followed by addition of *tert*-butyl acrylate (0.31 mL, 2.13 mmol, 4.8 equiv) at −78 °C. The reaction was quenched after 1 h, and product **3c** (70 mg, 0.266 mmol, 60% yield) was obtained after purification by column chromatography (5-10% EtOAc in CH_2Cl_2). Ee: 96% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 11.491 min (minor); t_2 = 15.222 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.60 – 8.50 (m, 1H), 7.61 (s, 1H), 7.12 (s, 2H), 2.77 (s, 1H), 2.09 – 2.03 (m, 2H), 1.98 (dt, *J* = 10.7, 6.4 Hz, 2H), 1.73 (ddt, *J* = 13.6, 9.3, 4.7 Hz, 1H), 1.64 (dt, *J*

= 10.7, 5.9 Hz, 1H), 1.41 (s, 10H), 1.24 – 1.18 (m, 1H), 1.13 (dddd, *J* = 13.2, 10.3, 7.4, 5.6 Hz, 1H), 0.85 (t, *J* = 7.3 Hz, 4H).

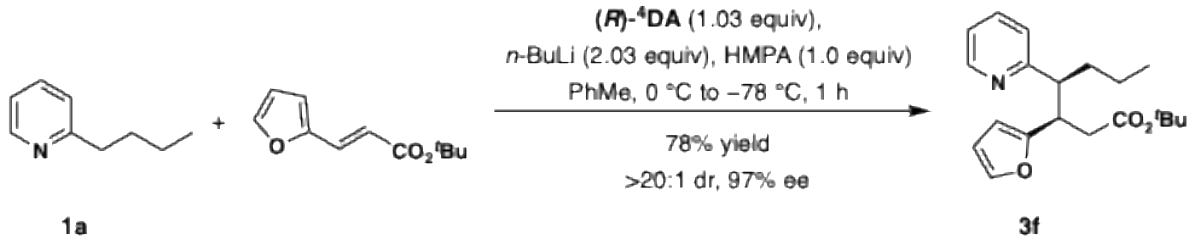


***tert*-butyl (*3S,4S*)-3-cyclohexyl-4-(pyridin-2-yl)heptanoate (3d).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.13 mL) followed by addition of solution of *tert*-butyl (*E*)-3-cyclohexylacrylate (112 mg, 0.53 mmol, 1.2 equiv) in toluene (0.5 mL) at –78 °C. The reaction was quenched after 1 h, and product **3d** (104 mg, 0.301 mmol, 68% yield) was obtained after purification by column chromatography (5%-10% EtOAc in CH_2Cl_2). Ee: 99% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 8.074 min (minor); t_2 = 9.766 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.55 (dt, *J* = 4.0, 1.4 Hz, 1H), 7.58 (td, *J* = 7.7, 1.9 Hz, 1H), 7.15 (dt, *J* = 7.8, 1.1 Hz, 1H), 7.10 (ddd, *J* = 7.5, 4.8, 1.2 Hz, 1H), 2.92 (ddd, *J* = 10.0, 7.6, 4.9 Hz, 1H), 2.28 – 2.19 (m, 2H), 2.11 – 2.03 (m, 1H), 1.83 – 1.69 (m, 5H), 1.69 – 1.55 (m, 4H), 1.36 (s, 8H), 1.30 – 0.95 (m, 8H), 0.86 (t, *J* = 7.3 Hz, 3H).

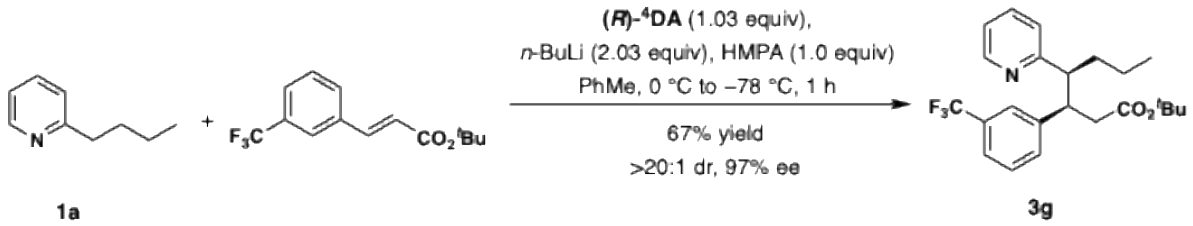


1a 3e

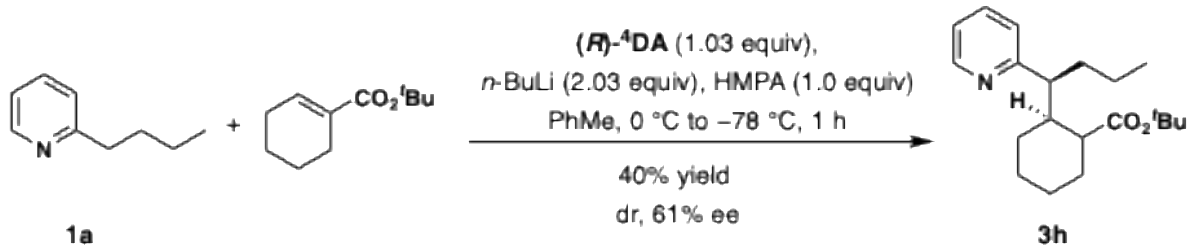
***tert*-butyl (*3R,4S)*-4-(pyridin-2-yl)-3-(thiophen-2-yl)heptanoate (3e).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.13 mL) followed by addition of solution of *tert*-butyl (*E*)-3-(thiophen-2-yl)acrylate (112 mg, 0.53 mmol, 1.2 equiv) in toluene (0.5 mL) at −78 °C. The reaction was quenched after 1 h, and product **3e** (122 mg, 0.355 mmol, 80% yield) was obtained after purification by column chromatography (1% EtOAc in hexane). Ee: 98% [Chiralcel® AD-H; 1% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 11.543 min (minor); t_2 = 14.667 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.64 – 8.59 (m, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 7.15 (dd, *J* = 15.0, 6.3 Hz, 2H), 7.11 (d, *J* = 7.7 Hz, 1H), 6.92 (dd, *J* = 5.0, 3.5 Hz, 1H), 6.86 (d, *J* = 3.4 Hz, 1H), 3.76 (td, *J* = 10.6, 4.4 Hz, 1H), 2.91 (t, *J* = 10.2 Hz, 1H), 2.32 (dd, *J* = 14.9, 11.0 Hz, 1H), 2.22 (dd, *J* = 14.9, 4.4 Hz, 1H), 1.67 (dddd, *J* = 14.0, 11.1, 8.5, 6.1 Hz, 1H), 1.48 (tdd, *J* = 10.1, 7.9, 3.5 Hz, 1H), 1.20 (s, 8H), 1.03 – 0.89 (m, 2H), 0.72 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 171.29, 162.98, 136.32, 126.42, 125.53, 123.99, 123.50, 121.71, 80.28, 54.39, 43.30, 42.30, 35.55, 27.93, 20.74, 14.05.



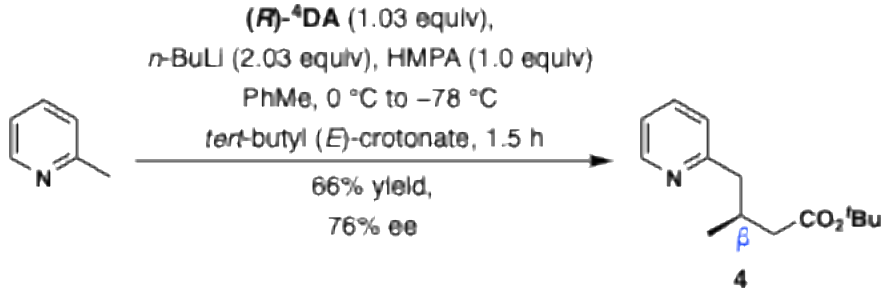
***tert*-butyl (*3R,4S)*-3-(furan-2-yl)-4-(pyridin-2-yl)heptanoate (3f).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.13 mL) followed by addition of solution of *tert*-butyl (*E*)-3-(furan-2-yl)acrylate (104 mg, 0.53 mmol, 1.2 equiv) in toluene (0.5 mL) at −78 °C. The reaction was quenched after 1 h, and product **3f** (114 mg, 0.346 mmol, 78% yield) was obtained after purification by column chromatography (1% EtOAc in hexane). Ee: 97% [Chiralcel® AD-H; 1% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 13.642 min (minor); t_2 = 14.166 min (major)]. ^{1}H NMR (500 MHz, $CDCl_3$) **δ** 8.60 (dd, *J* = 4.9, 1.8 Hz, 1H), 7.58 (td, *J* = 7.6, 1.9 Hz, 1H), 7.38 – 7.31 (m, 1H), 7.12 (dd, *J* = 7.5, 4.9 Hz, 1H), 7.05 (d, *J* = 7.7 Hz, 1H), 6.27 (dd, *J* = 3.2, 1.8 Hz, 1H), 6.06 (d, *J* = 3.2 Hz, 1H), 3.63 – 3.53 (m, 1H), 3.02 (td, *J* = 10.4, 3.8 Hz, 1H), 2.37 (dd, *J* = 14.9, 11.1 Hz, 1H), 2.21 – 2.10 (m, 1H), 1.74 – 1.67 (m, 1H), 1.37 (dddt, *J* = 12.5, 8.8, 6.1, 3.0 Hz, 1H), 1.25 (s, 9H), 0.97 (ddt, *J* = 14.6, 7.3, 4.2 Hz, 2H), 0.74 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 171.47, 162.83, 156.03, 149.78, 141.21, 136.20, 124.07, 121.62, 110.04, 107.02, 80.23, 51.39, 41.28, 38.85, 35.41, 28.01, 20.73, 14.14.



***tert*-butyl (*3R,4S)*-4-(pyridin-2-yl)-3-(3-(trifluoromethyl)phenyl)heptanoate (3g).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.13 mL) followed by addition of solution of *tert*-butyl (*E)*-3-(3-(trifluoromethyl)phenyl)acrylate (145 mg, 0.53 mmol, 1.2 equiv) in toluene (0.5 mL) at −78 °C. The reaction was quenched after 1 h, and product **3g** (121 mg, 0.300 mmol, 67% yield) was obtained after purification by column chromatography (1% EtOAc in CH_2Cl_2). Ee: 97% [Chiralcel® OD-H; 1% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 4.703 min (major); t_2 = 5.701 min (minor)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.63 (ddd, *J* = 4.8, 1.8, 0.9 Hz, 1H), 7.61 (td, *J* = 7.6, 1.9 Hz, 1H), 7.51 – 7.46 (m, 2H), 7.45 – 7.40 (m, 2H), 7.16 (ddd, *J* = 7.6, 4.9, 1.2 Hz, 1H), 7.10 (dt, *J* = 7.7, 1.1 Hz, 1H), 3.49 (ddd, *J* = 11.4, 10.2, 4.6 Hz, 1H), 2.97 – 2.84 (m, 1H), 2.37 (dd, *J* = 14.8, 11.4 Hz, 1H), 2.20 (dd, *J* = 14.8, 4.6 Hz, 1H), 1.70 – 1.59 (m, 1H), 1.31 – 1.23 (m, 1H), 1.10 (s, 9H), 0.92 (dt, *J* = 15.1, 7.4 Hz, 3H), 0.68 (t, *J* = 7.3 Hz, 3H).

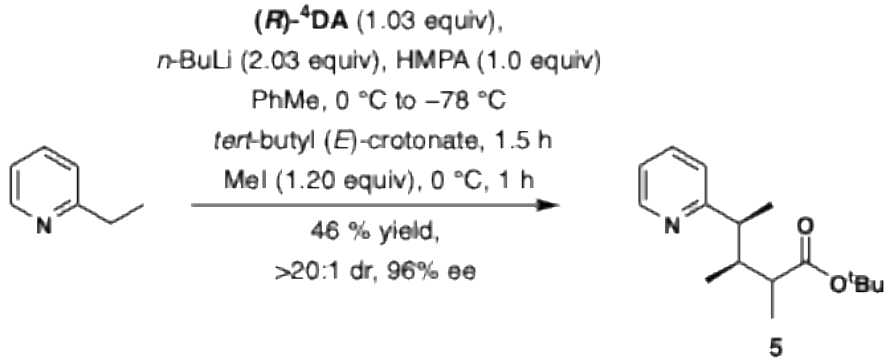


***tert*-butyl (2*S*)-2-((*S*)-1-(pyridin-2-yl)butyl)cyclohexane-1-carboxylate (3h).** The title compound was prepared according to **general procedure III** using 2-butylpyridine (60 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), and **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), in toluene (4.13 mL) followed by addition of solution of *tert*-butyl cyclohex-1-ene-1-carboxylate (97 mg, 0.53 mmol, 1.2 equiv) in toluene (0.5 mL) at −78 °C. The reaction was quenched after 1 h, and product **3h** (55 mg, 0.178 mmol, 40% yield) was obtained after purification by column chromatography (1-5% EtOAc in CH_2Cl_2). Ee: 61% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 4.469 min (major); t_2 = 4.803 min (minor)]. ^{1}H NMR (400 MHz, $CDCl_3$) **δ** 8.59 (dd, *J* = 5.1, 1.7 Hz, 1H), 7.51 (td, *J* = 7.6, 1.9 Hz, 1H), 7.08 (ddd, *J* = 7.6, 4.8, 1.2 Hz, 1H), 7.00 (d, *J* = 7.7 Hz, 1H), 2.94 (td, *J* = 10.2, 3.6 Hz, 1H), 1.92 – 1.73 (m, 6H), 1.72 – 1.56 (m, 2H), 1.38 (s, 9H), 1.33 – 1.21 (m, 2H), 1.07 – 0.83 (m, 3H), 0.79 (t, *J* = 7.1 Hz, 3H).



***tert*-butyl (*S*)-3-methyl-4-(pyridin-2-yl)butanoate (4).** The title compound was prepared according to **general procedure II** using 2-methylpyridine (41 mg, 0.44 mmol), HMPA (0.68 mL, 0.645 M in toluene,0.44 mmol, 1.0 equiv), **(*R*)-^{4}DA** (0.119 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.36 mL, 2.6 M in hexane, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by addition of *tert*-butyl *(E)*-crotonate (81 µL, 0.53 mmol, 1.2 equiv) at −78 °C. The reaction was quenched after 1.5 h, and product **4** (69 mg, 0.293 mmol, 66% yield)

was obtained after purification by column chromatography (2-10% EtOAc in hexane). Ee: 76% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 18.913 min (minor); t_2 = 22.384 min (major)]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56 – 8.48 (m, 1H), 7.59 (td, *J* = 7.6, 1.8 Hz, 1H), 7.18 – 7.06 (m, 2H), 2.81 (dd, *J* = 13.3, 6.6 Hz, 1H), 2.66 (dd, *J* = 13.3, 7.8 Hz, 1H), 2.54 – 2.34 (m, 1H), 2.29 (dd, *J* = 14.8, 5.6 Hz, 1H), 2.08 (dd, *J* = 14.7, 8.4 Hz, 1H), 1.43 (s, 9H), 0.96 (d, *J* = 6.6 Hz, 3H).

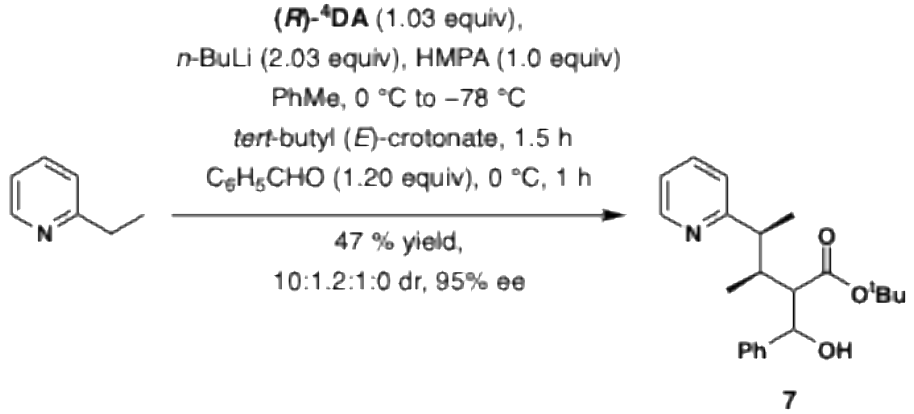


5

Quench procedure I:

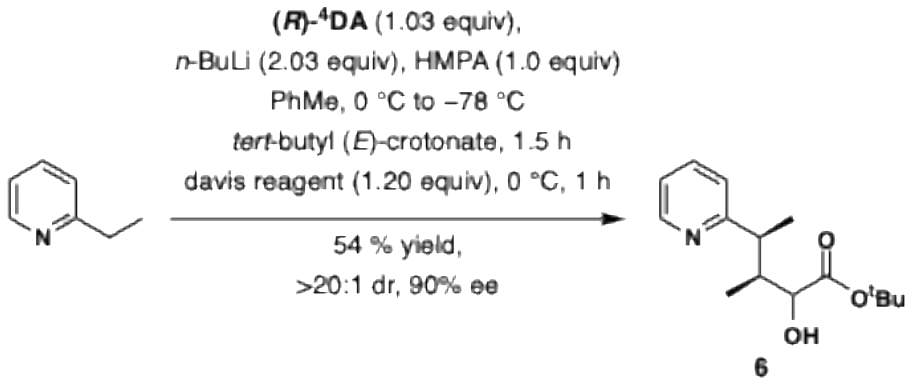
***tert*-butyl (*3S,4S*)-2,3-dimethyl-4-(pyridin-2-yl)pentanoate (5).** A round bottom flask equipped with a stir bar was flame dried under vacuum and cooled under an atmosphere of dry argon. **(*R*)-^{4}DA** (0.118 g, 0.46 mmol, 1.03 equiv) is added and the flask is backfilled with argon three times. 2-ethylpyridine (48 mg, 0.44 mmol) and HMPA (0.66 mL, 0.650 M in toluene, 0.44 mmol, 1.00 equiv) were added by syringe and dissolved in toluene (4.63 ml). The solution was cooled to 0 °C and *n*-BuLi (0.390 mL, 2.29 M in hexanes, 0.90 mmol, 2.03 equiv) was added dropwise. The solution was stirred for 15 min, then cooled to −78 °C and stirred for an additional 15 min. *tert*-butyl (*E*)-crotonate (81 µL, 0.53 mmol, 1.2 equiv) was added dropwise at –78 °C, and the solution was stirred at this temperature for 1.5 h. The solution was warmed to 0 °C and methyl iodide (52 µL, 0.533 mmol, 1.2 equiv) was added.

The solution was stirred at this temperature for 1 h. Upon completion, the reaction was quenched with 1 mL of methanol at 0 °C and the solution was stirred for 15 min before being brought to room temperature. The reaction was diluted with deionized H_2O (5 mL) and EtOAc (2 mL) and transferred to a separatory funnel. The aqueous layer was extracted 3 times with EtOAc (5 mL). Combined organic layers were rinsed with a 800 μL portion of deionized H2O containing 0.552 mmol of HCl to recover **(*R*)-^{4}DA.** Organic layers were rinsed with brine, dried over anhydrous Na_2SO_4, concentrated, and the crude extract is purified by column chromatography on silica gel (20% EtOAc in hexane) to afford **5** (53 mg, 0.202 mmol, 46% yield) as a colorless oil. Ee: 96% [Chiralcel® AD-H; 0.5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 6.565 min (minor); t_2 = 7.344 min (major)]. ^{1}H NMR (500 MHz, cdcl$_3$) **δ** 8.54 (ddd, *J* = 4.8, 1.8, 0.9 Hz, 1H), 7.65 – 7.58 (m, 1H), 7.22 (dt, *J* = 7.8, 1.1 Hz, 1H), 7.13 (ddd, *J* = 7.5, 4.9, 1.2 Hz, 1H), 4.10 (s, 1H), 3.81 (d, *J* = 2.3 Hz, 1H), 2.35 (dqd, *J* = 9.2, 6.9, 2.3 Hz, 1H), 1.46 (s, 9H), 1.33 (d, *J* = 7.0 Hz, 3H), 0.90 (d, *J* = 6.9 Hz, 3H). ^{13}C NMR (126 MHz, CDCl$_3$) **δ** 174.38, 164.95, 149.11, 136.85, 123.49, 121.47, 82.04, 71.54, 44.60, 41.79, 28.15, 19.23, 11.49.



7

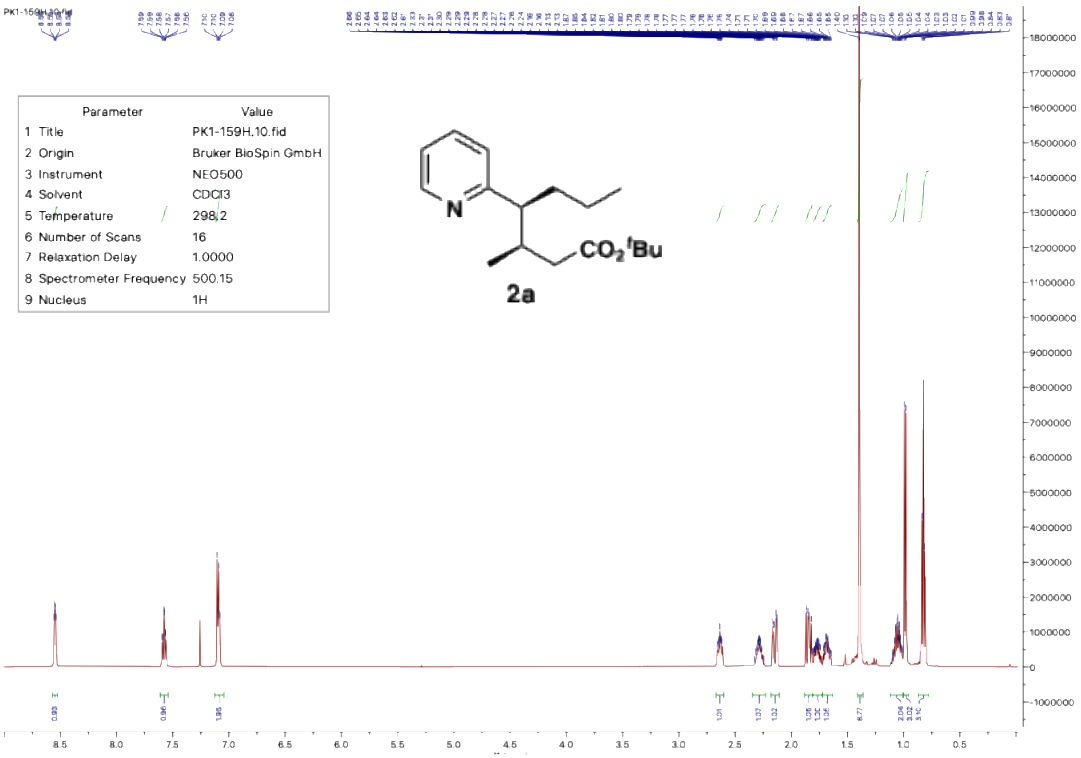
***tert*-butyl (*3S,4S*)-2-(hydroxy(phenyl)methyl)-3-methyl-4-(pyridin-2-yl)pentanoate (7).** The title compound was prepared according to **Quench Procedure II** using 2-ethylpyridine (48 mg, 0.44 mmol), HMPA (0.68 mL, 0.650 M in toluene, 0.44 mmol, 1.00 equiv), and **(*R*)-^{4}DA** (0.118 g, 0.46 mmol, 1.03 equiv), *n*-BuLi (0.390 mL, 2.29 M in hexanes, 0.90 mmol, 2.03 equiv) in toluene (4.63 mL) followed by the addition of *tert*-butyl (*E*)-crotonate (81 μL, 0.533 mmol, 1.2 equiv) at – 78 °C. The reaction was stirred at this temperature for 1.5 h. The solution was then warmed to 0 °C and benzaldehyde (55 μL, 0.533 mmol, 1.2 equiv) was added and stirred at this temperature for 1 h. The reaction was quenched after at 0 °C and product **5** (74 mg, 0.207 mmol, 47% yield) was obtained as an off-white solid after purification by column chromatography on silica gel (25% EtOAc in hexane). Ee: 95% [Chiralcel® AD-H; 5% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 7.874 min (major); t_2 = 10.225 min (minor)].^{1}H NMR (600 MHz, cdcl$_3$) **δ** 8.55 (dd, *J* = 5.0, 1.8 Hz, 1H), 7.71 (td, *J* = 7.7, 1.8 Hz, 1H), 7.31 (d, *J* = 7.9 Hz, 1H), 7.26 (s, 4H), 7.20 (ddd, *J* = 12.5, 6.4, 3.5 Hz, 2H), 5.87 (s, 1H), 4.66 (d, *J* = 10.4 Hz, 1H), 3.48 (p, *J* = 7.0 Hz, 1H), 2.59 (dd, *J* = 10.4, 3.3 Hz, 1H), 2.55 (qd, *J* = 7.0, 3.4 Hz, 1H), 1.32 (d, *J* = 7.0 Hz, 3H), 1.26 – 1.19 (m, 3H), 1.18 (d, *J* = 2.6 Hz, 10H). ^{13}C NMR (126 MHz, CDCl$_3$) **δ** 172.56, 166.81, 148.64, 143.11, 137.45, 128.19, 127.54, 127.26, 121.79, 121.66, 80.44, 72.62, 58.91, 42.03, 38.92, 27.92, 17.36, 15.36.

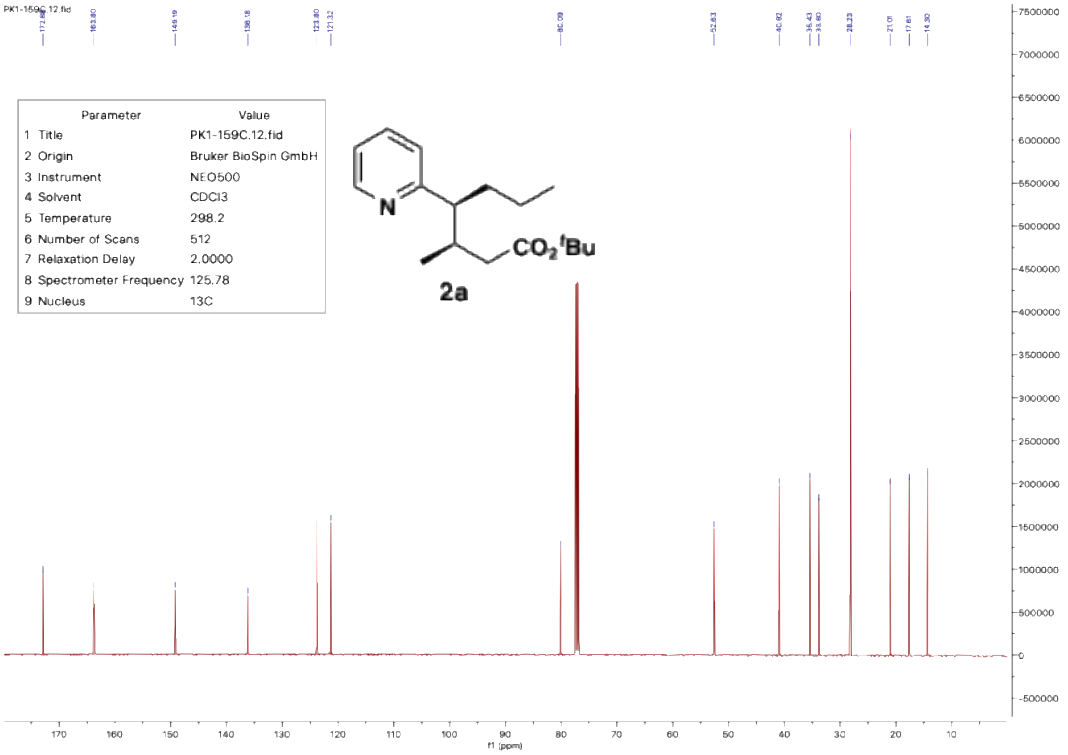


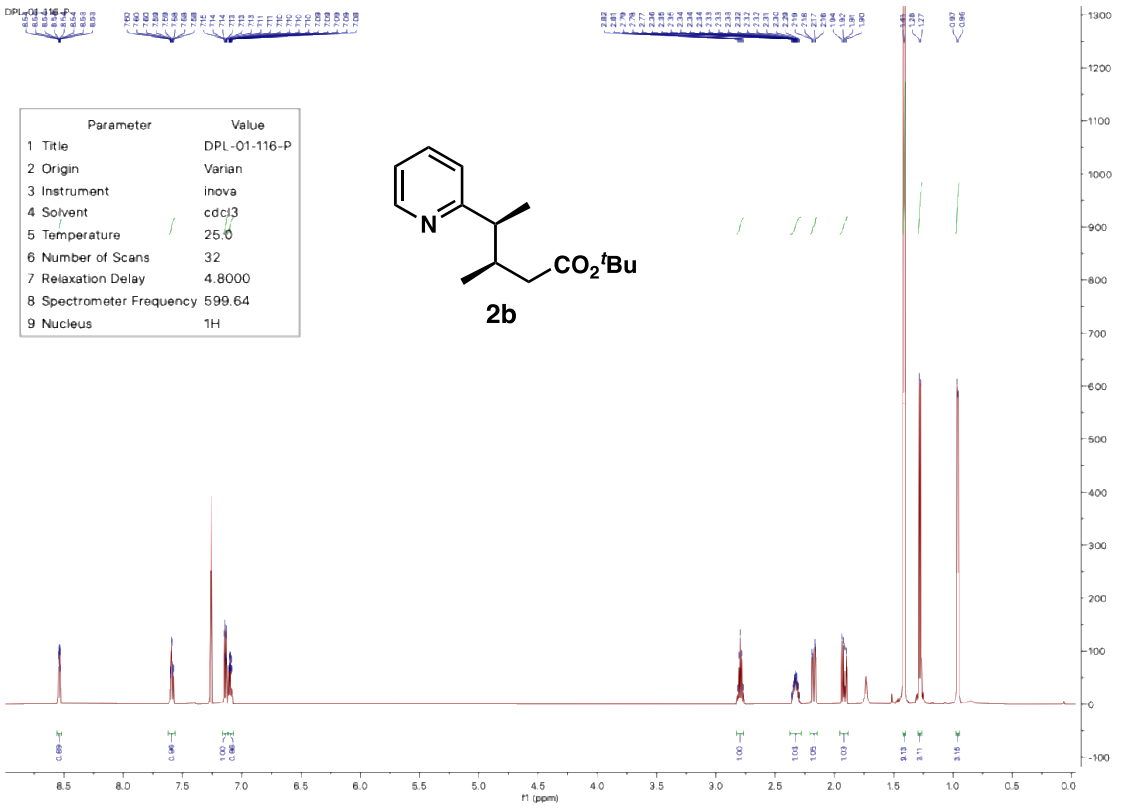
***tert*-butyl (*3S,4S*)-2-hydroxy-3-methyl-4-(pyridin-2-yl)pentanoate (6).** A round bottom flask equipped with a stir bar was flame dried under vacuum and cooled under an atmosphere of dry argon. **(*R*)-^{4}DA** (0.118 g, 0.46 mmol, 1.03 equiv) is added and the flask is backfilled with argon three times. 2-ethylpyridine (48 mg, 0.44 mmol) and HMPA (0.68 mL, 0.650 M in toluene, 0.44 mmol, 1.00 equiv) were added by syringe and dissolved in toluene (4.63 ml). The solution was cooled to 0 °C and *n*-BuLi (0.390 mL, 2.29 M in hexanes, 0.893 mmol, 2.03 equiv) was added dropwise. The solution was stirred for 15 min, then cooled to −78 °C and stirred for an additional 15 min. *tert*-Butyl (*E*)-crotonate (81 µL, 0.533 mmol, 1.2 equiv) was added dropwise at –78 °C, and the solution was stirred at this temperature for 1.5 h. The solution was warmed to 0 °C and a 1mL toluene solution containing the Davis reagent (0.146 g, 0.533 mmol, 1.2 equiv) was added. The solution was stirred at this temperature for 1 h. Upon completion, the reaction was quenched with 1 mL of 1M acetic acid in methanol at 0 °C and the solution was stirred for 15 min before being brought to room temperature. The reaction was diluted with deionized H_2O (5 mL) and EtOAc (2 mL) and transferred to a separatory funnel. The aqueous layer was extracted 3 times with EtOAc (5 mL). Combined organic layers were rinsed with a 800 µL portion of deionized H_2O containing 0.552 mmol of HCl to recover **(*R*)-^{4}DA.** Organic layers were

rinsed with brine, dried over anhydrous Na_2SO_4, concentrated, and the crude extract is purified by column chromatography on silica gel (25% EtOAc in hexane) to afford **6** (64 mg, 0.238 mmol, 54% yield) as a colorless oil. Ee: 90% [Chiralcel® OD-H; 4% *i*-PrOH in hexane; flow rate = 1.0 mL/min; detection at 254 nm; t_1 = 6.004 min (major); t_2 = 6.523 min (minor)]. ^{1}H NMR (500 MHz, cdcl$_3$) **δ** 8.54 (ddd, *J* = 4.8, 1.8, 0.9 Hz, 1H), 7.65 – 7.58 (m, 1H), 7.22 (dt, *J* = 7.8, 1.1 Hz, 1H), 7.13 (ddd, *J* = 7.5, 4.9, 1.2 Hz, 1H), 4.10 (s, 1H), 3.81 (d, *J* = 2.3 Hz, 1H), 2.35 (dqd, *J* = 9.2, 6.9, 2.3 Hz, 1H), 1.46 (s, 9H), 1.33 (d, *J* = 7.0 Hz, 3H), 0.90 (d, *J* = 6.9 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) **δ** 174.38, 164.95, 149.11, 136.85, 123.49, 121.47, 82.04, 71.54, 44.60, 41.79, 28.15, 19.23, 11.49.

^{1}H NMR and ^{13}C NMR



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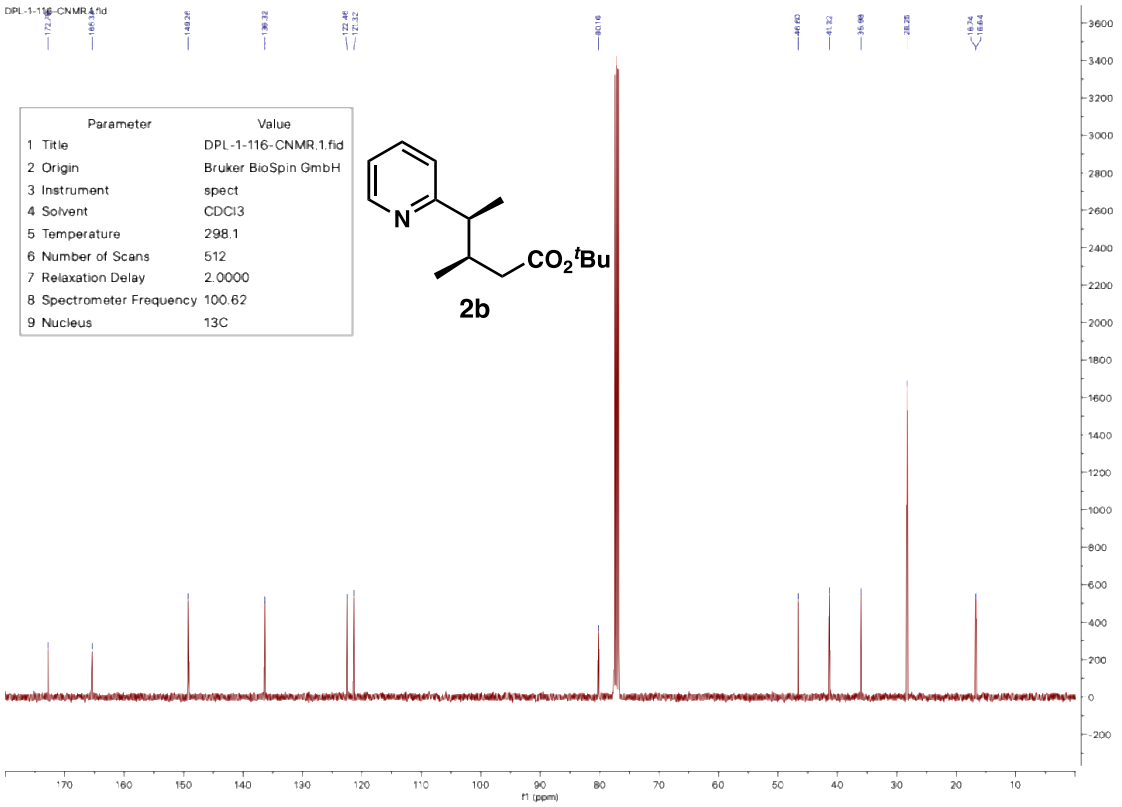
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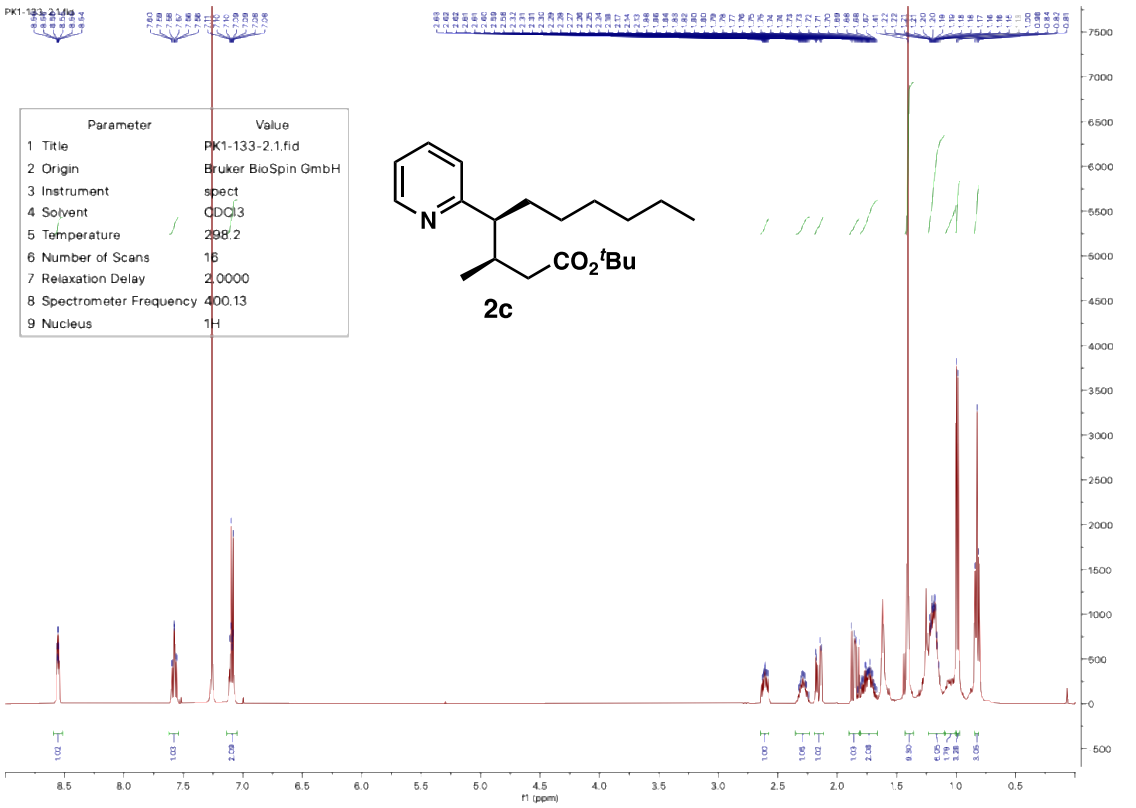
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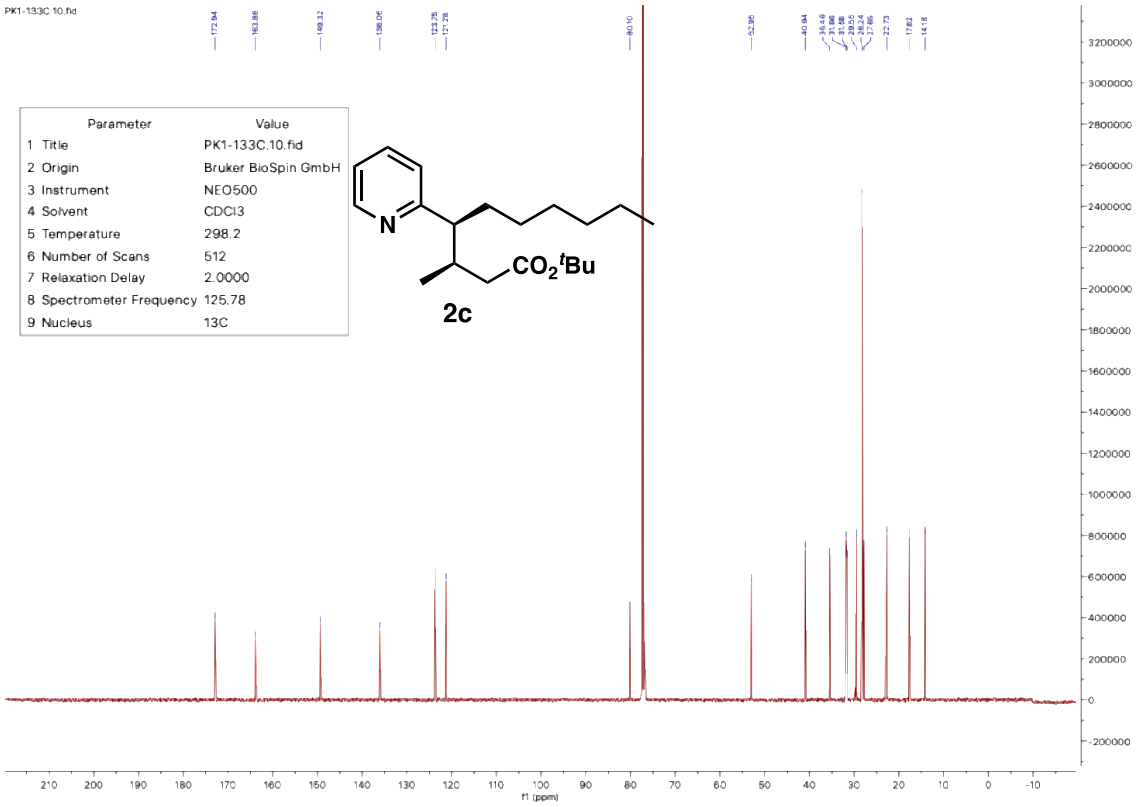
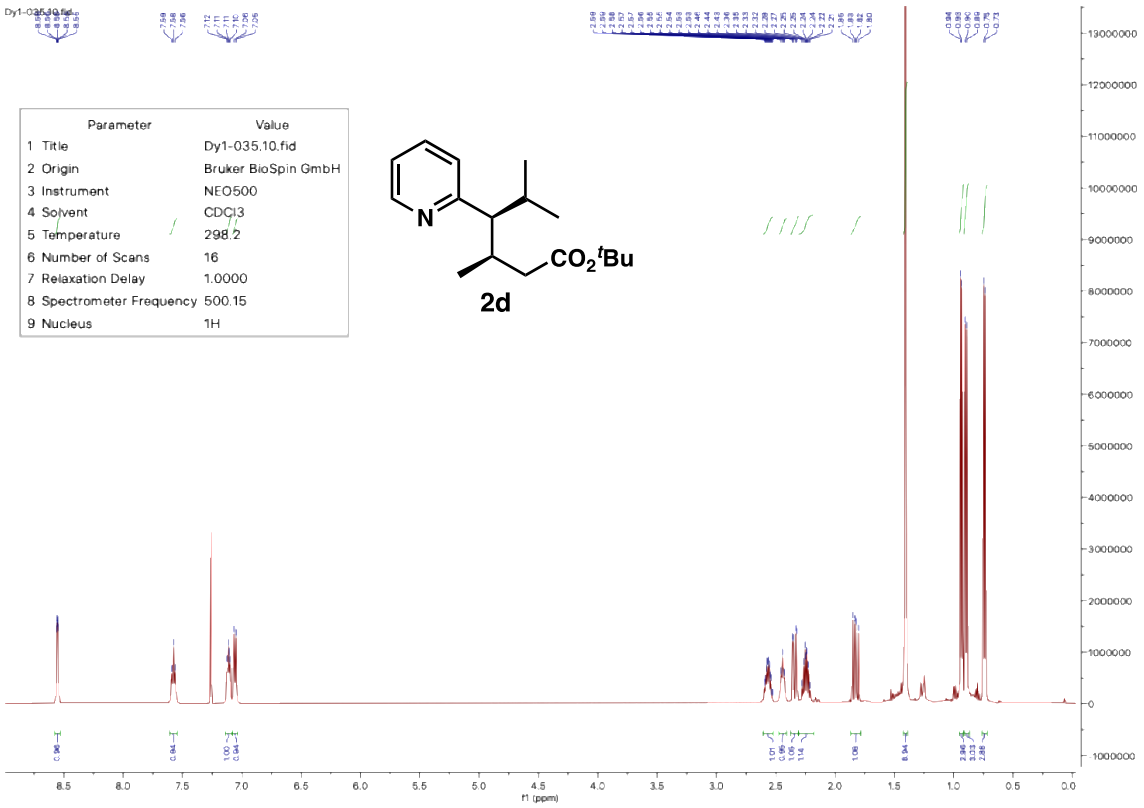
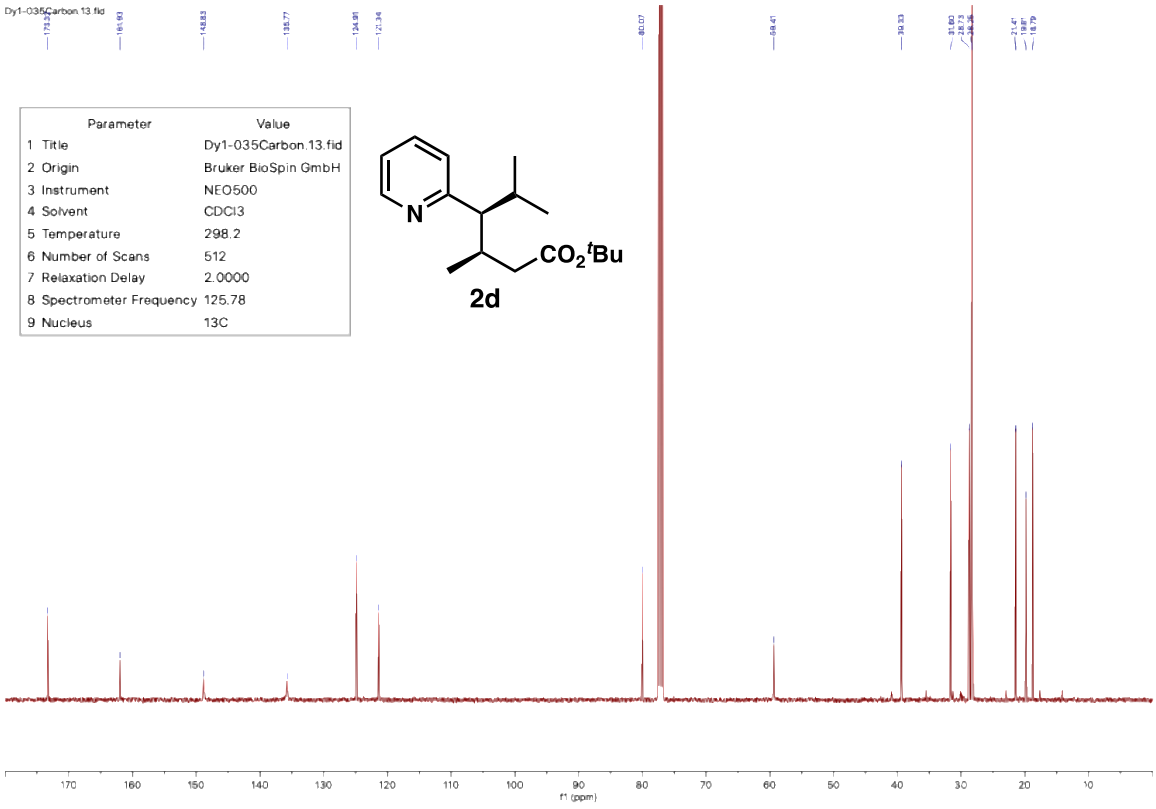
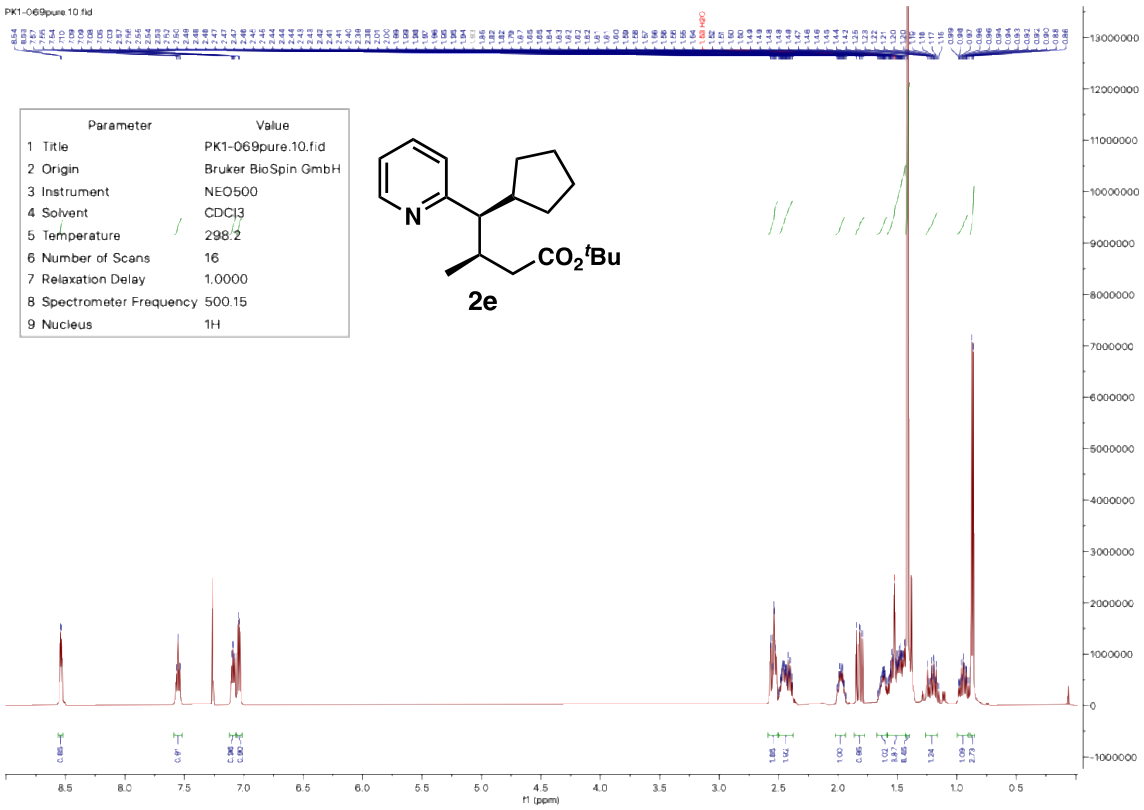
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
CO2tBu
2c
f1 (ppm)


Parameter Value
1 Title PK1-133C.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2c
f1 (ppm)


Parameter Value
1 Title Dy1-035.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
2d
f1 (ppm)


Parameter Value
1 Title Dy1-035Carbon.13.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2d
f1 (ppm)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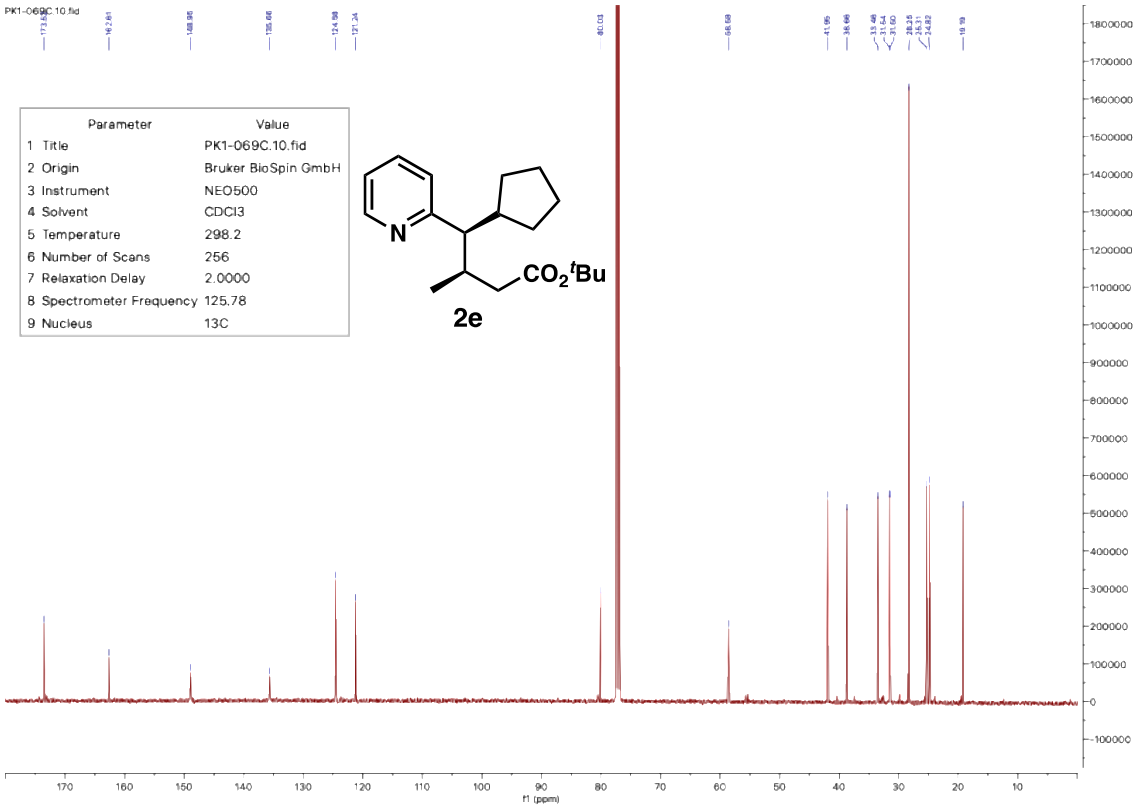
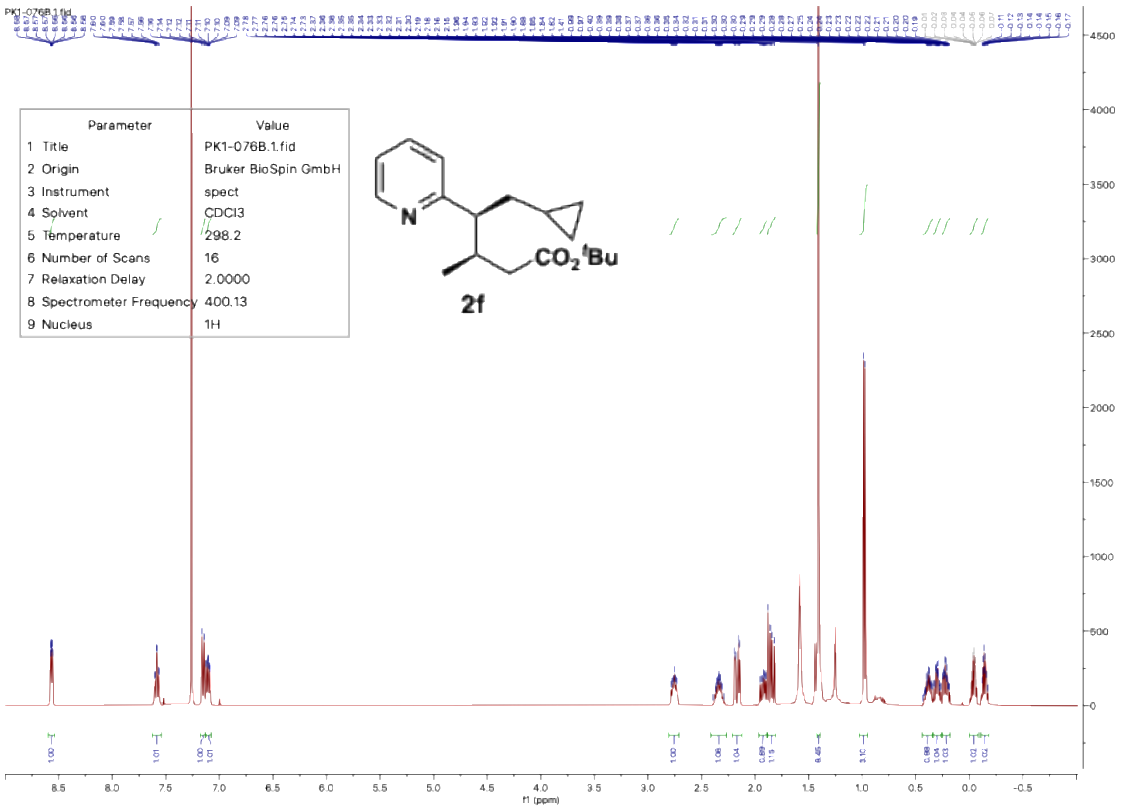
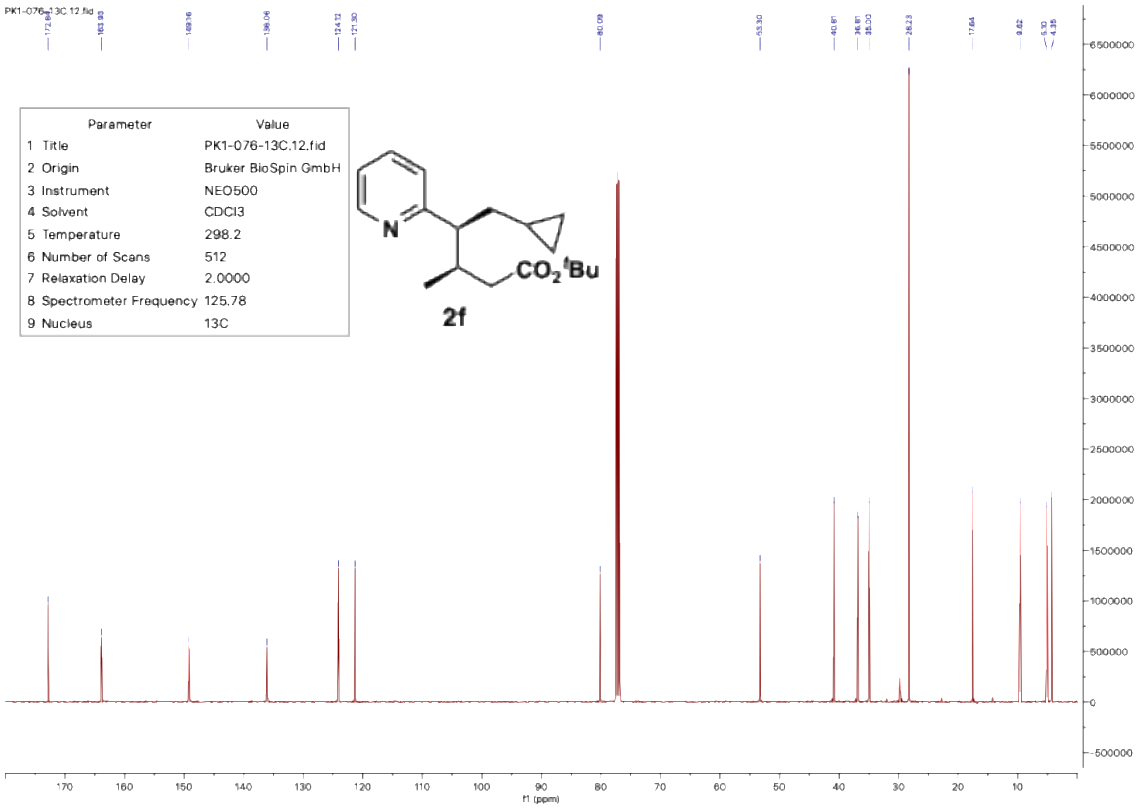
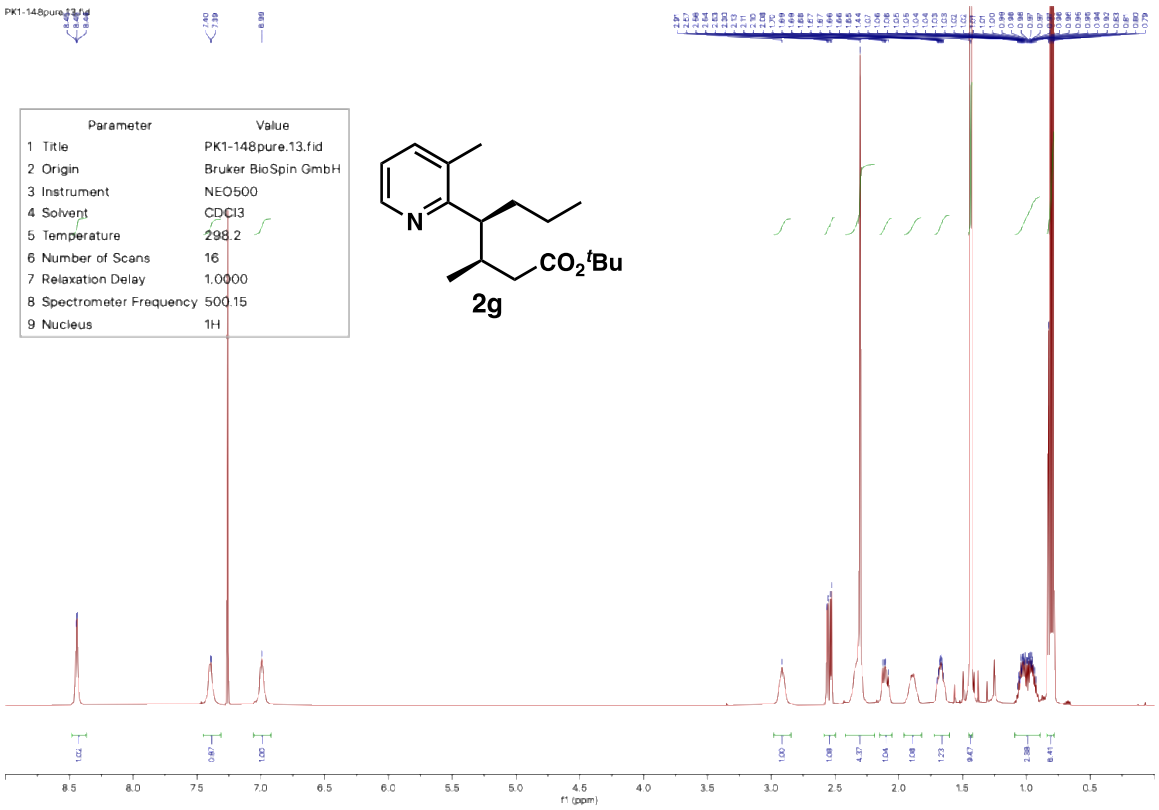
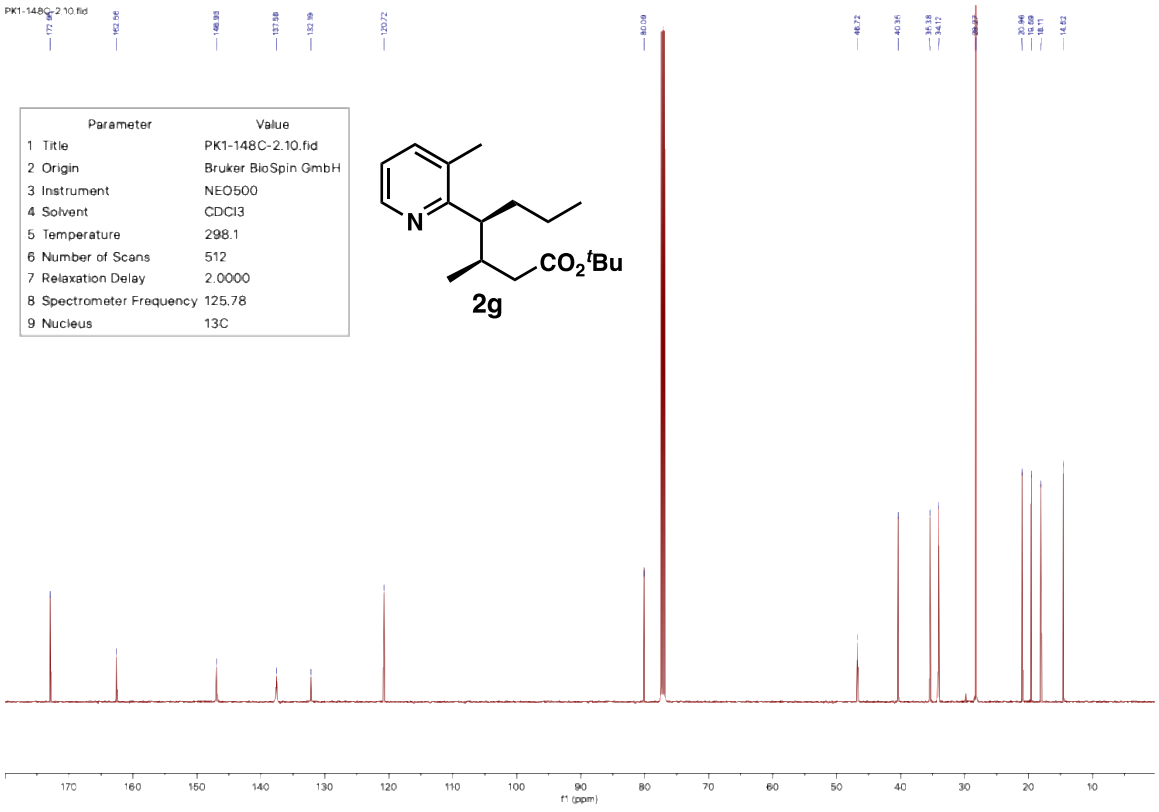
Parameter Value
1 Title PK1-069pure.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
2e
f1 (ppm)

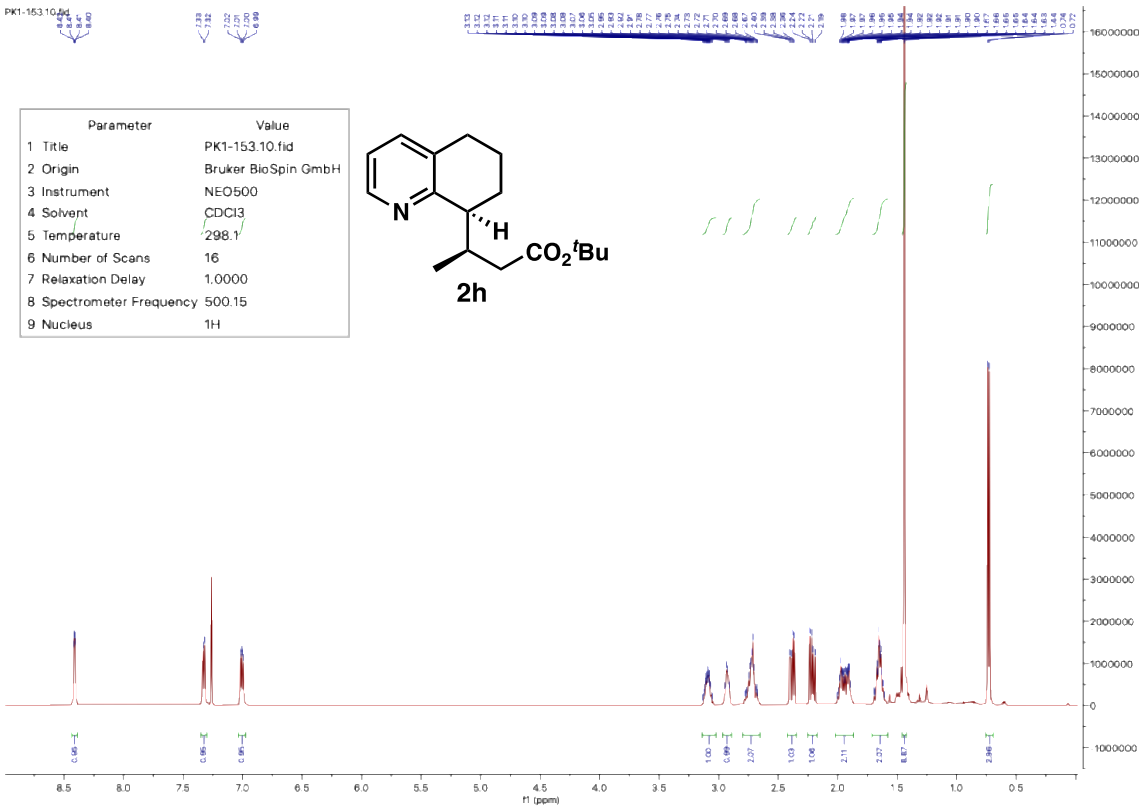

PK1-069C.10.fid
Parameter Value
1 Title PK1-069C.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 256
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2e
f1 (ppm)

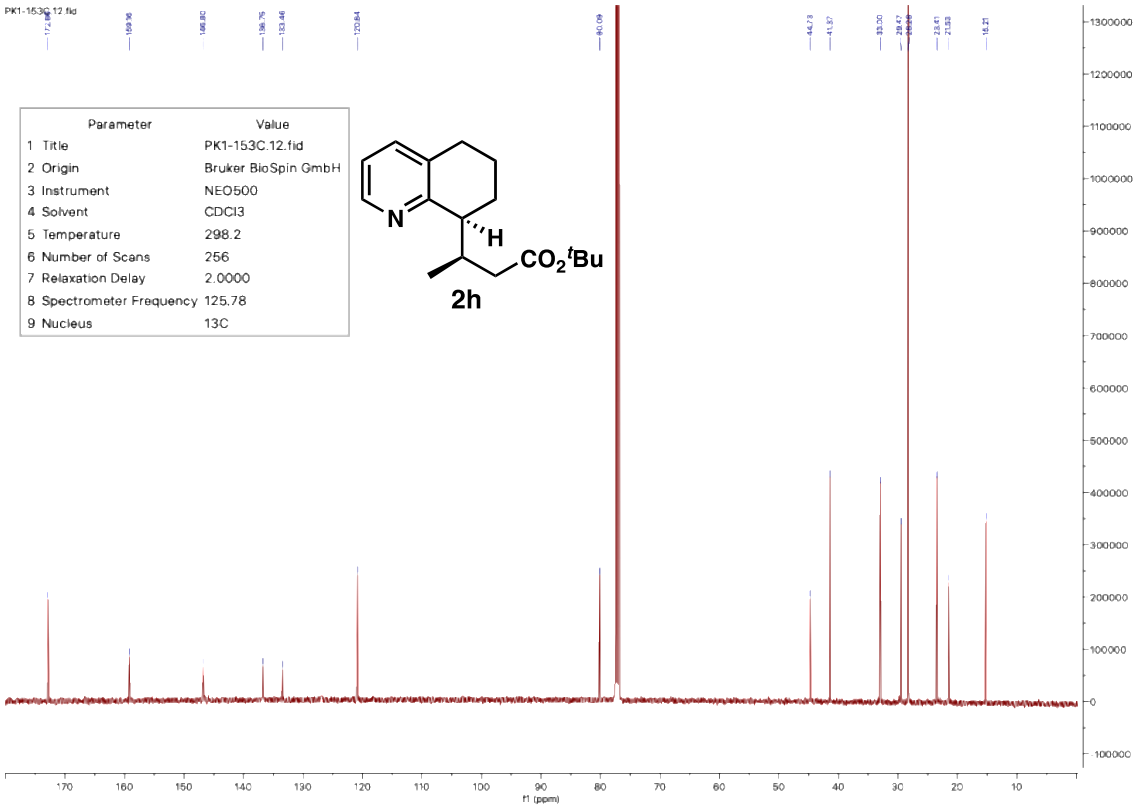

PK1-076B.1.fid
Parameter Value
1 Title PK1-076B.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
CO2tBu
2f
f1 (ppm)

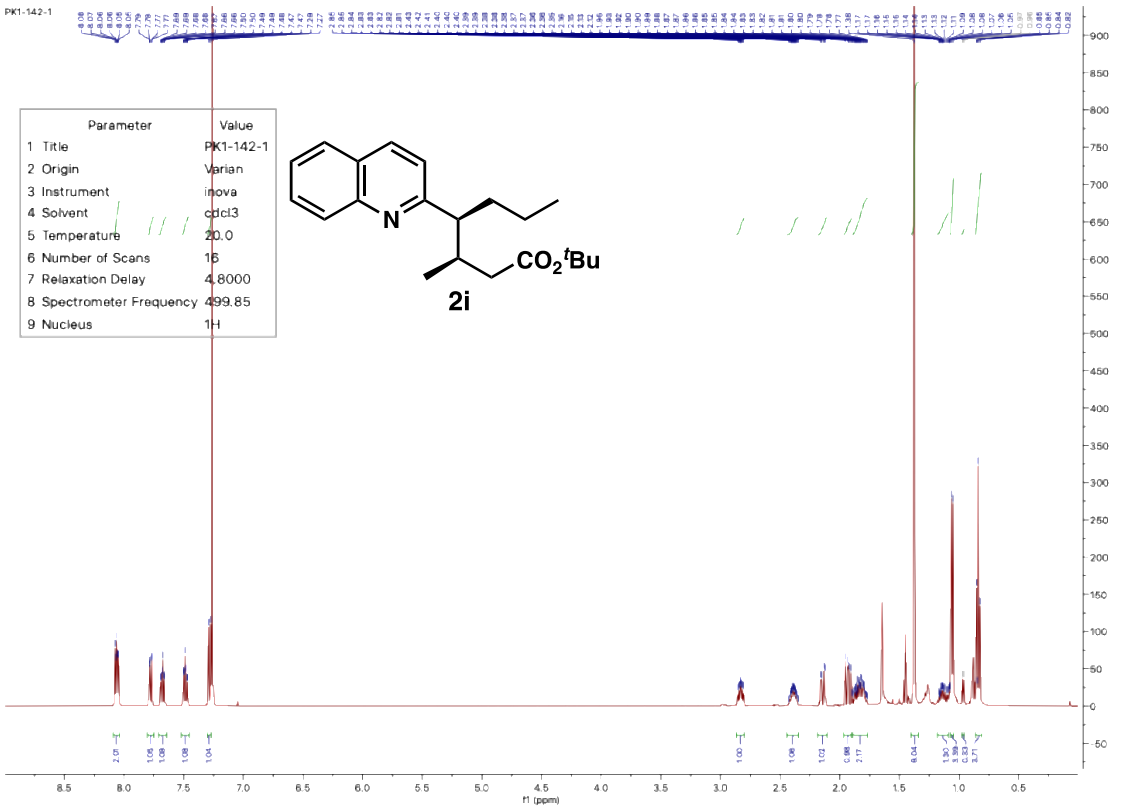

PK1-076-13C.12.fid
Parameter Value
1 Title PK1-076-13C.12.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2f
f1 (ppm)

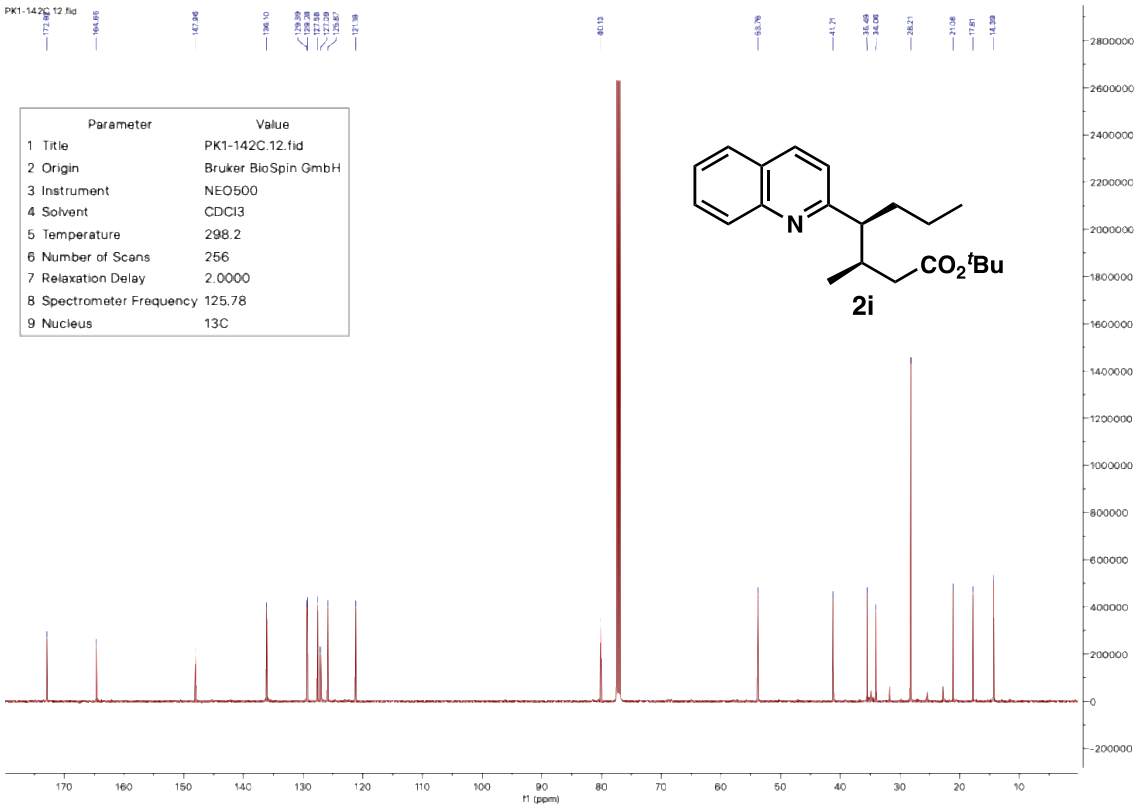

Parameter Value
1 Title PK1-148pure.13.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
2g
f1 (ppm)

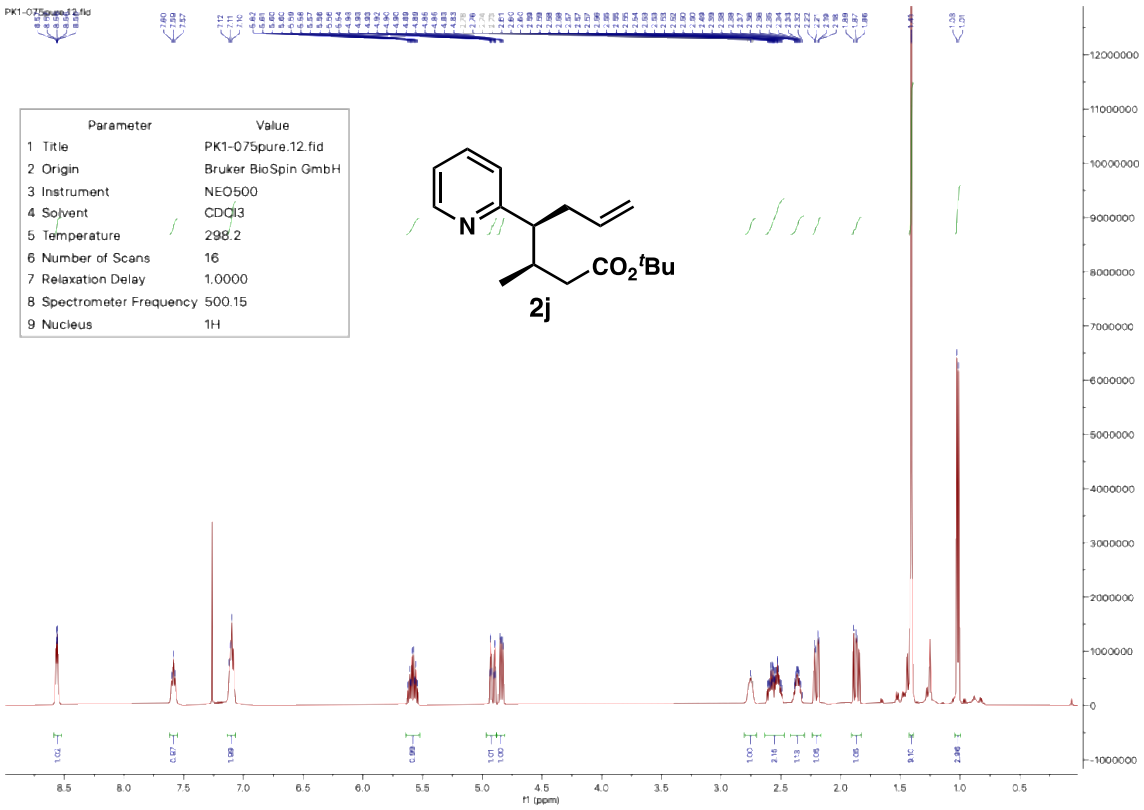

Parameter Value
1 Title PK1-148C-2.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2g
f1 (ppm)

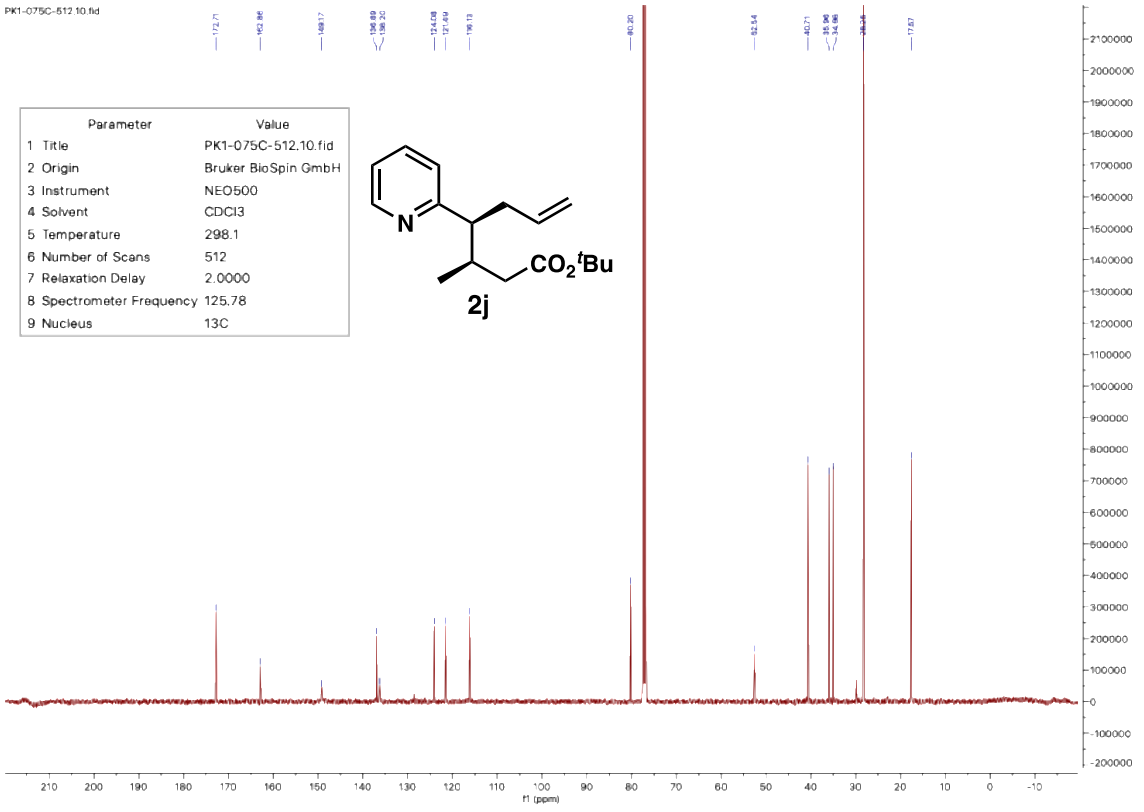

Parameter Value
1 Title PK1-153.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
H
CO2tBu
2h
f1 (ppm)

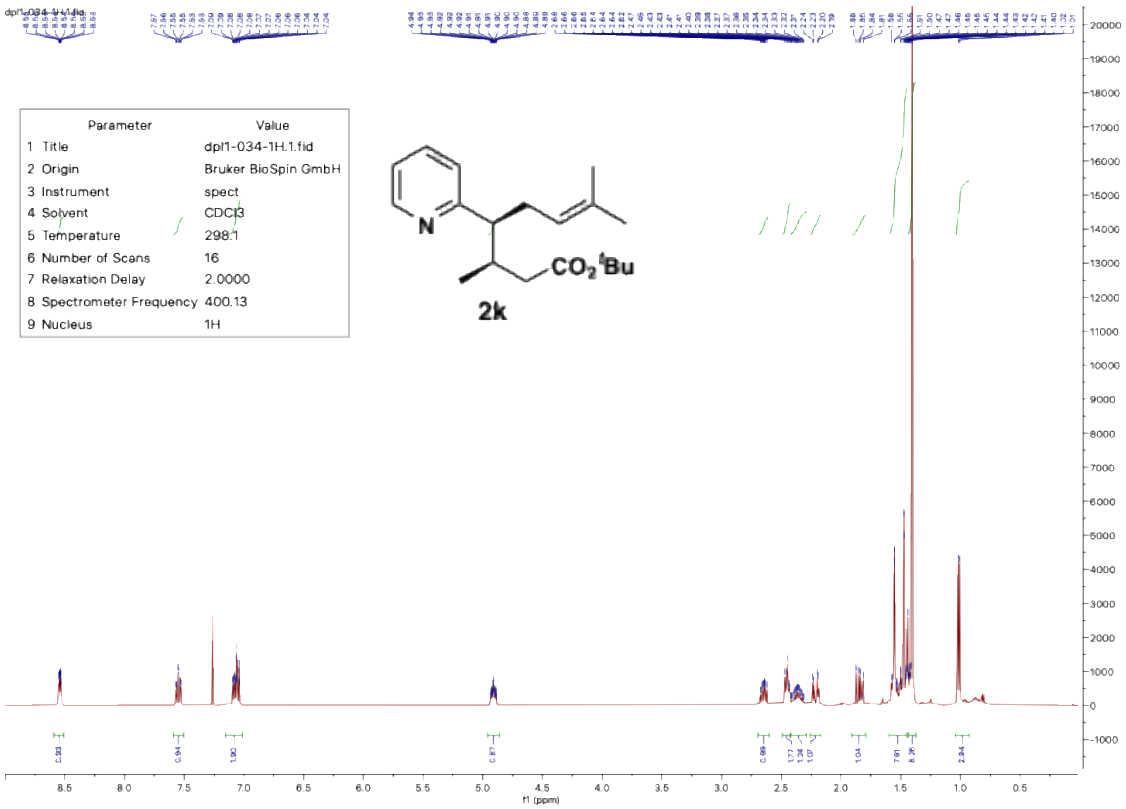

Parameter Value
1 Title PK1-153C.12.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 256
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
H
CO2tBu
2h
f1 (ppm)

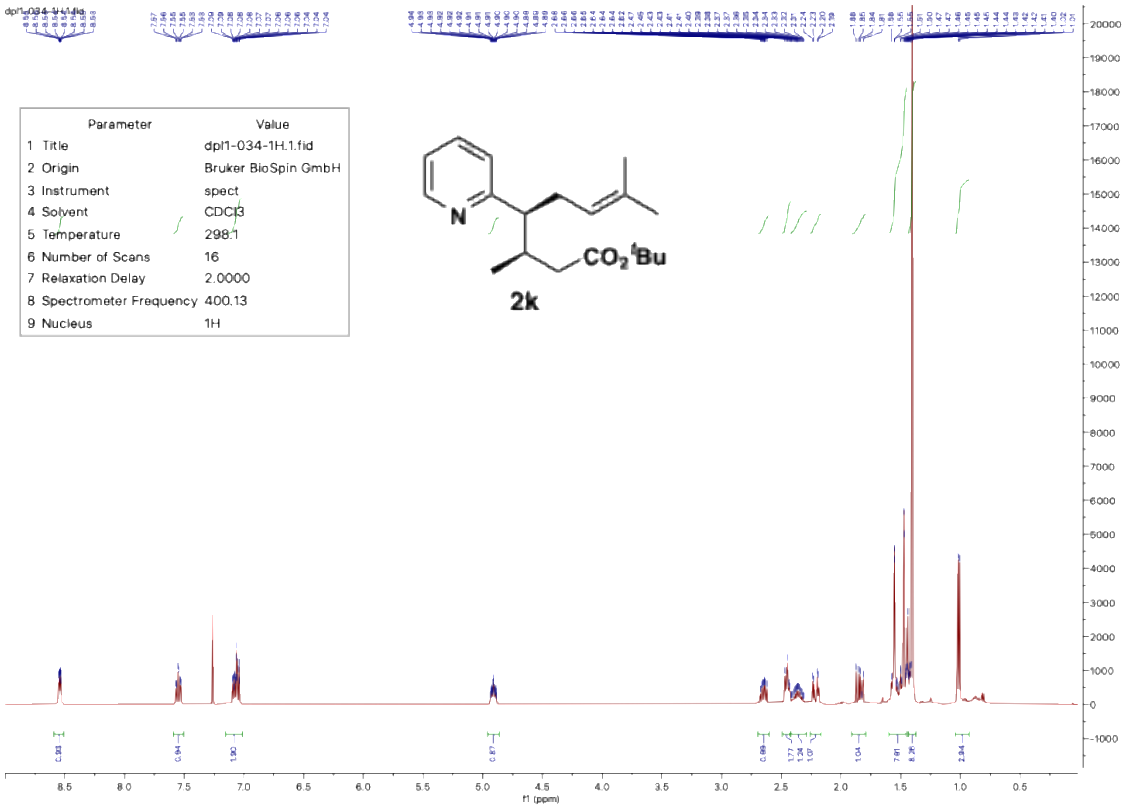

PK1-142-1
Parameter Value
1 Title PK1-142-1
2 Origin Varian
3 Instrument inova
4 Solvent cdcl3
5 Temperature 20.0
6 Number of Scans 16
7 Relaxation Delay 4.8000
8 Spectrometer Frequency 499.85
9 Nucleus 1H
N
CO2tBu
2i
f1 (ppm)

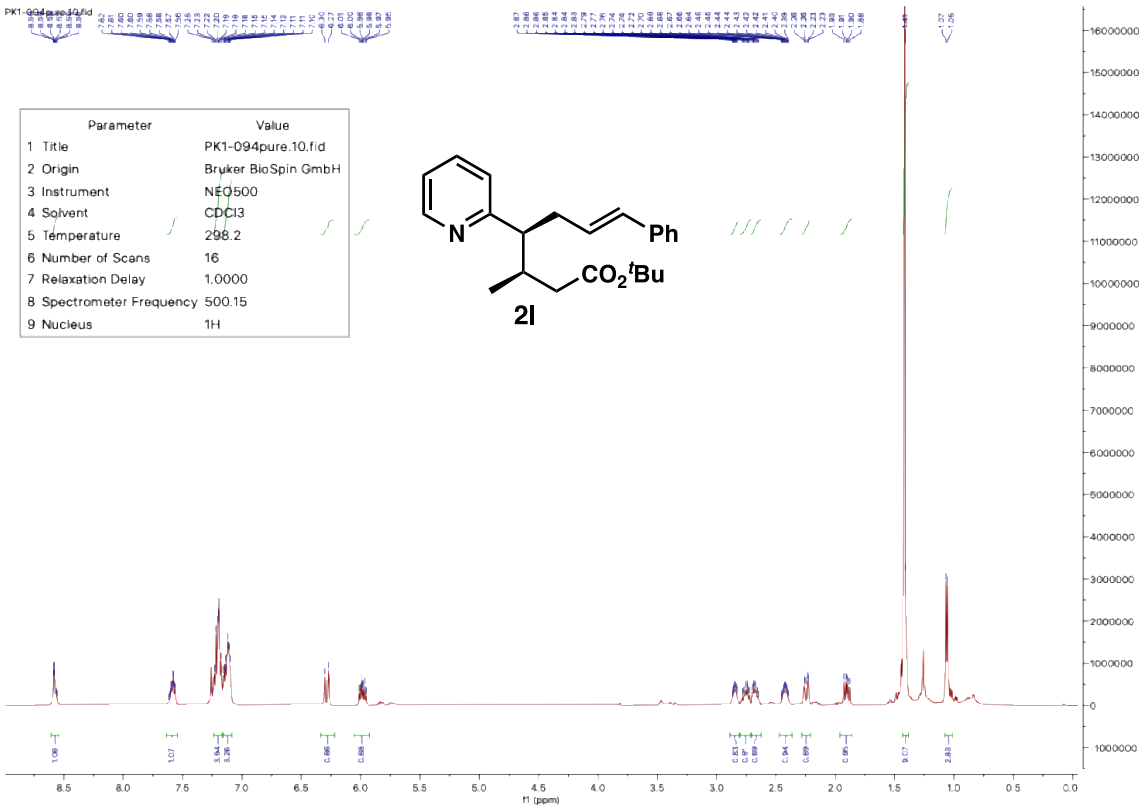

PK1-142C.12.fid
Parameter Value
1 Title PK1-142C.12.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 256
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2i
f1 (ppm)

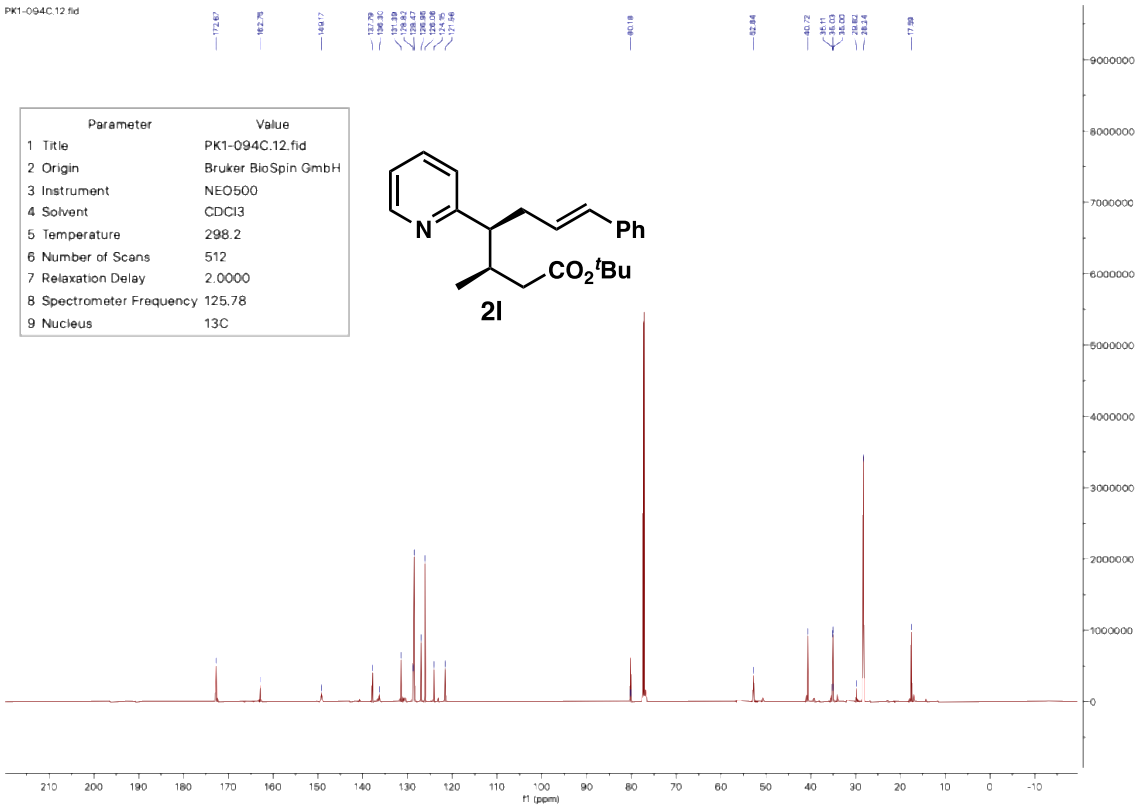

Parameter Value
1 Title PK1-075pure.12.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
2j
f1 (ppm)

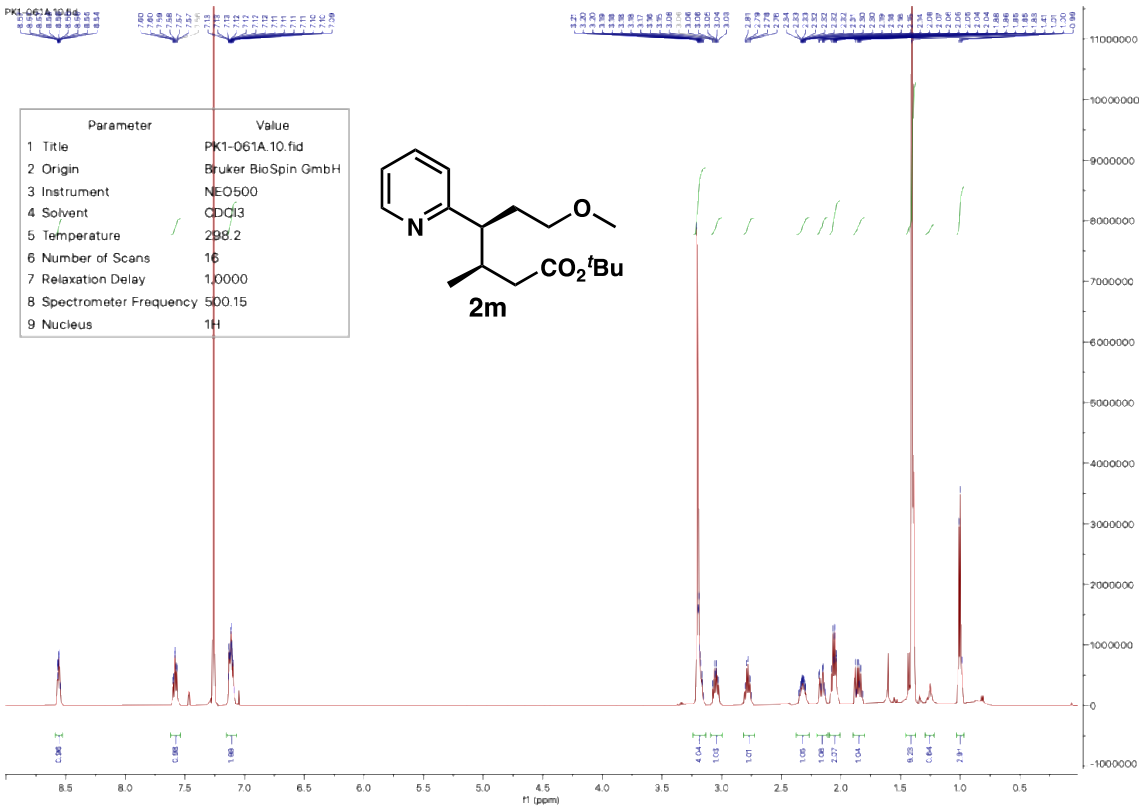

Parameter Value
1 Title PK1-075C-512.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
2j
f1 (ppm)

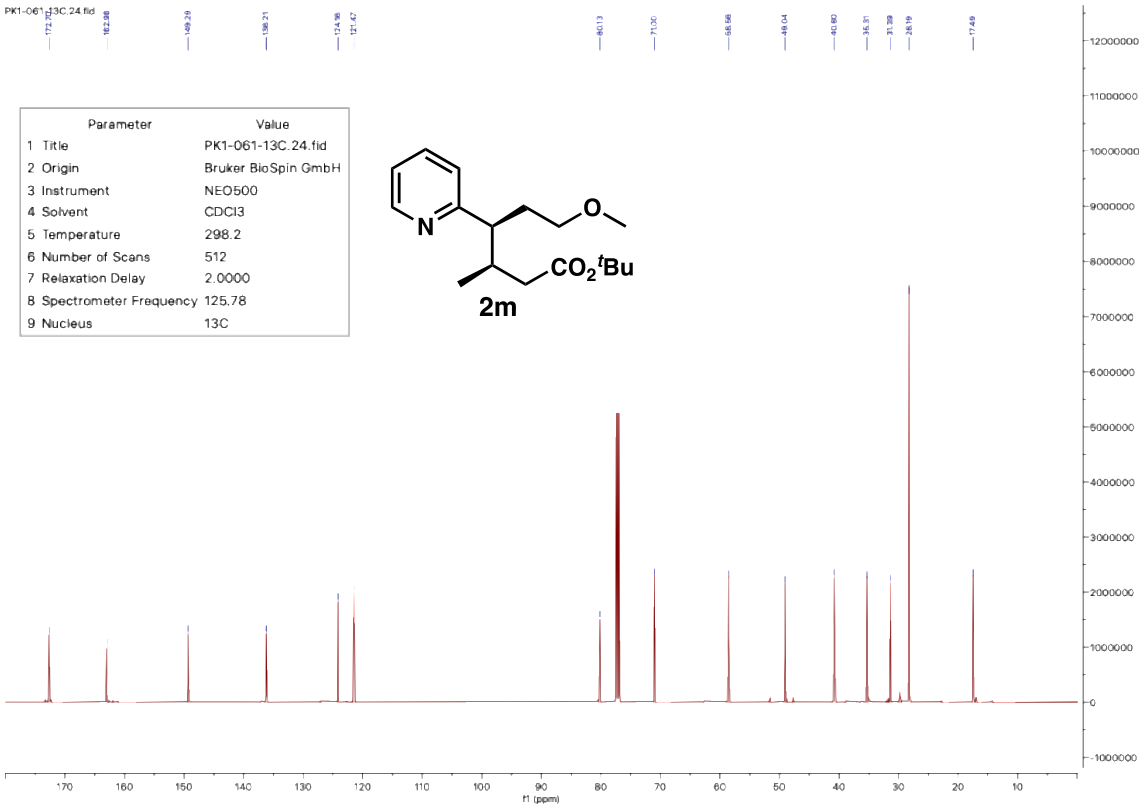

Parameter Value
1 Title dpl1-034-1H.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
CO2tBu
2k
f1 (ppm)

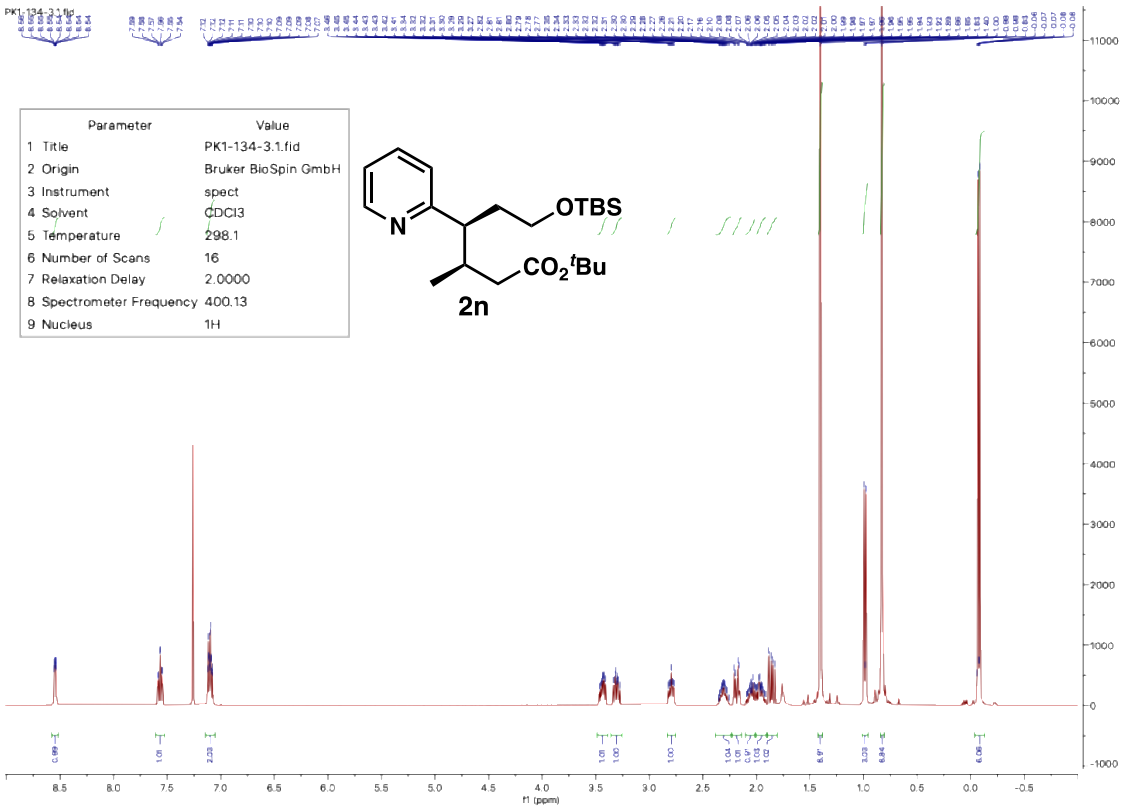

Parameter Value
1 Title dpl1-034-1H.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
CO2tBu
2k
f1 (ppm)

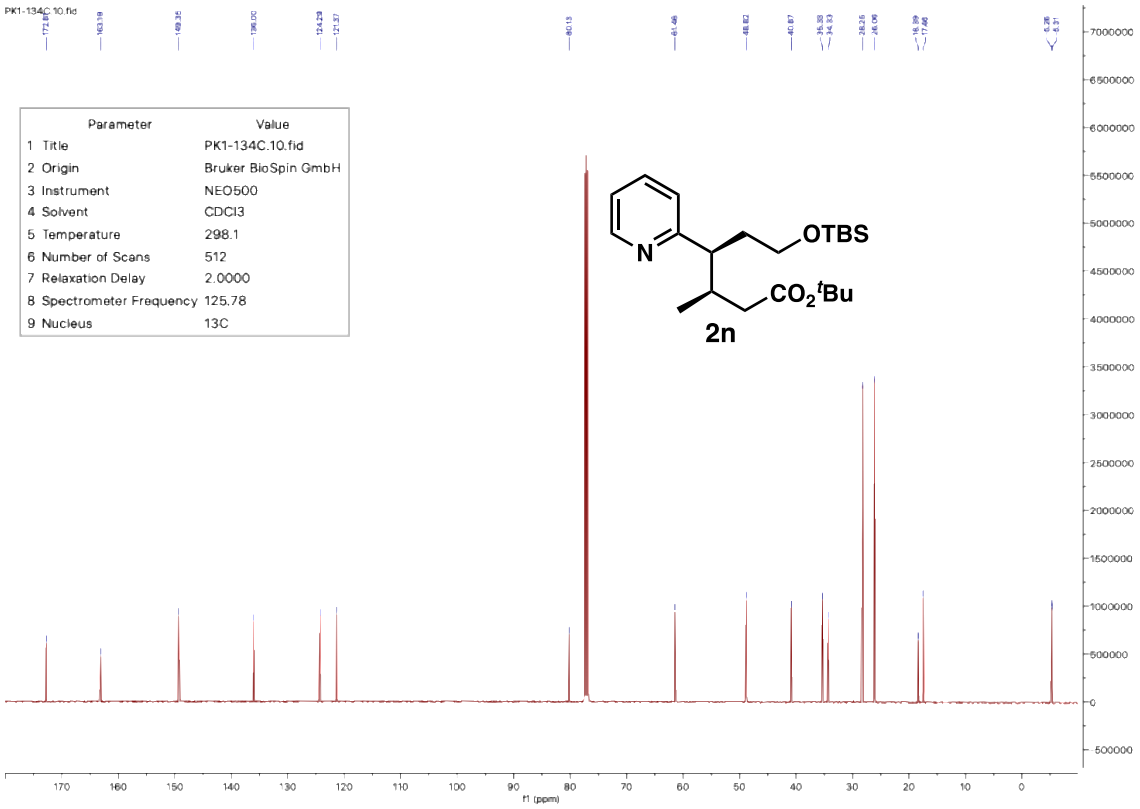

Parameter Value
1 Title PK1-094pure.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
Ph
CO2tBu
2l
f1 (ppm)

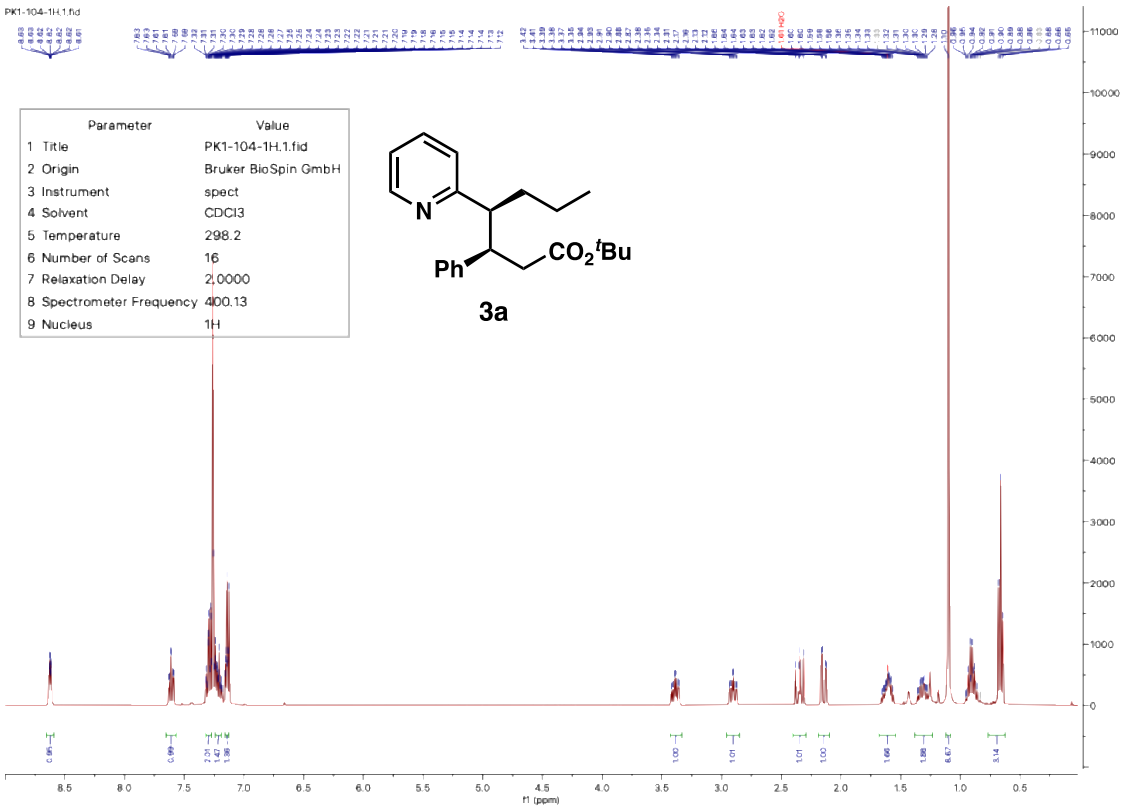

PK1-094C.12.fid
Parameter Value
1 Title PK1-094C.12.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
Ph
CO2tBu
2l
f1 (ppm)

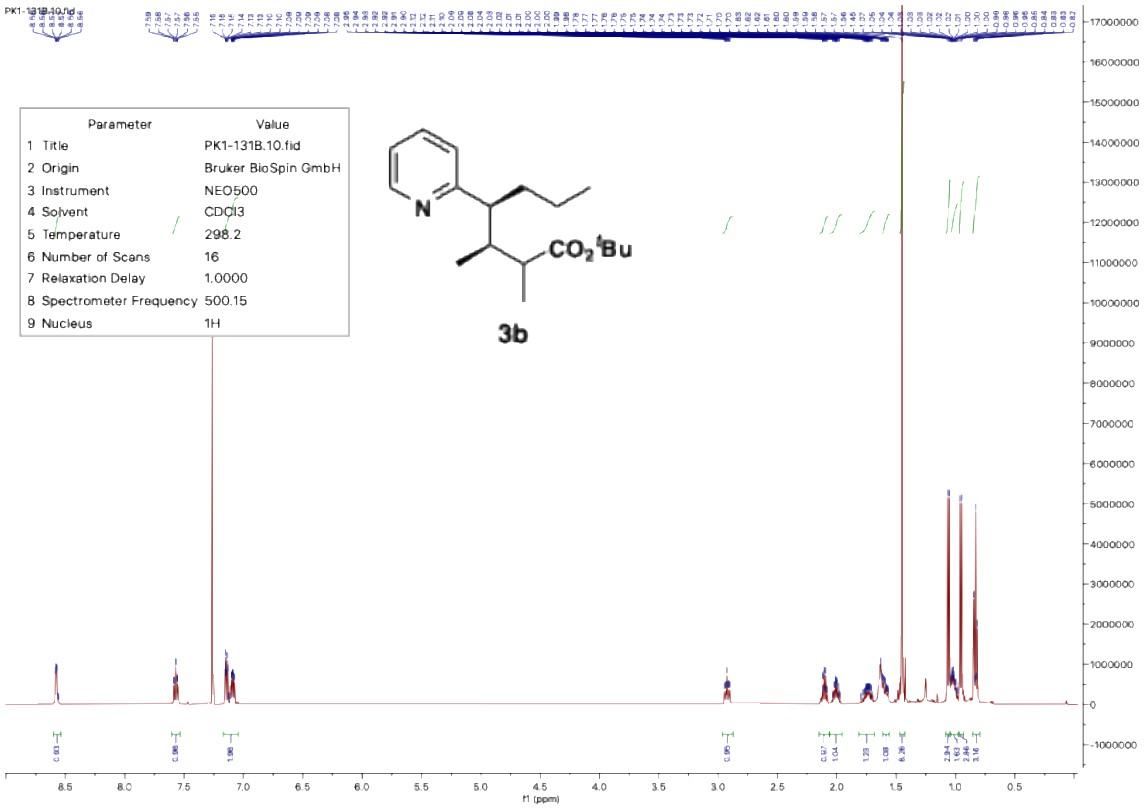

Parameter Value
1 Title PK1-061A.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
O
CO2tBu
2m
f1 (ppm)

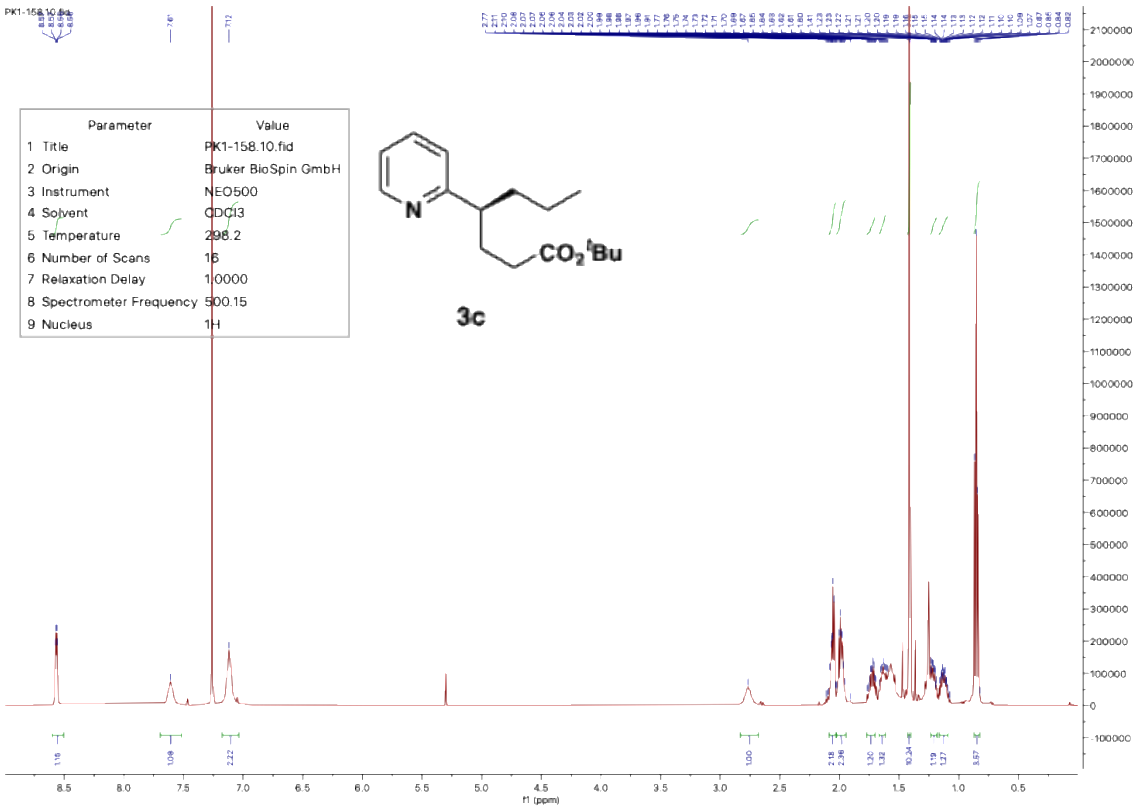

Parameter Value
1 Title PK1-061-13C.24.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
O
CO2tBu
2m
f1 (ppm)

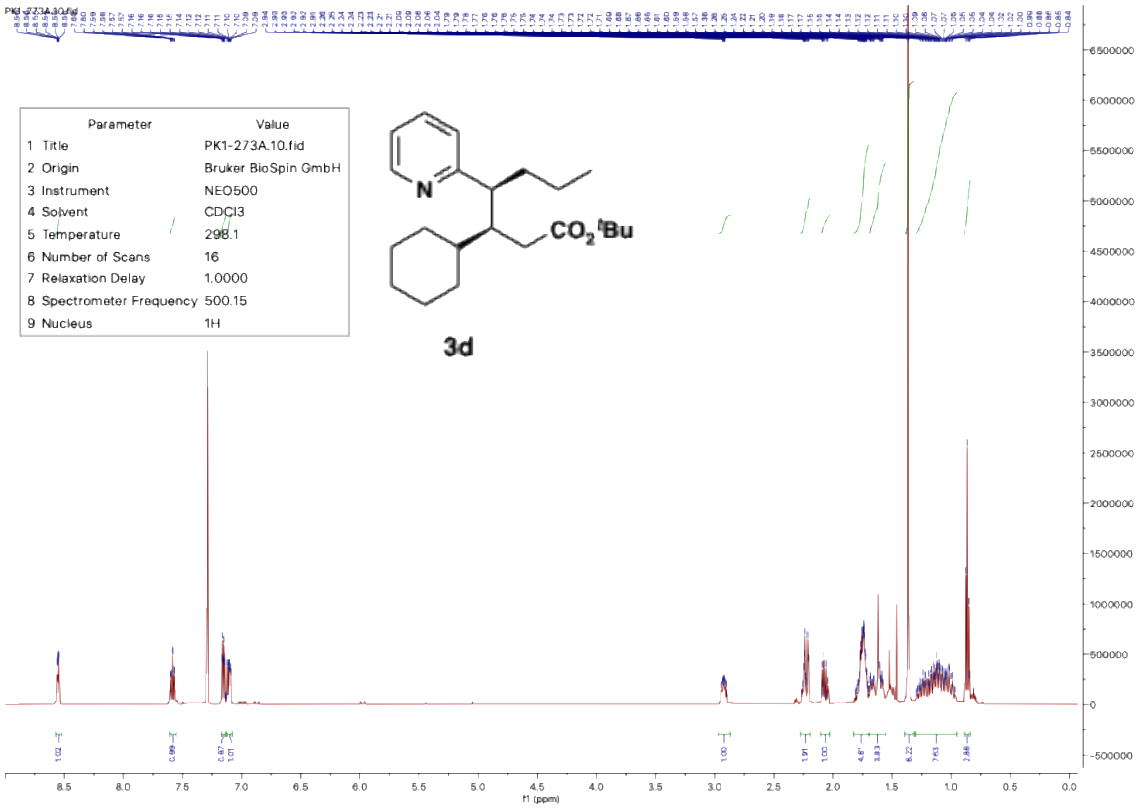

PK1-134-3.1.fid
Parameter Value
1 Title PK1-134-3.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
OTBS
CO2tBu
2n
f1 (ppm)

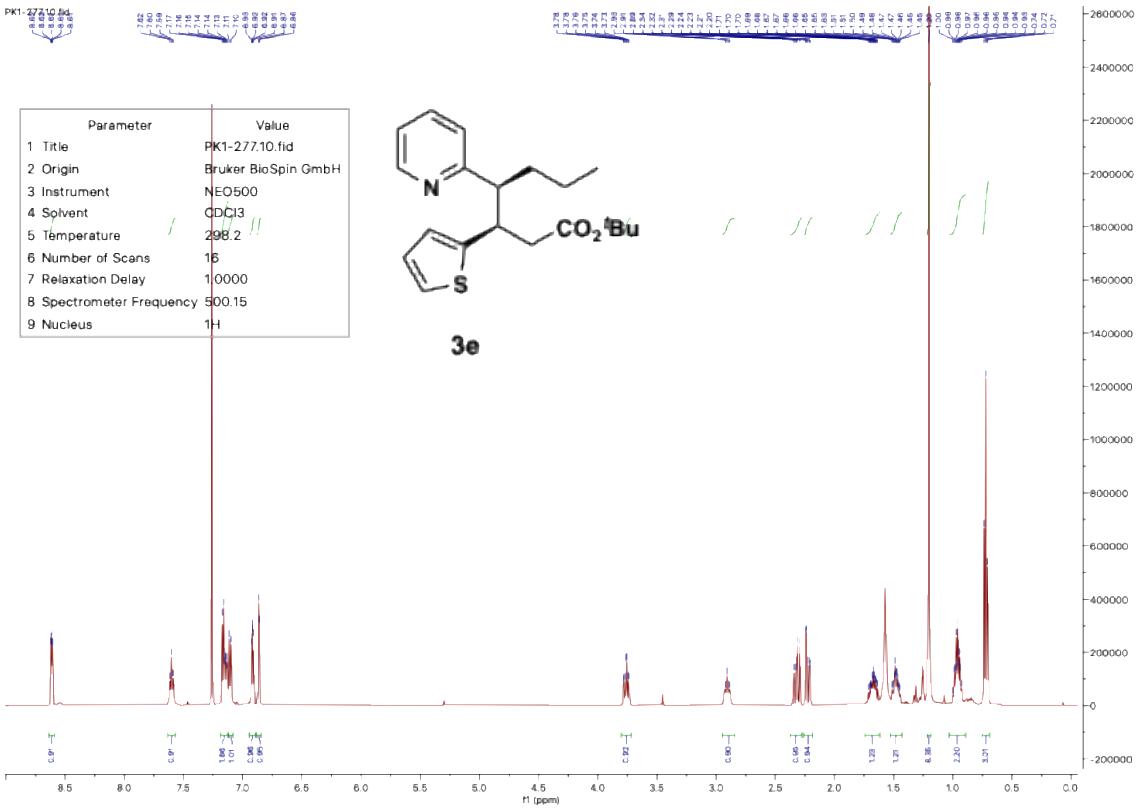

PK1-134C.10.fid
Parameter Value
1 Title PK1-134C.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
OTBS
CO2tBu
2n
f1 (ppm)

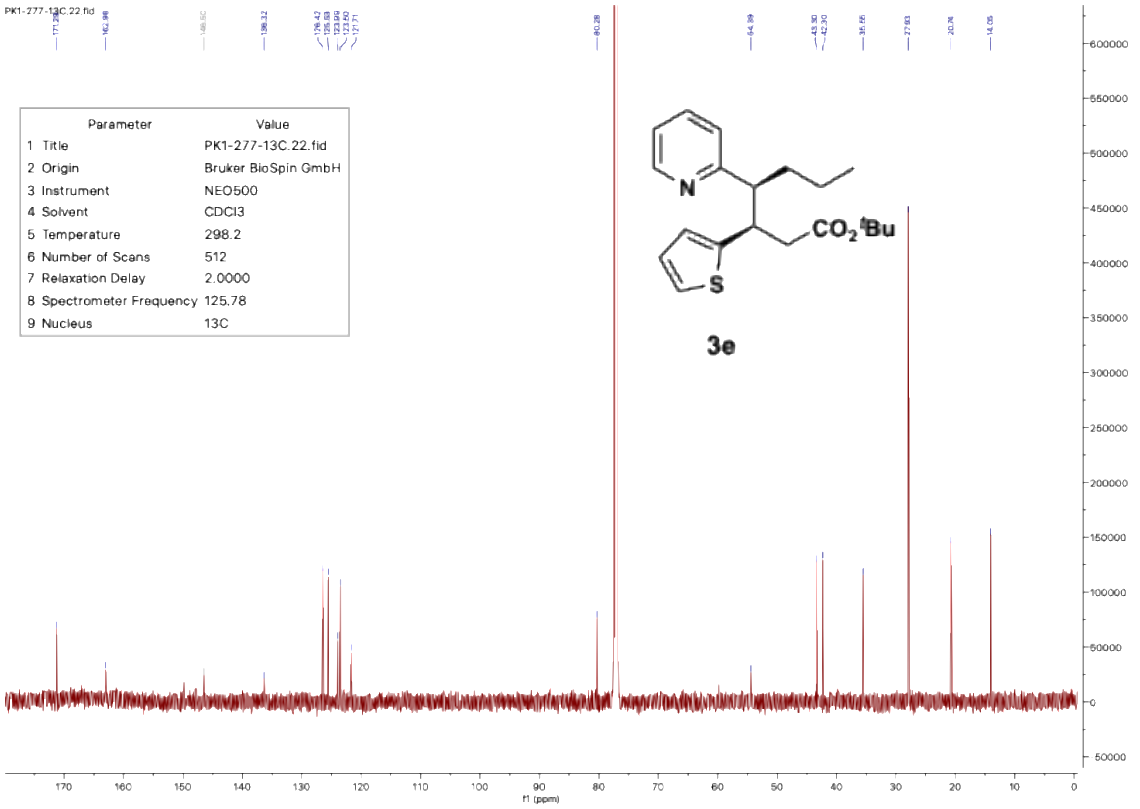

PK1-104-1H.1.fid
Parameter Value
1 Title PK1-104-1H.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
Ph
CO2tBu
3a
f1 (ppm)

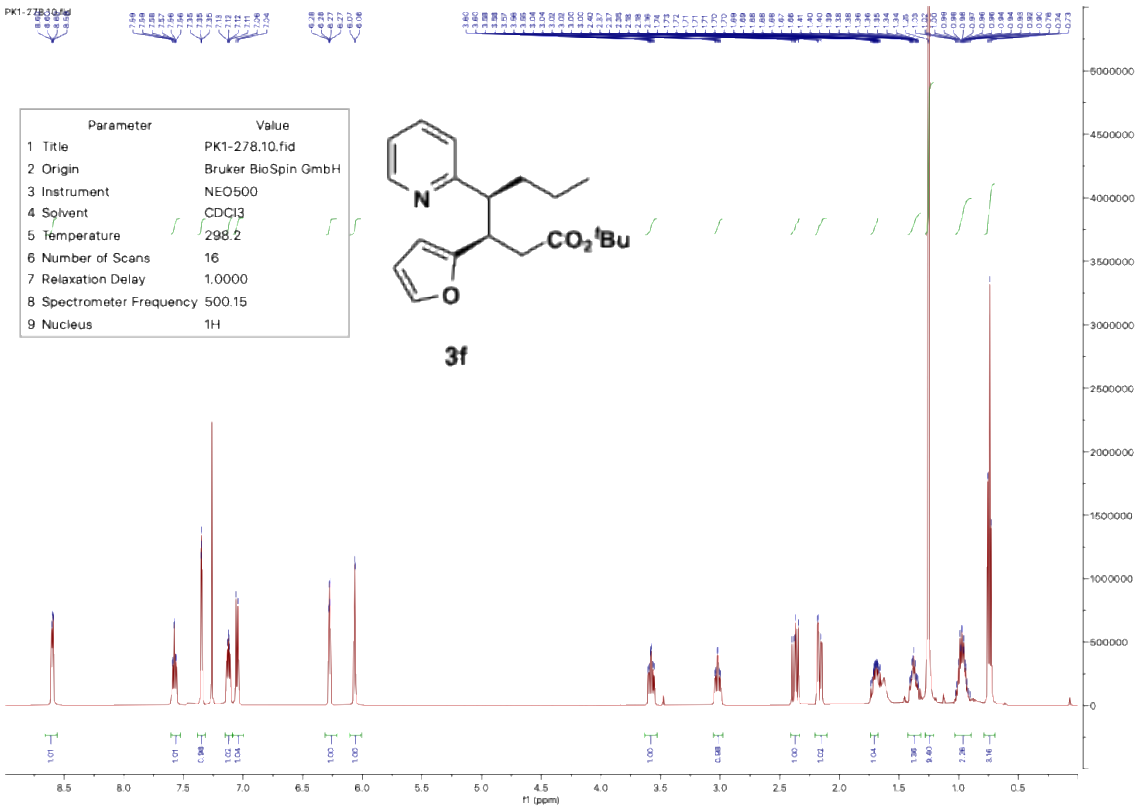

PK1-131B.10.fid
Parameter Value
1 Title PK1-131B.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
3b
f1 (ppm)

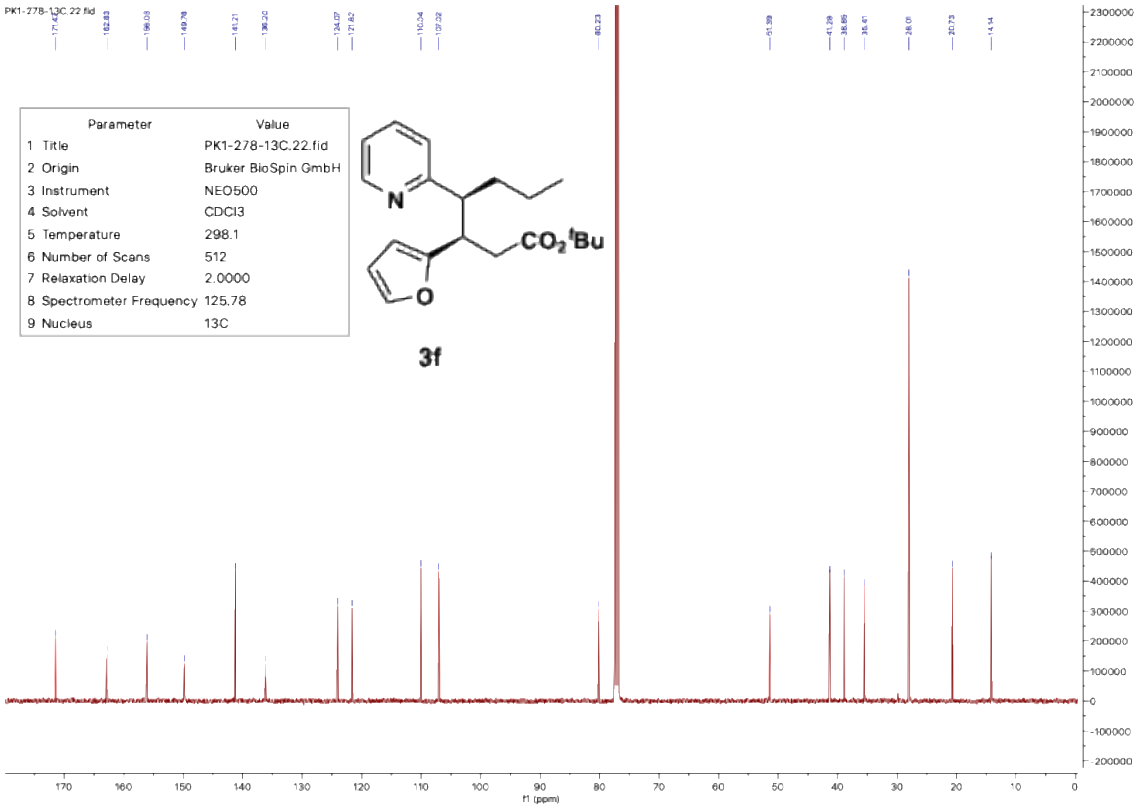

Parameter Value
1 Title PK1-158.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
3c
f1 (ppm)

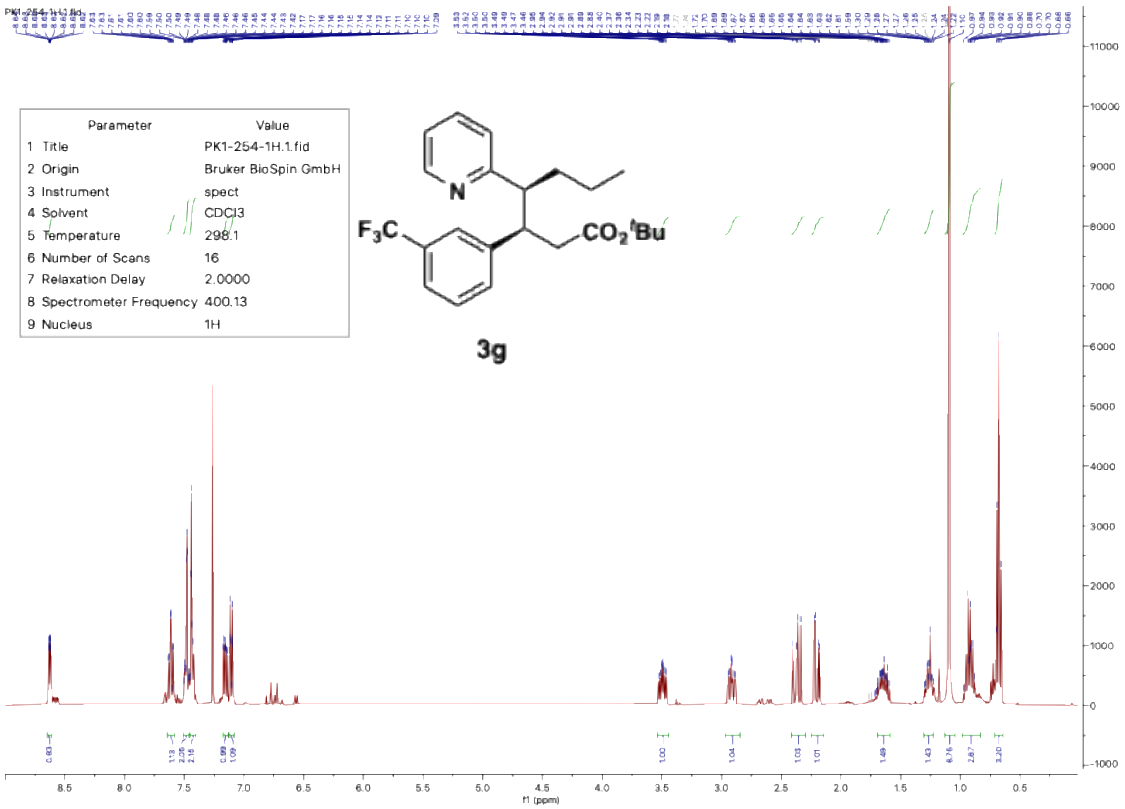

Parameter Value
1 Title PK1-273A.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
3d
f1 (ppm)

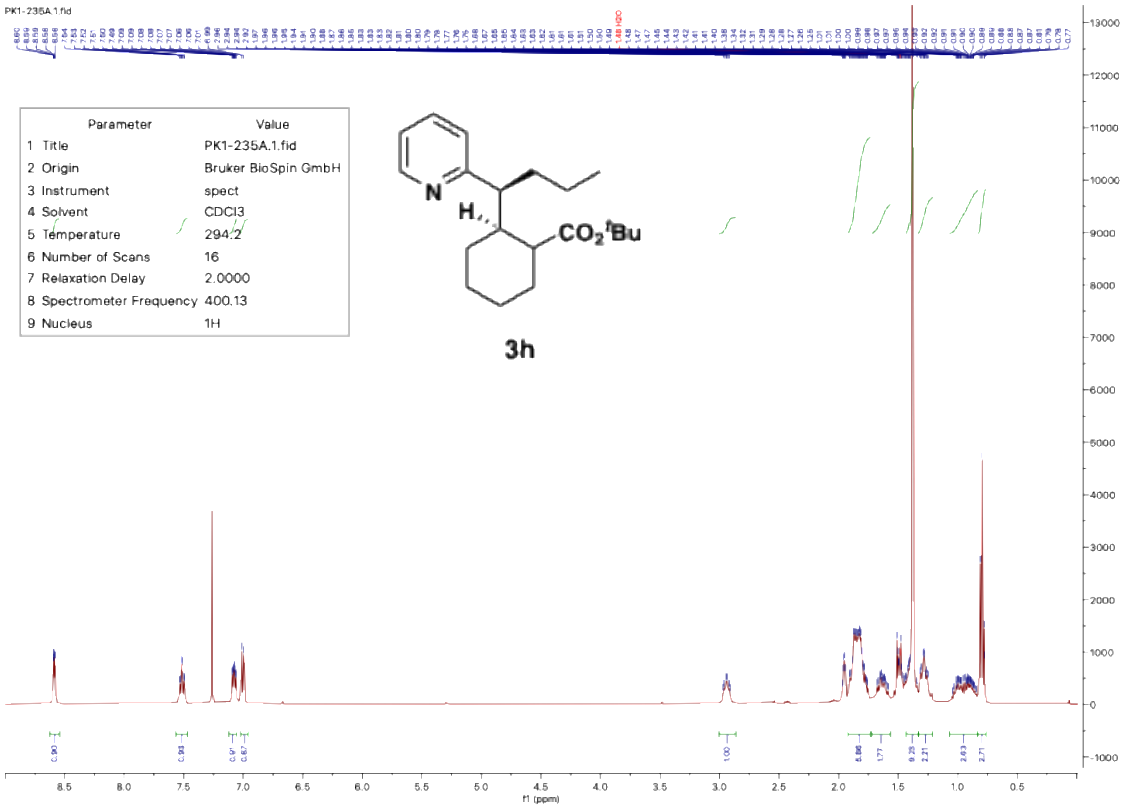

Parameter Value
1 Title PK1-277.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
S
3e
f1 (ppm)

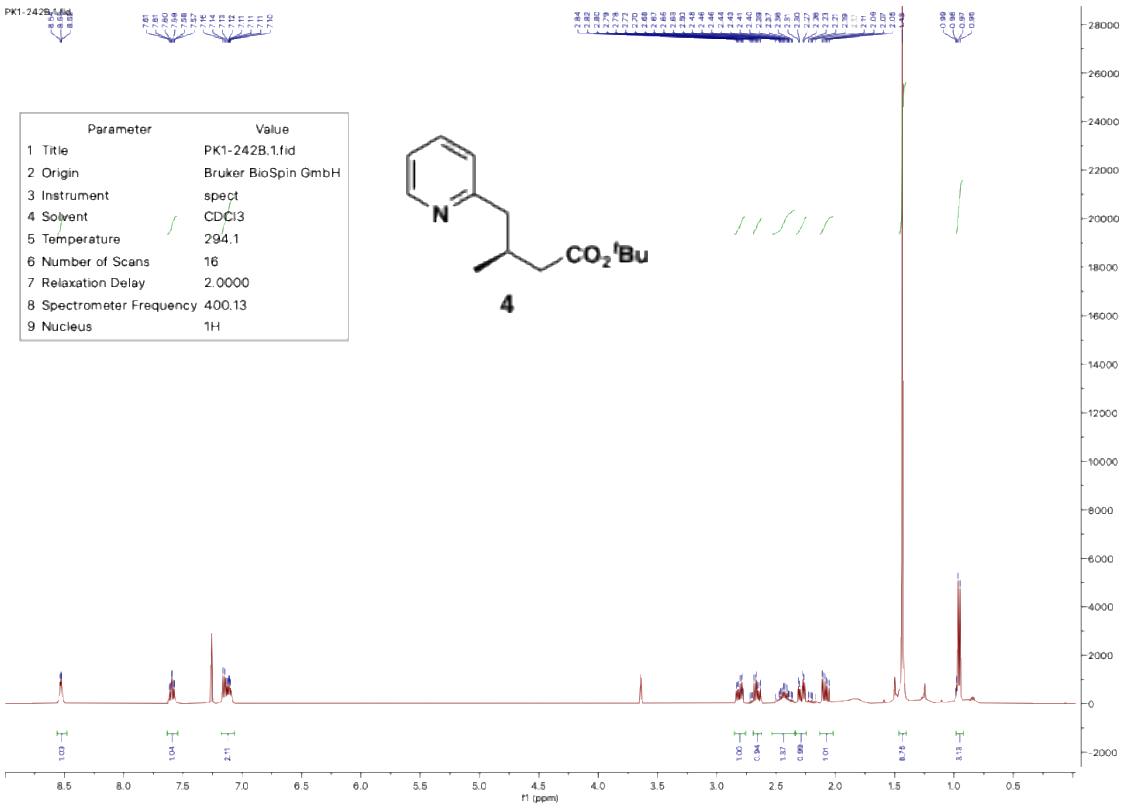

Parameter Value
1 Title PK1-277-13C.22.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
S
3e
f1 (ppm)

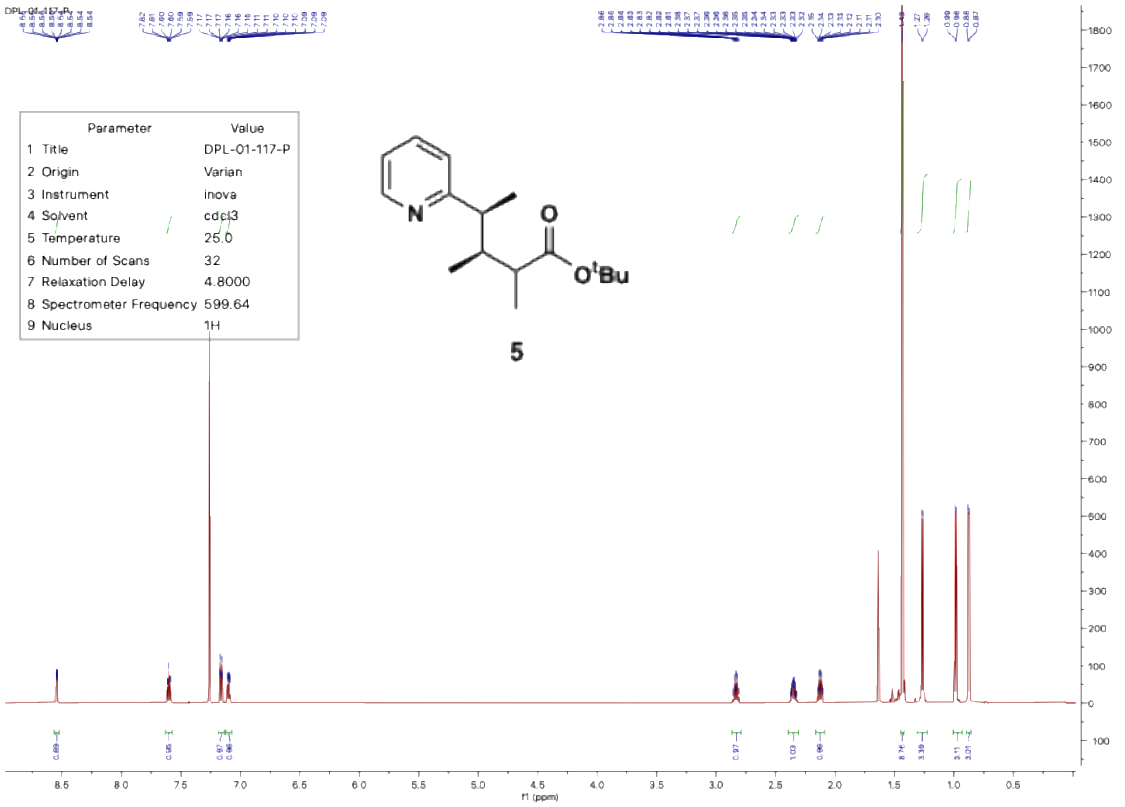

Parameter Value
1 Title PK1-278.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 16
7 Relaxation Delay 1.0000
8 Spectrometer Frequency 500.15
9 Nucleus 1H
N
CO2tBu
O
3f
f1 (ppm)


Parameter Value
1 Title PK1-278-13C.22.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
CO2tBu
O
3f
f1 (ppm)


Parameter Value
1 Title PK1-254-1H.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
F3C
CO2tBu
3g
f1 (ppm)


Parameter Value
1 Title PK1-235A.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 294.2
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
H
CO2tBu
3h
f1 (ppm)


Parameter Value
1 Title PK1-242B.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 294.1
6 Number of Scans 16
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 400.13
9 Nucleus 1H
N
CO2tBu
4
f1 (ppm)


Parameter Value
1 Title DPL-01-117-P
2 Origin Varian
3 Instrument inova
4 Solvent cdcl3
5 Temperature 25.0
6 Number of Scans 32
7 Relaxation Delay 4.8000
8 Spectrometer Frequency 599.64
9 Nucleus 1H
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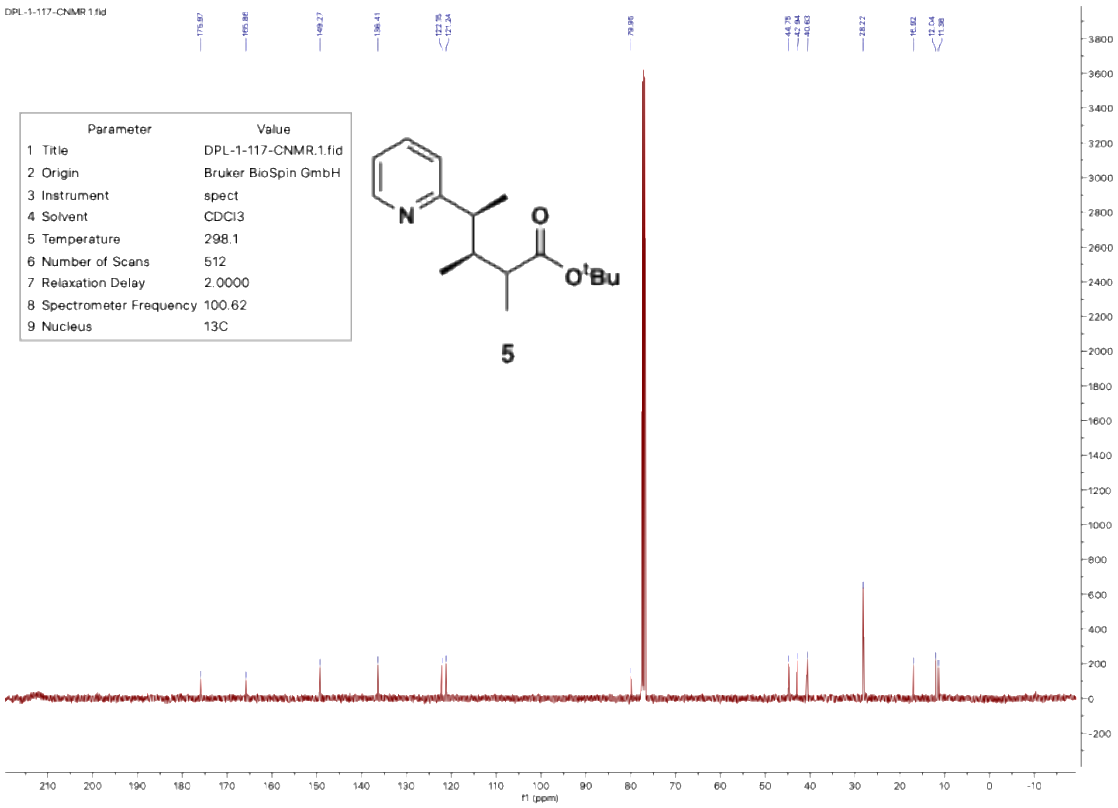
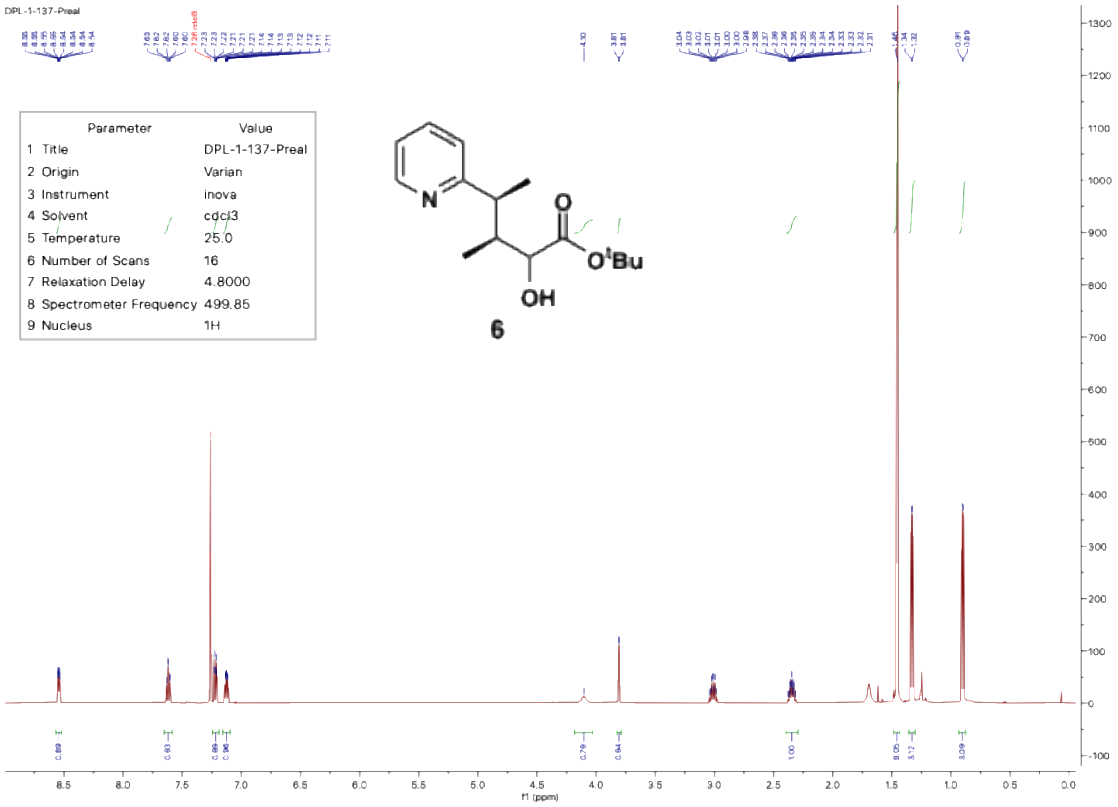
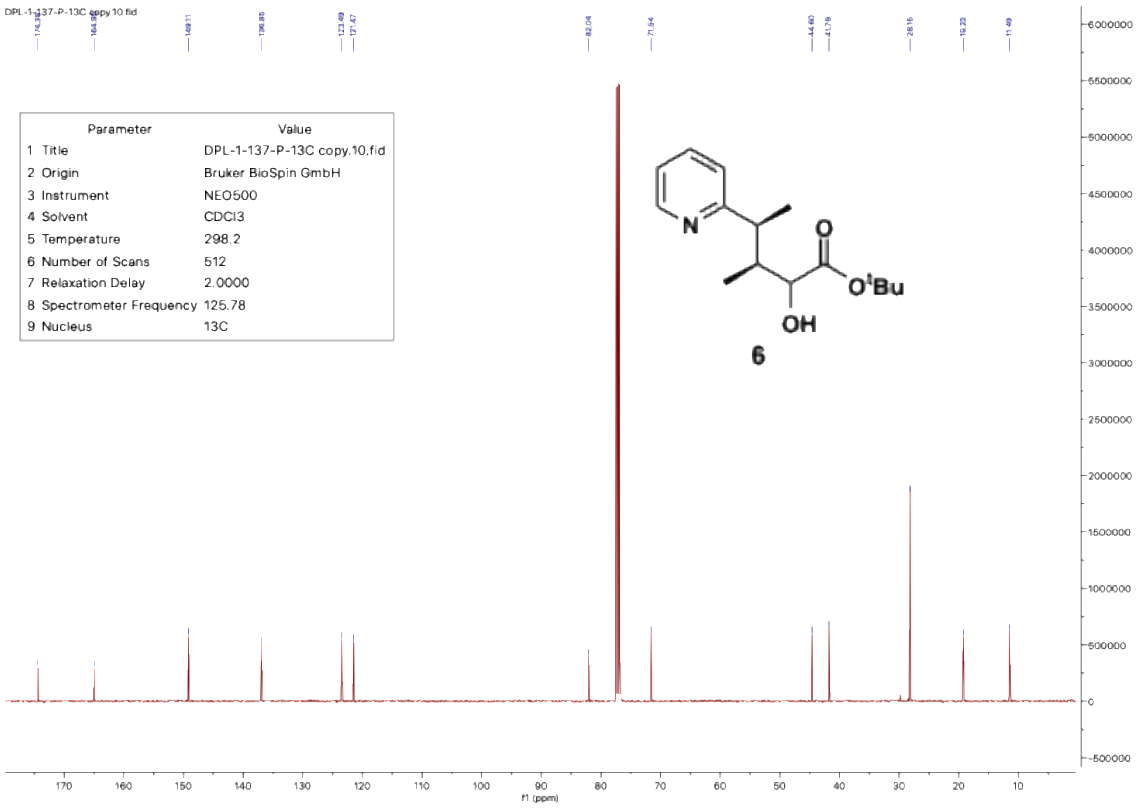
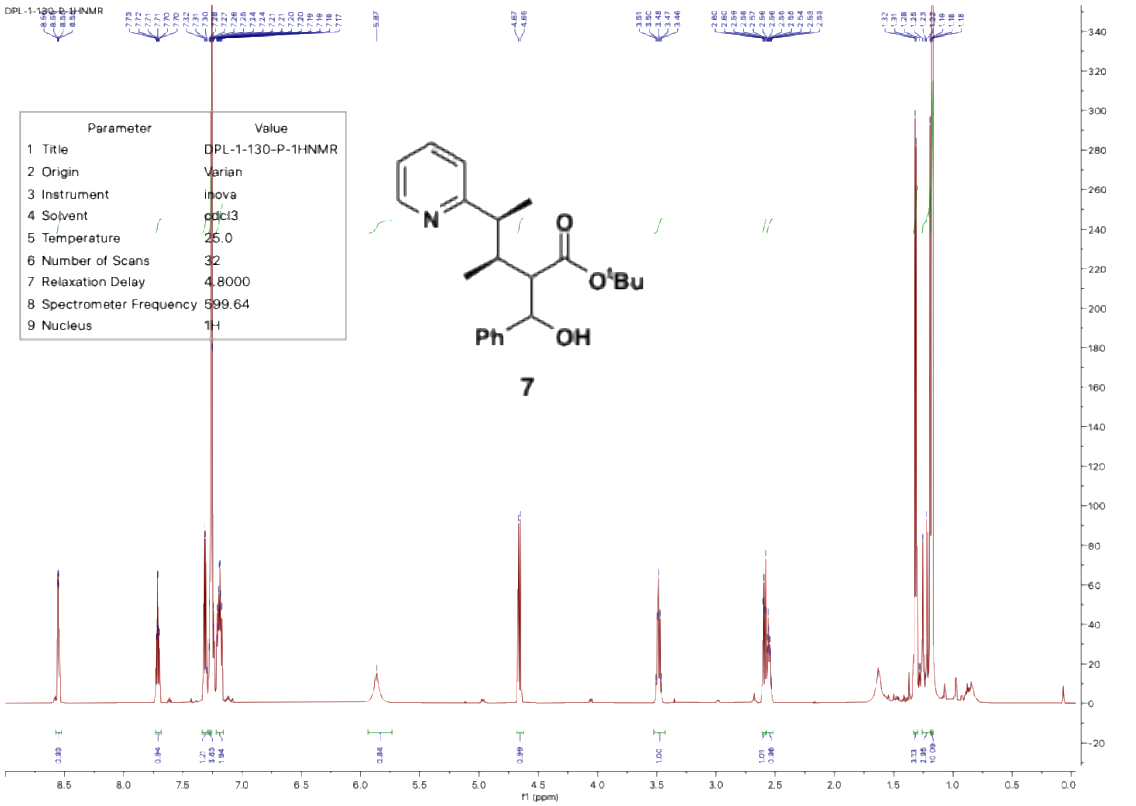
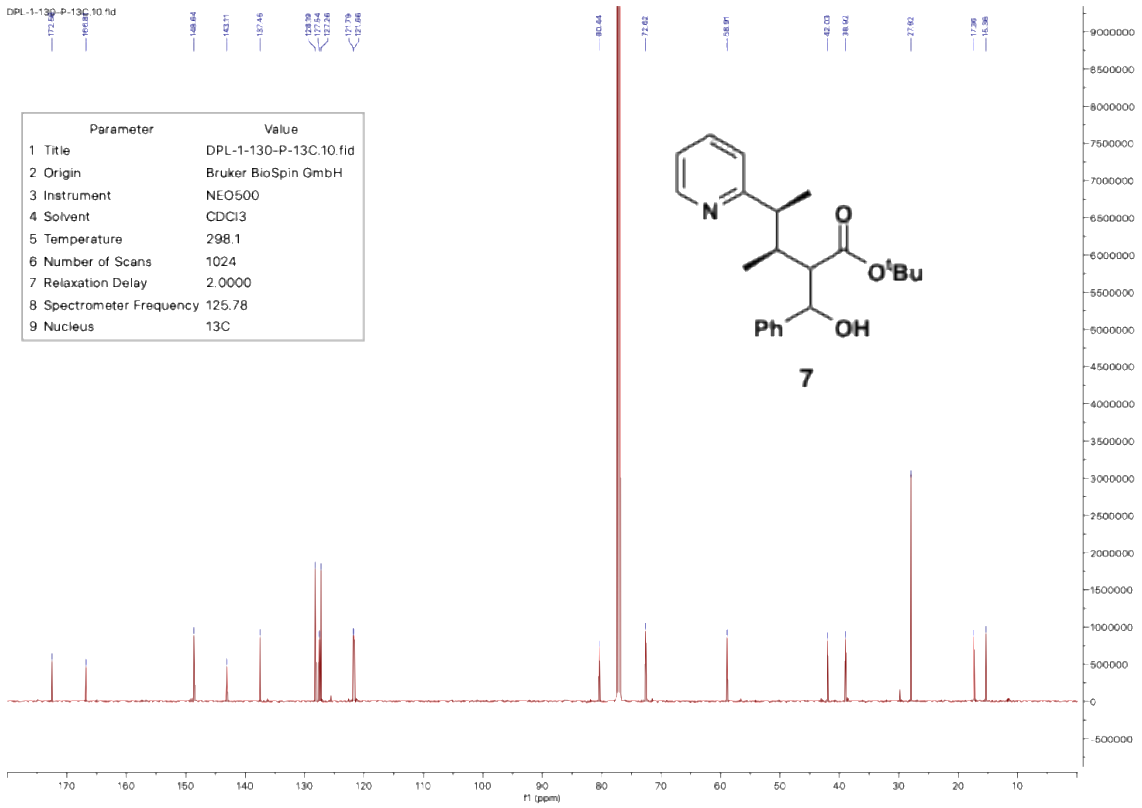
O
OtBu
5
f1 (ppm)


DPL-1-117-CNMR 1.fid
Parameter Value
1 Title DPL-1-117-CNMR.1.fid
2 Origin Bruker BioSpin GmbH
3 Instrument spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 100.62
9 Nucleus 13C
N
O
O^{t}Bu
5
f1 (ppm)


DPL-1-137-Preal
Parameter Value
1 Title DPL-1-137-Preal
2 Origin Varian
3 Instrument inova
4 Solvent cdcl3
5 Temperature 25.0
6 Number of Scans 16
7 Relaxation Delay 4.8000
8 Spectrometer Frequency 499.85
9 Nucleus 1H
N
O
O^{t}Bu
OH
6
f1 (ppm)


DPL-1-137-P-13C copy.10.fid
Parameter Value
1 Title DPL-1-137-P-13C copy.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.2
6 Number of Scans 512
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
O
O^{t}Bu
OH
6
f1 (ppm)


DPL-1-130-P-1HNMR
Parameter Value
1 Title DPL-1-130-P-1HNMR
2 Origin Varian
3 Instrument inova
4 Solvent cdcl3
5 Temperature 25.0
6 Number of Scans 32
7 Relaxation Delay 4.8000
8 Spectrometer Frequency 599.64
9 Nucleus 1H
N
O
O^{t}Bu
Ph
OH
7
f1 (ppm)


DPL-1-130-P-13C.10.fid
Parameter Value
1 Title DPL-1-130-P-13C.10.fid
2 Origin Bruker BioSpin GmbH
3 Instrument NEO500
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 1024
7 Relaxation Delay 2.0000
8 Spectrometer Frequency 125.78
9 Nucleus 13C
N
O
O^{t}Bu
Ph
OH
7
f1 (ppm)

HPLC Spectra

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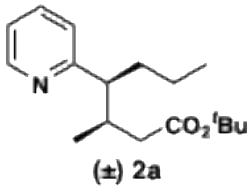
Analysis Report



(±) 2a

<Sample Information>

Sample Name	: PK1-046C		
Sample ID	: PK1-046C		
Data Filename	: Data171.lcd		
Method Filename	: a.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 6/15/2022 12:19:37 PM	Acquired by	: Joshua Gladfelder
Date Processed	: 6/15/2022 12:36:55 PM	Processed by	: Joshua Gladfelder

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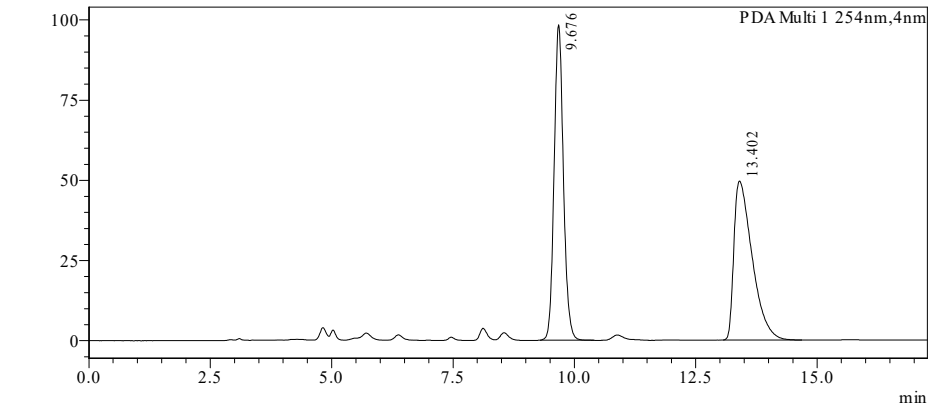

<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	9.676	1307160	98298	50.186			
2	13.402	1297467	49512	49.814			
Total		2604627	147810				

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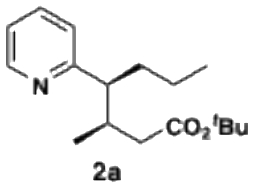
Analysis Report

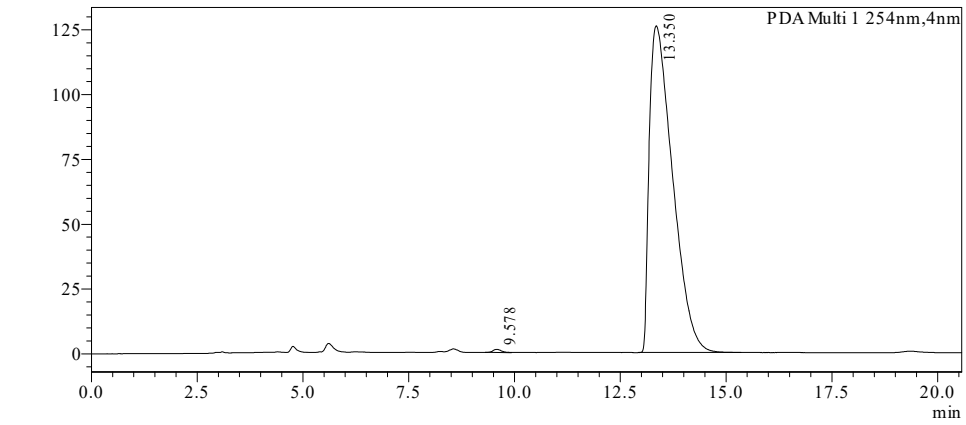


2a

<Sample Information>

Sample Name	: PK1-053C		
Sample ID	: PK1-053C		
Data Filename	: LL-1-179.lcd		
Method Filename	: a.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 8/15/2022 3:11:18 PM	Acquired by	: Joshua Gladfelder
Date Processed	: 8/15/2022 3:31:55 PM	Processed by	: Joshua Gladfelder

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	9.578	15877	1212	0.328			
2	13.350	4826762	126002	99.672			
Total		4842640	127214				

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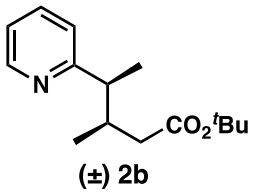
Analysis Report

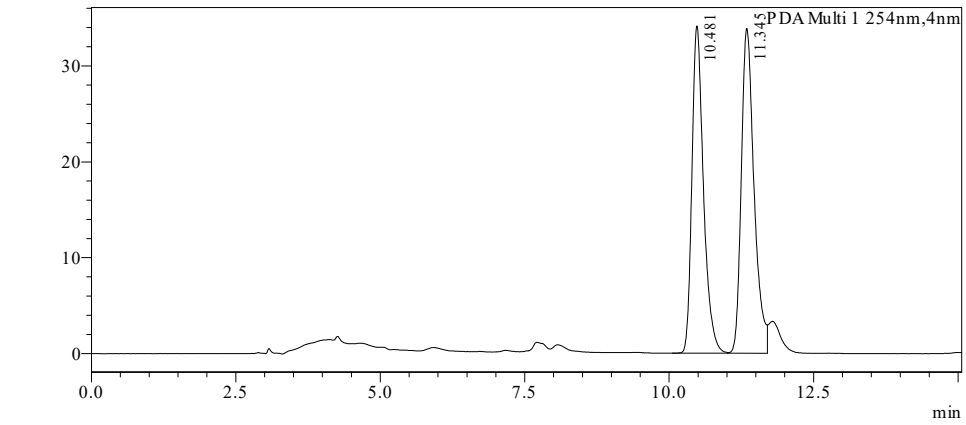


(±) 2b

<Sample Information>

Sample Name	: DPL-1-112 0.5% AD-H		
Sample ID	:		
Data Filename	: DPL-1-112 0.5% AD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 7/6/2023 10:58:59 AM	Acquired by	: Dyllan Ly
Date Processed	: 7/6/2023 11:14:04 AM	Processed by	: Dyllan Ly

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	10.481	477625	34120	47.784			
2	11.345	521934	33858	52.216		V	
Total		999559	67979				

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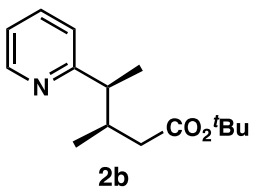
Analysis Report

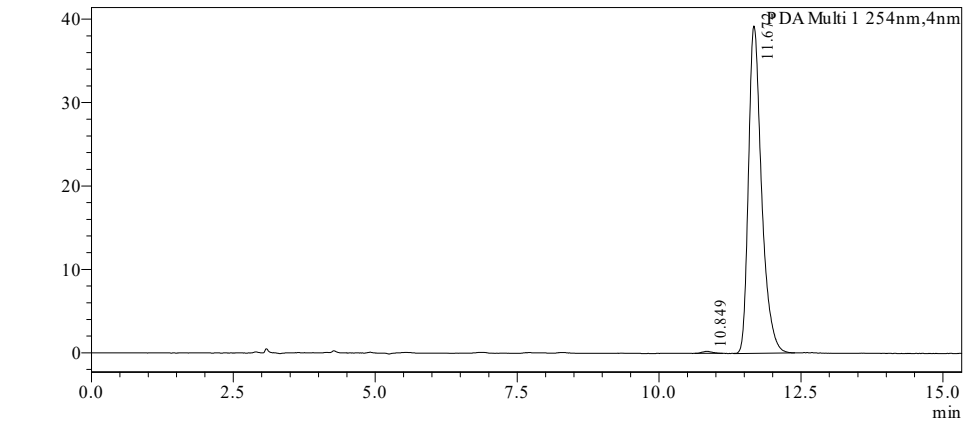


2b

<Sample Information>

Sample Name	: DPL-1-116 0.5% AD-H		
Sample ID	:		
Data Filename	: DPL-1-116 0.5% AD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 7/6/2023 11:18:46 AM	Acquired by	: Dyllan Ly
Date Processed	: 7/6/2023 11:34:07 AM	Processed by	: Dyllan Ly

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	10.849	3040	247	0.481			
2	11.672	628326	39250	99.519			
Total		631366	39498				

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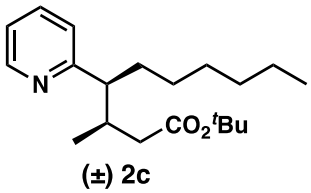
Analysis Report

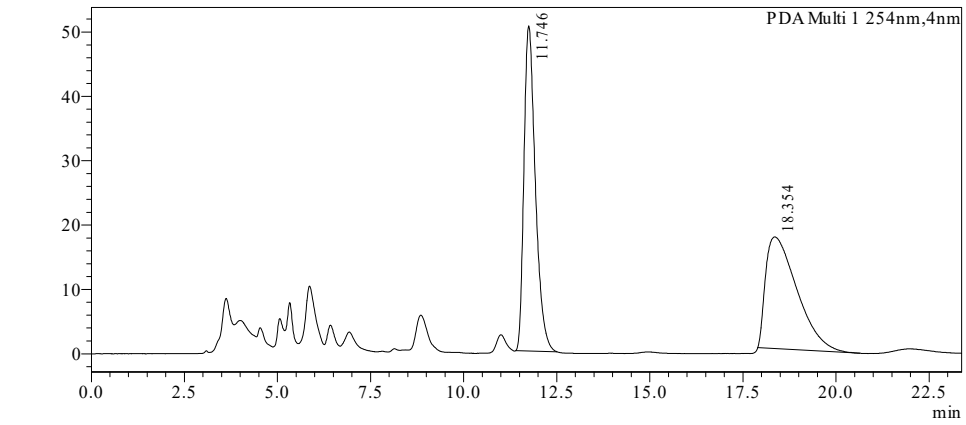


(±) 2c

<Sample Information>

Sample Name	: PK1-127 AD-H 0.5%		
Sample ID	: PK1-127 AD-H 0.5%		
Data Filename	: DPL-1-036 0.5% AD-H002.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 12/29/2022 8:10:19 PM	Acquired by	: Priya Kandiyal
Date Processed	: 12/29/2022 8:33:44 PM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.746	1077868	50494	51.390			
2	18.354	1019572	17350	48.610			
Total		2097441	67844				

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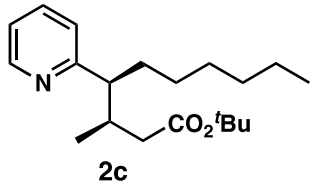
Analysis Report

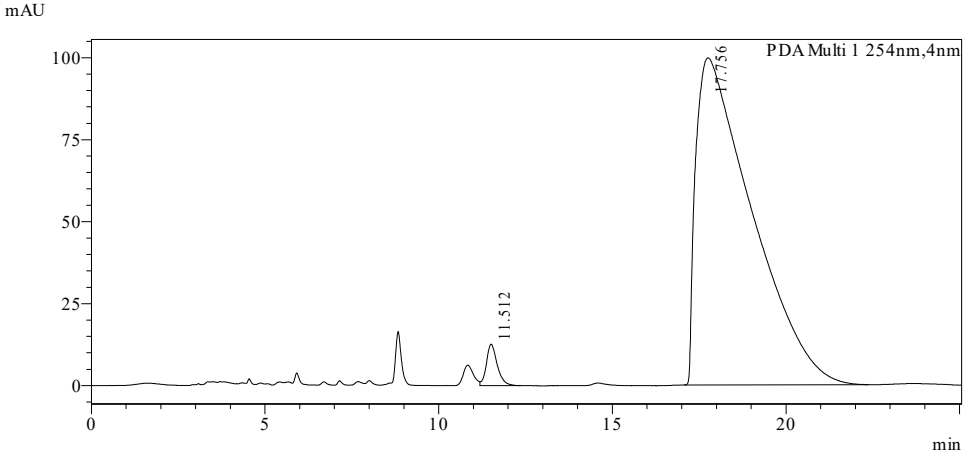


2c

<Sample Information>

Sample Name	: PK1-133 AD-H 0.5%		
Sample ID	: PK1-133 AD-H 0.5%		
Data Filename	: LNS-1-62.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/30/2023 12:37:25 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/30/2023 1:02:32 PM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.512	274960	12668	2.387			
2	17.756	11244230	99773	97.613			
Total		11519190	112440				

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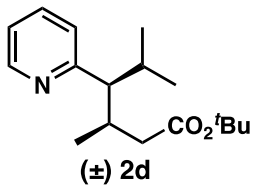
Analysis Report

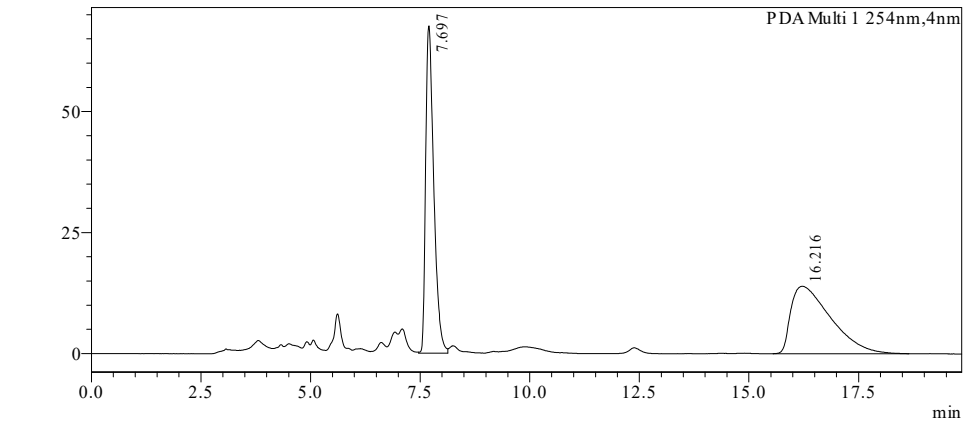


(±) 2d

<Sample Information>

Sample Name	: PK1-072 AD-H 0.5%		
Sample ID	: PK1-072 AD-H 0.5%		
Data Filename	: LNS-1-157.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/16/2024 11:26:42 AM	Acquired by	: Priya Kandiyal
Date Processed	: 1/16/2024 11:46:36 AM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.697	870886	67571	49.607			
2	16.216	884682	13939	50.393			
Total		1755568	81511				

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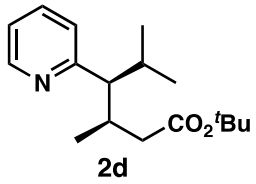
Analysis Report

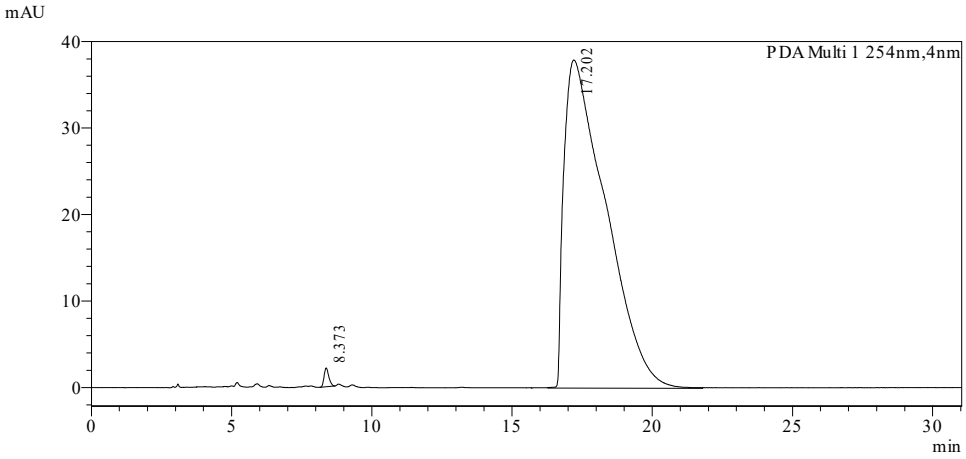


2d

<Sample Information>

Sample Name	: DPL-1-035 0.5% AD-H		
Sample ID	: DPL-1-035 0.5% AD-H		
Data Filename	: DPL-1-035 0.5% AD-H001.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 12/23/2022 9:23:09 PM	Acquired by	: Priya Kandiyal
Date Processed	: 12/23/2022 9:54:15 PM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	8.373	25438	2183	0.642			
2	17.202	3939355	37926	99.358			
Total		3964793	40109				

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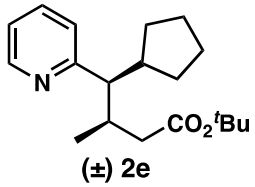
Analysis Report

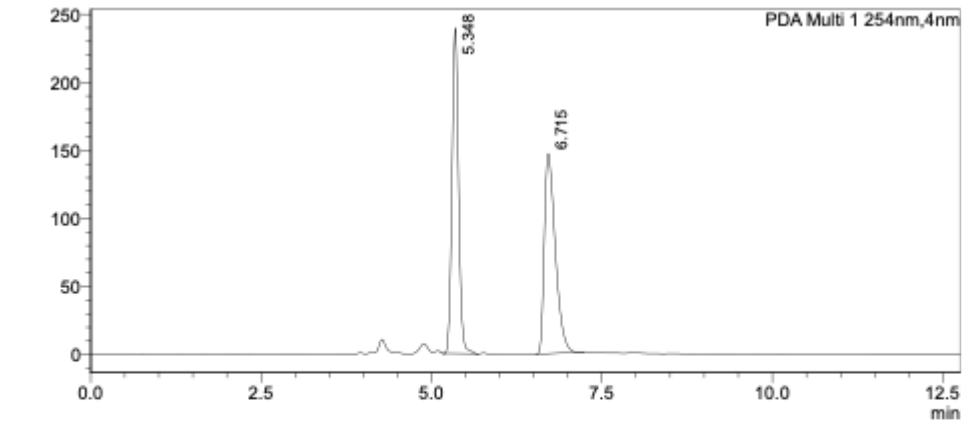


(±) 2e

<Sample Information>

Sample Name	: PK1-069 1% AD-H T		
Sample ID	: PK1-069 1% AD-H T		
Data Filename	: ab_2_266.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 10/24/2022 5:52:39 PM	Acquired by	: Priya Kandiyal
Date Processed	: 10/24/2022 6:05:26 PM	Processed by	: Priya Kandiyal

<Chromatogram>



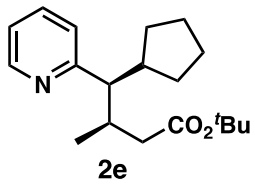
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.348	1612913	239234	49.704			
2	6.715	1632124	146949	50.296			
Total		3245037	386183				

SHIMADZU LabSolutions

Analysis Report

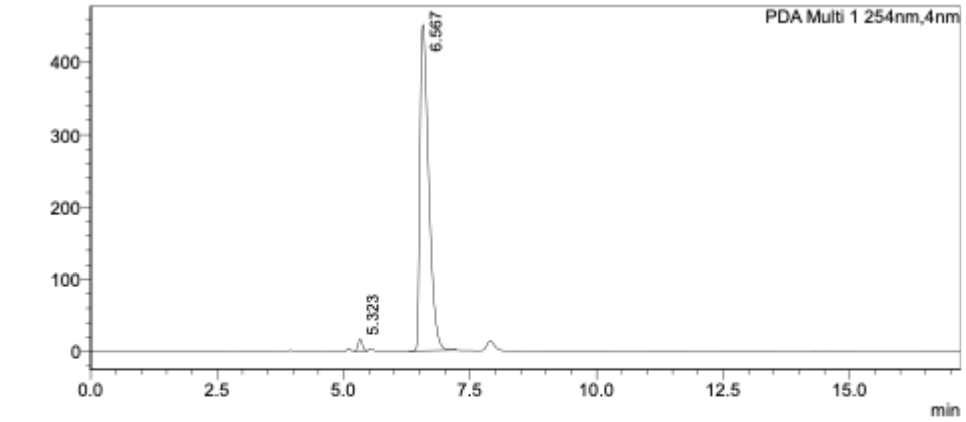


2e

<Sample Information>

Sample Name	: PK1-068 1% AD-H T		
Sample ID	: PK1-068 1% AD-H T		
Data Filename	: ab_2_265.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 10/24/2022 5:34:34 PM	Acquired by	: Priya Kandiyal
Date Processed	: 10/24/2022 5:51:47 PM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

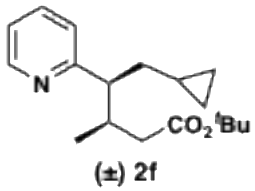
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.323	96698	16643	1.763			
2	6.567	5388851	451085	98.237			
Total		5485549	467728				

C:\LabSolutions\Data\Project1\ab_2_265.lcd

SHIMADZU LabSolutions

Analysis Report

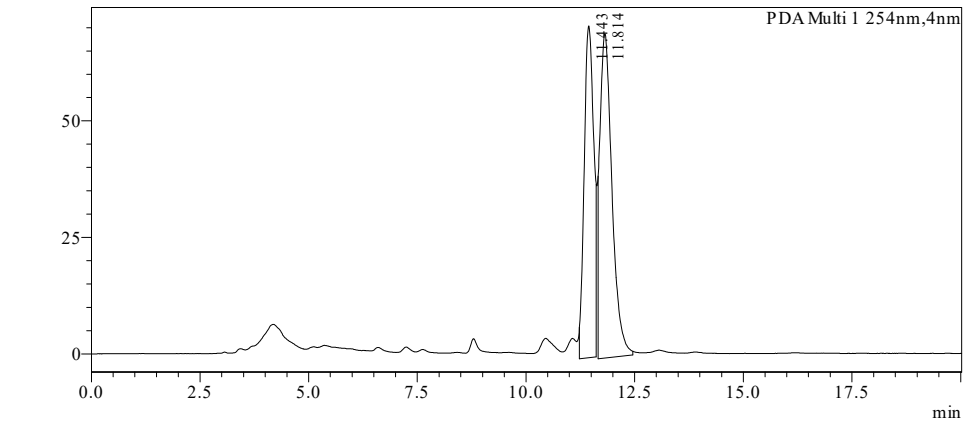


(±) 2f

<Sample Information>

Sample Name	: PK1-073B AD-H 0.5%IPA/hex TEA		
Sample ID	: PK1-073B AD-H 0.5%IPA/hex TEA		
Data Filename	: Data184.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/22/2022 3:39:39 PM	Acquired by	: Priya Kandiyal
Date Processed	: 9/22/2022 3:59:44 PM	Processed by	: Priya Kandiyal

<Chromatogram>



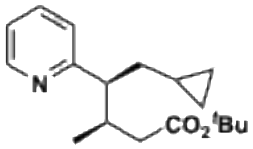
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.443	1089944	71216	44.991			
2	11.814	1332615	69499	55.009			
Total		2422559	140715				

SHIMADZU LabSolutions

Analysis Report



2f

<Sample Information>

Sample Name	: PK1-076B AD-H 0.5%		
Sample ID	: PK1-076B AD-H 0.5%		
Data Filename	: LNS-1-79.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 2/21/2023 2:39:42 PM	Acquired by	: Priya Kandiyal
Date Processed	: 2/21/2023 2:55:53 PM	Processed by	: Priya Kandiyal

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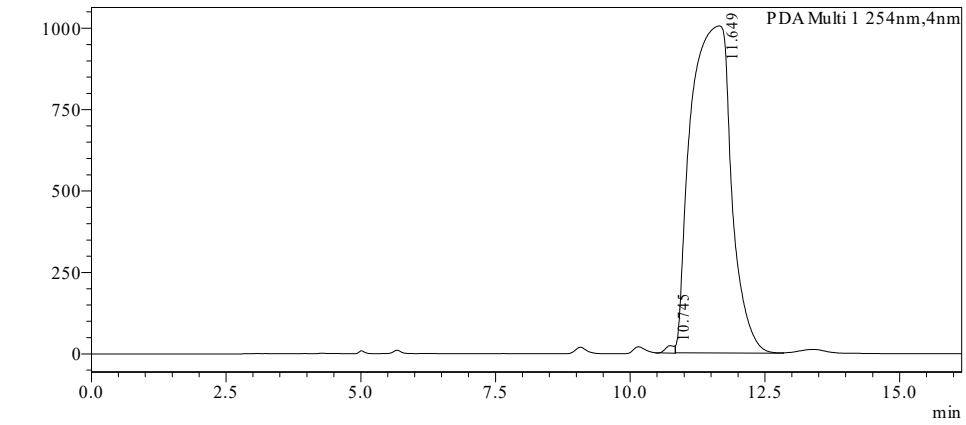


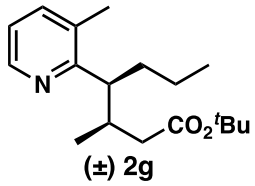
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	10.745	266886	22977	0.506			
2	11.649	52526607	1004311	99.494			
Total		52793493	1027288				

SHIMADZU LabSolutions

Analysis Report

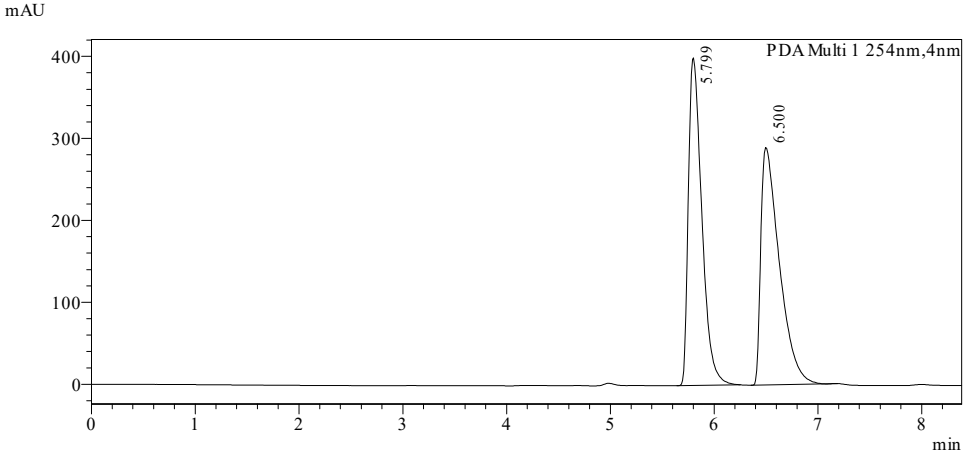


(±) 2g

<Sample Information>

Sample Name	: PK1-148 AD-H 0.5%		
Sample ID	: PK1-148 AD-H 0.5%		
Data Filename	: LNS-1-69.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 2/8/2023 1:05:43 PM	Acquired by	: Priya Kandiyal
Date Processed	: 2/8/2023 1:14:09 PM	Processed by	: Priya Kandiyal

<Chromatogram>



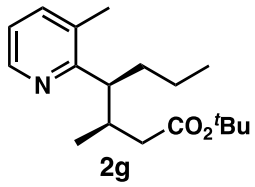
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.799	3615318	399813	50.110			
2	6.500	3599504	289769	49.890			
Total		7214822	689582				

SHIMADZU LabSolutions

Analysis Report

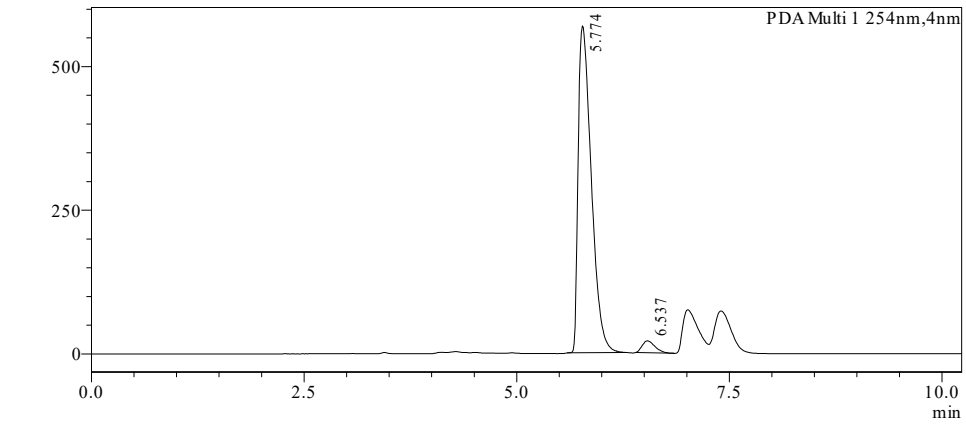


2g

<Sample Information>

Sample Name	: PK1-143 AD-H 0.5%		
Sample ID	: PK1-143 AD-H 0.5%		
Data Filename	: LNS-1-59.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/30/2023 11:45:51 AM	Acquired by	: Priya Kandiyal
Date Processed	: 1/30/2023 12:04:58 PM	Processed by	: Priya Kandiyal

<Chromatogram>



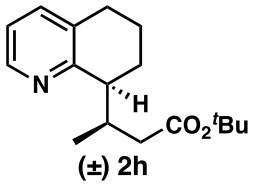
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.774	6107558	568963	96.532			
2	6.537	219447	20852	3.468			
Total		6327005	589815				

SHIMADZU LabSolutions

Analysis Report

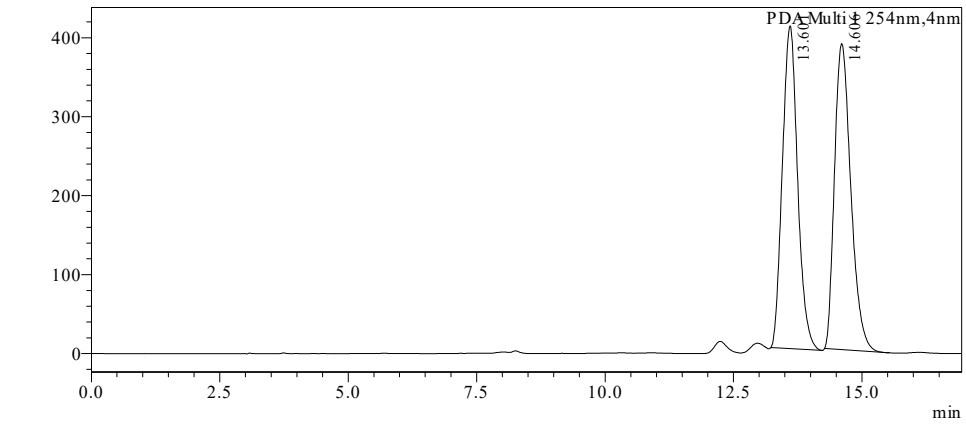


(±) 2h

<Sample Information>

Sample Name	: PK1-102 0.5% AD-H		
Sample ID	: PK1-102 0.5% AD-H		
Data Filename	: ab_2_275.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 11/3/2022 4:26:56 PM	Acquired by	: Priya Kandiyal
Date Processed	: 11/3/2022 4:43:55 PM	Processed by	: Priya Kandiyal

<Chromatogram>



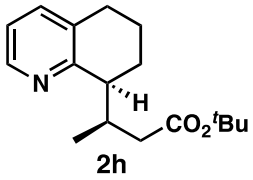
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	13.601	8424684	408695	49.574			
2	14.606	8569335	387545	50.426			
Total		16994018	796241				

SHIMADZU LabSolutions

Analysis Report

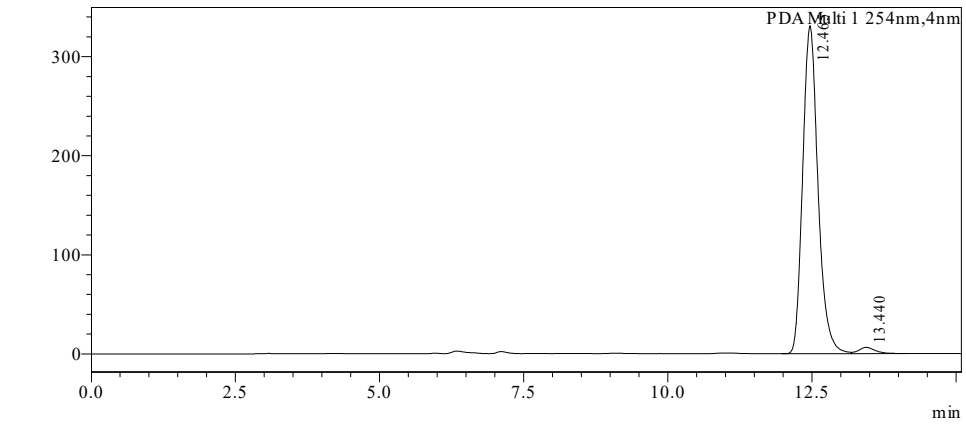


2h

<Sample Information>

Sample Name	: PK1-153 AD-H 0.5%		
Sample ID	: PK1-153 AD-H 0.5%		
Data Filename	: LNS-1-65.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 2/8/2023 11:12:09 AM	Acquired by	: Priya Kandiyal
Date Processed	: 2/8/2023 11:27:17 AM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

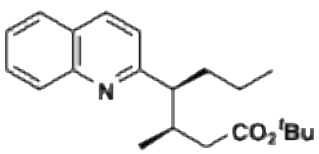
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	12.465	6107501	330813	97.993			
2	13.440	125068	6287	2.007		V	
Total		6232569	337100				

C:\LabSolutions\Data\Project1\LNS-1-65.lcd

SHIMADZU LabSolutions

Analysis Report

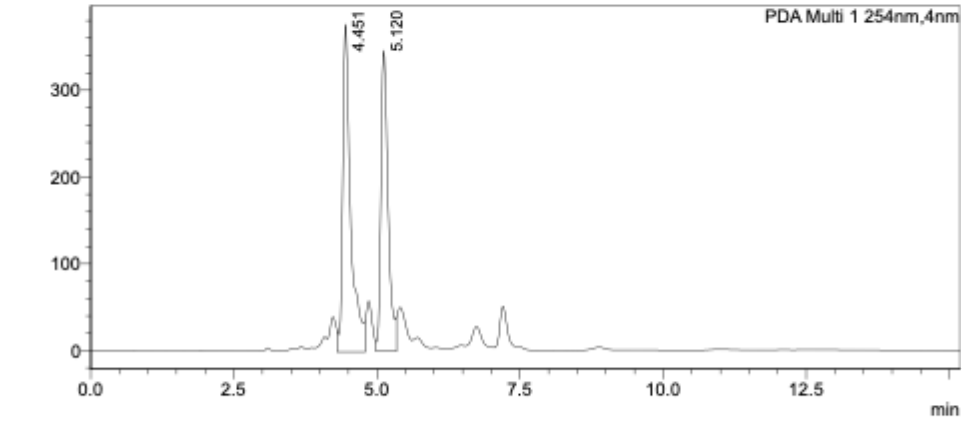


(±) 2i

<Sample Information>

Sample Name	: PK1-147 AD-H 0.5%		
Sample ID	: PK1-147 AD-H 0.5%		
Data Filename	: LNS-1-70.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 2/8/2023 1:15:00 PM	Acquired by	: Priya Kandiyal
Date Processed	: 2/8/2023 1:35:36 PM	Processed by	: Priya Kandiyal

<Chromatogram>



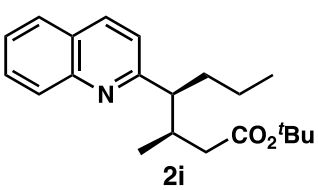
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	4.451	3646029	377236	54.513			
2	5.120	3042317	346102	45.487			
Total		6688346	723338				

SHIMADZU LabSolutions

Analysis Report



2i

<Sample Information>

Sample Name	: PK1-142 AD-H 0.5%		
Sample ID	: PK1-142 AD-H 0.5%		
Data Filename	: LNS-1-60.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/30/2023 11:57:07 AM	Acquired by	: Priya Kandiyal
Date Processed	: 1/30/2023 12:08:27 PM	Processed by	: Priya Kandiyal

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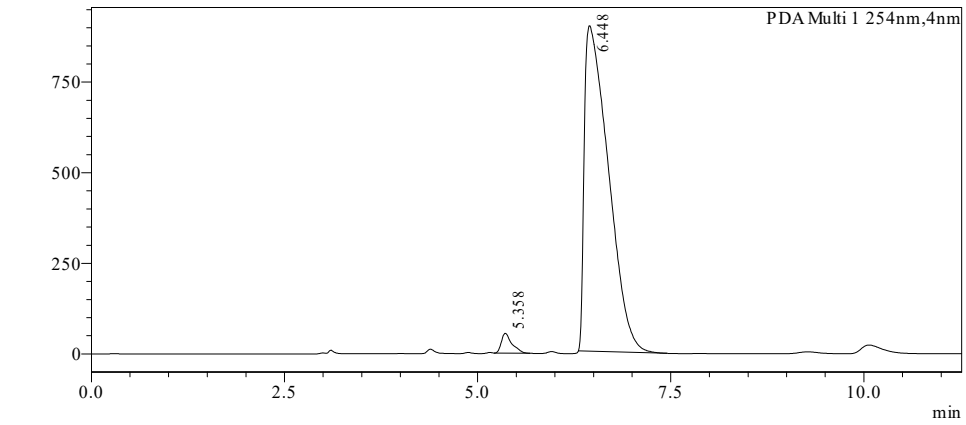


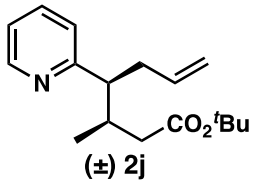
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.358	519072	54666	2.599			
2	6.448	19456397	897725	97.401			
Total		19975469	952391				

SHIMADZU LabSolutions

Analysis Report

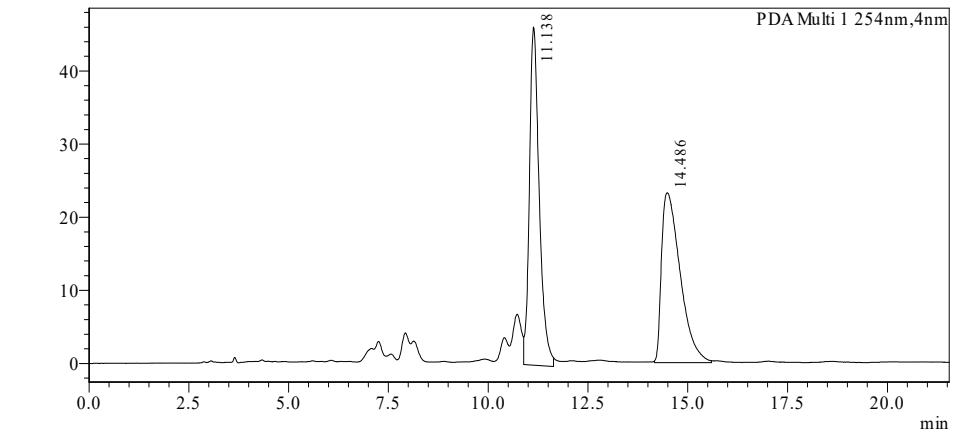


(±) 2j

<Sample Information>

Sample Name	: PK1-074B AD-H 0.5%IPA/hex TEA		
Sample ID	: PK1-074B AD-H 0.5%IPA/hex TEA		
Data Filename	: Data183.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/22/2022 3:17:03 PM	Acquired by	: Priya Kandiyal
Date Processed	: 9/22/2022 3:38:38 PM	Processed by	: Priya Kandiyal

<Chromatogram>



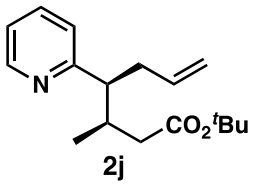
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.138	792930	46266	51.154			
2	14.486	757150	23262	48.846			
Total		1550079	69528				

SHIMADZU LabSolutions

Analysis Report



2j

<Sample Information>

Sample Name	: PK1-075B AD-H 0.5%IPA/hex TEA		
Sample ID	: PK1-075B AD-H 0.5%IPA/hex TEA		
Data Filename	: Data188.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/30/2022 9:33:17 AM	Acquired by	: Priya Kandiyal
Date Processed	: 9/30/2022 9:53:14 AM	Processed by	: Priya Kandiyal

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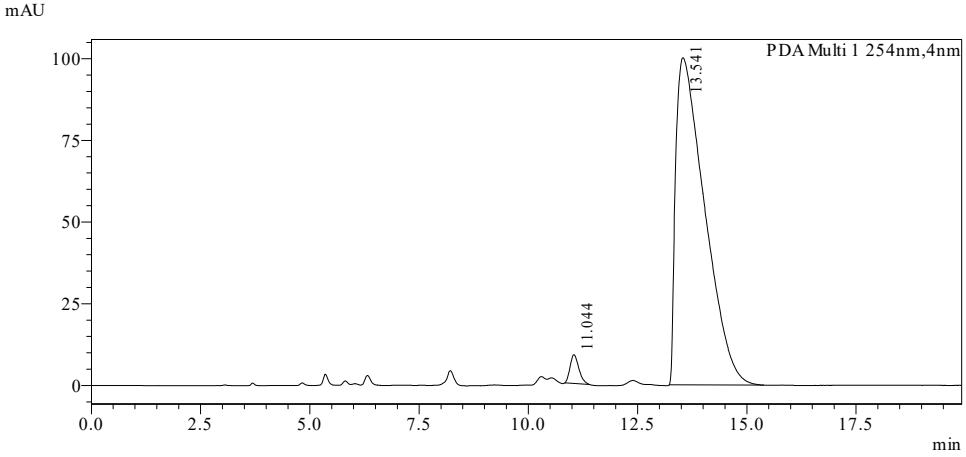


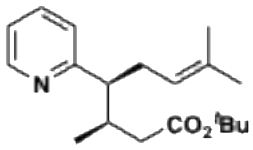
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.044	122970	8821	2.592			
2	13.541	4622102	100052	97.408			
Total		4745073	108873				

SHIMADZU LabSolutions

Analysis Report

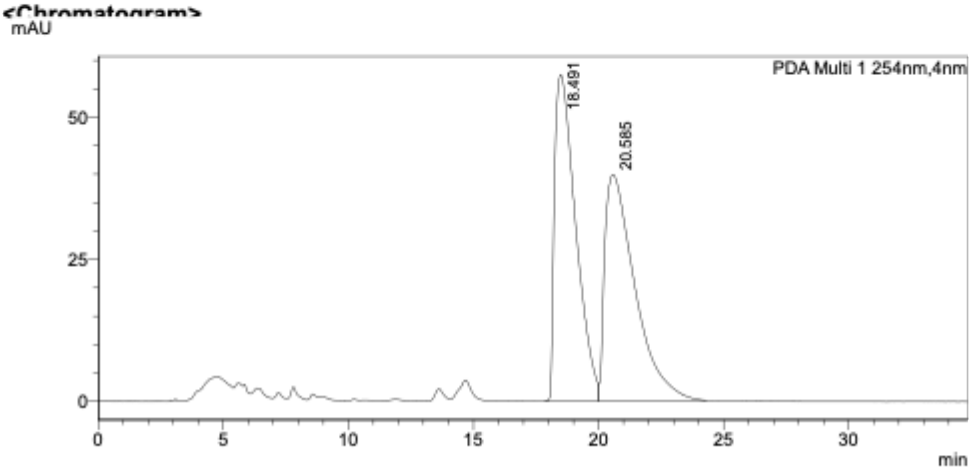


(±) 2k

<Sample Information>

Sample Name	: DPL-1-034 0.5% AD-H		
Sample ID	: DPL-1-034 0.5% AD-H		
Data Filename	: DPL-1-034 0.5% AD-H.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 12/23/2022 11:23:06 PM	Acquired by	: Priya Kandiyal
Date Processed	: 12/23/2022 11:57:55 PM	Processed by	: Priya Kandiyal

<Chromatogram>



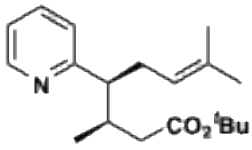
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	18.491	3376726	57462	50.264			
2	20.585	3341262	39835	49.736		V	
Total		6717988	97297				

SHIMADZU LabSolutions

Analysis Report



2k

<Sample Information>

Sample Name	: DPL-1-036 0.5% AD-H		
Sample ID	: DPL-1-036 0.5% AD-H		
Data Filename	: DPL-1-036 0.5% AD-H.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 12/24/2022 12:23:32 AM	Acquired by	: Priya Kandiyal
Date Processed	: 12/24/2022 12:56:05 AM	Processed by	: Priya Kandiyal

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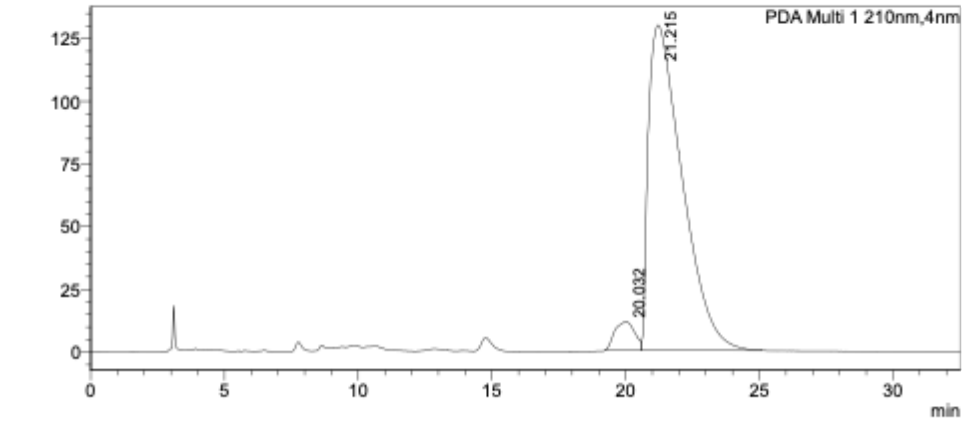


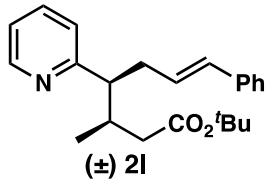
<Peak Table>

PDA Ch1 210nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	20.032	594175	11481	4.956			
2	21.215	11395136	129716	95.044		V	
Total		11989311	141197				

SHIMADZU LabSolutions

Analysis Report



(±) 2l

<Sample Information>

Sample Name	: PK1-079AB OD-H 1%		
Sample ID	: PK1-079AB OD-H 1%		
Data Filename	: ab_2_227-5.lcd		
Method Filename	: a.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/29/2022 6:51:18 PM	Acquired by	: Joshua Gladfelder
Date Processed	: 9/29/2022 7:06:15 PM	Processed by	: Joshua Gladfelder

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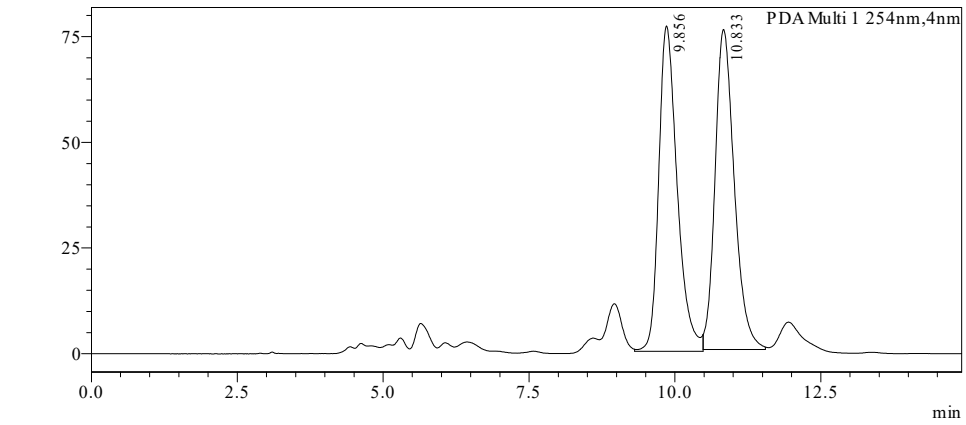


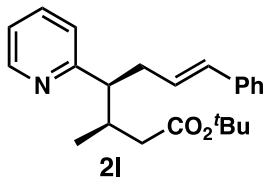
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	9.856	1699599	76957	49.548			
2	10.833	1730578	75667	50.452			
Total		3430177	152624				

SHIMADZU LabSolutions

Analysis Report

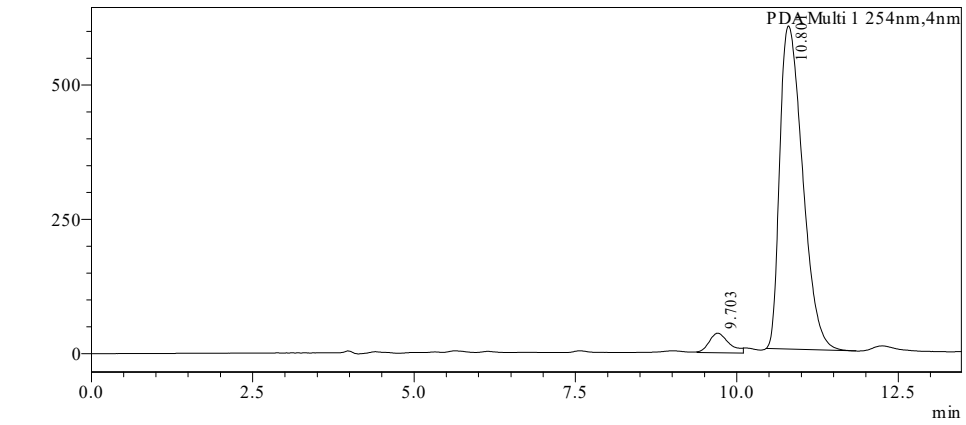


2l

<Sample Information>

Sample Name	: PK1-094B 1% AD-H T		
Sample ID	: PK1-094B 1% AD-H T		
Data Filename	: ab_2_258.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 10/22/2022 2:17:13 PM	Acquired by	: Priya Kandiyal
Date Processed	: 10/22/2022 2:30:44 PM	Processed by	: Priya Kandiyal

<Chromatogram>



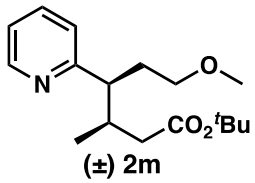
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	9.703	791246	36474	5.068			
2	10.801	14820328	601609	94.932			
Total		15611573	638083				

SHIMADZU LabSolutions

Analysis Report

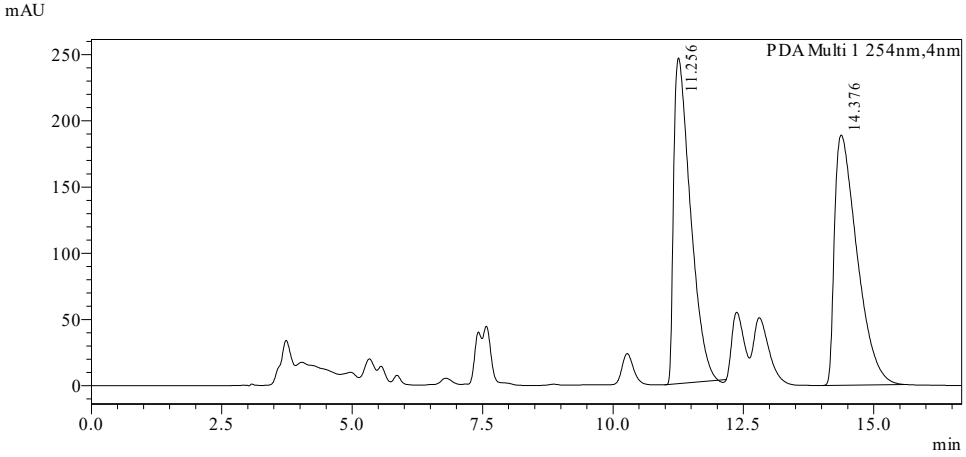


(±) 2m

<Sample Information>

Sample Name	: PK1-063AB 0.5% AD-H		
Sample ID	: PK1-063AB 0.5% AD-H		
Data Filename	: ab_2_242.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 10/12/2022 1:15:18 PM	Acquired by	: Priya Kandiyal
Date Processed	: 10/12/2022 1:32:02 PM	Processed by	: Priya Kandiyal

<Chromatogram>



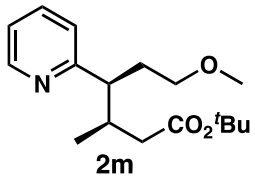
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.256	5528540	246006	49.281			
2	14.376	5689954	188972	50.719			
Total		11218494	434979				

SHIMADZU LabSolutions

Analysis Report

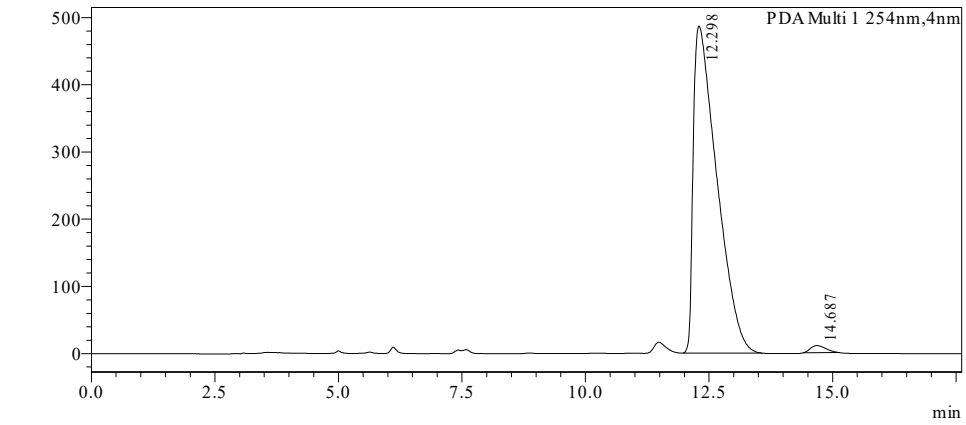


2m

<Sample Information>

Sample Name	: PK1-061A 0.5% AD-H		
Sample ID	: PK1-061A 0.5% AD-H		
Data Filename	: ab_2_241.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 10/12/2022 12:56:18 PM	Acquired by	: Priya Kandiyal
Date Processed	: 10/12/2022 1:13:57 PM	Processed by	: Priya Kandiyal

<Chromatogram>



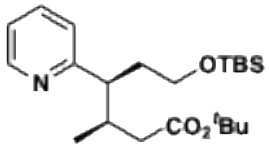
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	12.298	16142083	486706	98.613			
2	14.687	227020	10566	1.387			
Total		16369103	497272				

SHIMADZU LabSolutions

Analysis Report

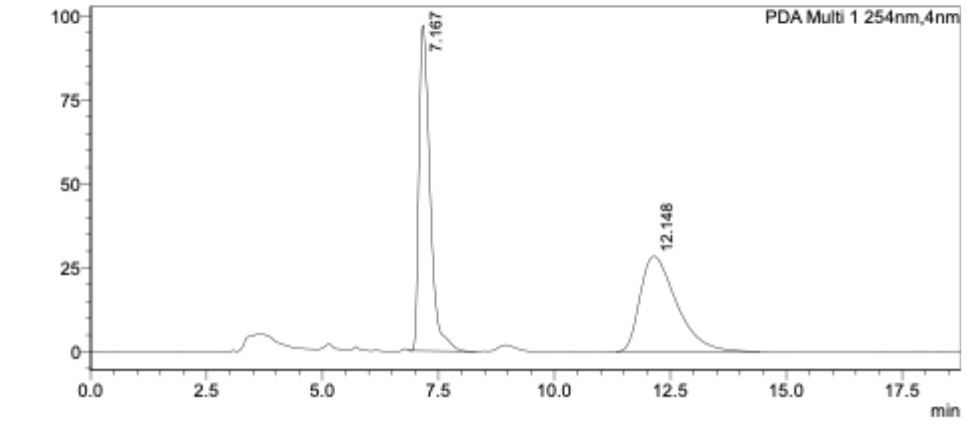


(±) 2n

<Sample Information>

Sample Name	: DPL-1-017 0.5% AD-H		
Sample ID	: DPL-1-017 0.5% AD-H		
Data Filename	: ab_2_271.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 10/29/2022 12:35:54 PM	Acquired by	: Priya Kandiyal
Date Processed	: 10/29/2022 12:54:41 PM	Processed by	: Priya Kandiyal

<Chromatogram>



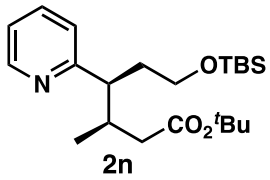
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.167	1612938	97032	50.934			
2	12.148	1553799	28369	49.066			
Total		3166737	125401				

SHIMADZU LabSolutions

Analysis Report

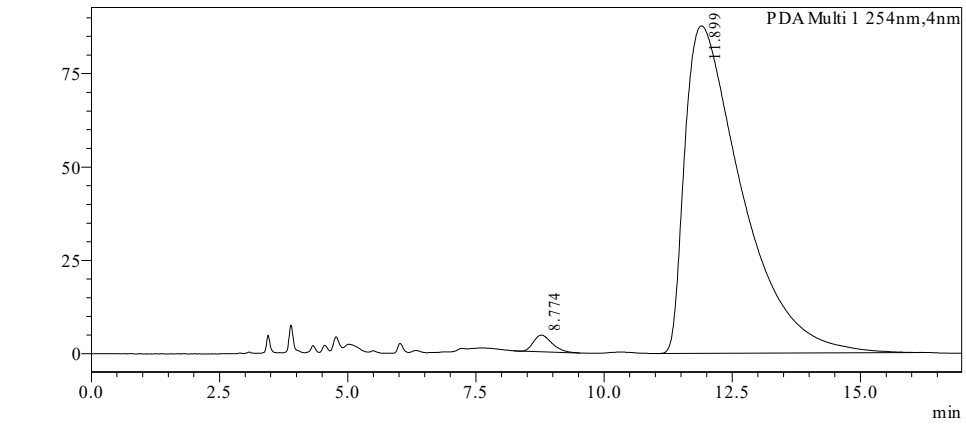


2n

<Sample Information>

Sample Name	: PK1-134 AD-H 0.5%		
Sample ID	: PK1-134 AD-H 0.5%		
Data Filename	: LNS-1-63.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/30/2023 1:03:38 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/30/2023 1:20:39 PM	Processed by	: Priya Kandiyal

<Chromatogram>



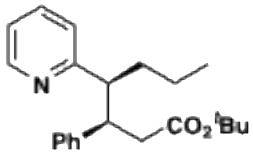
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	8.774	111182	4431	1.603			
2	11.899	6824452	87731	98.397			
Total		6935633	92162				

SHIMADZU LabSolutions

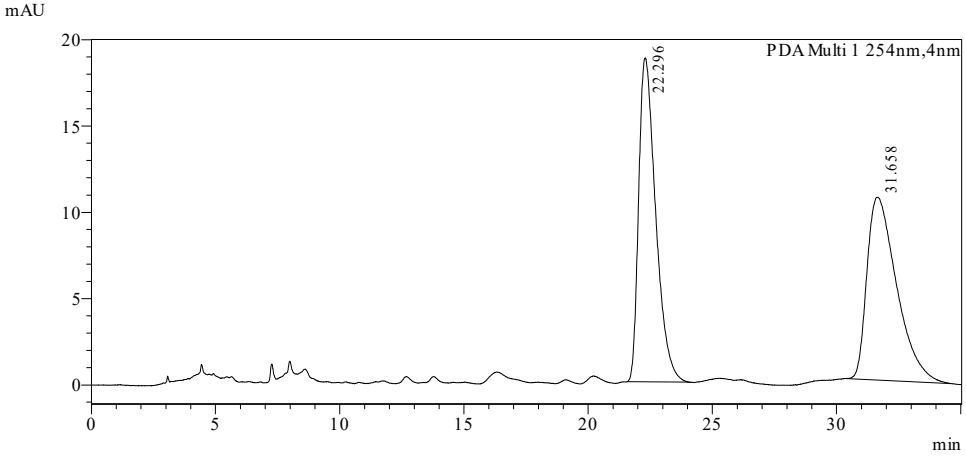
Analysis Report



<Sample Information>

Sample Name	: PK1-099 0.5% AD-H			
Sample ID	: PK1-099 0.5% AD-H			
Data Filename	: ab_2_270.lcd			
Method Filename	: ab.lcm			
Batch Filename	:			
Vial #	: 1-1	Sample Type	: Unknown	**3a**
Injection Volume	: 1 uL			
Date Acquired	: 10/28/2022 5:25:16 PM	Acquired by	: Priya Kandiyal	
Date Processed	: 10/28/2022 6:00:20 PM	Processed by	: Priya Kandiyal	

<Chromatogram>



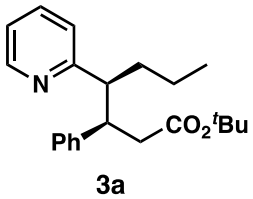
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	22.296	894597	18770	50.316			
2	31.658	883358	10601	49.684			
Total		1777955	29371				

SHIMADZU LabSolutions

Analysis Report

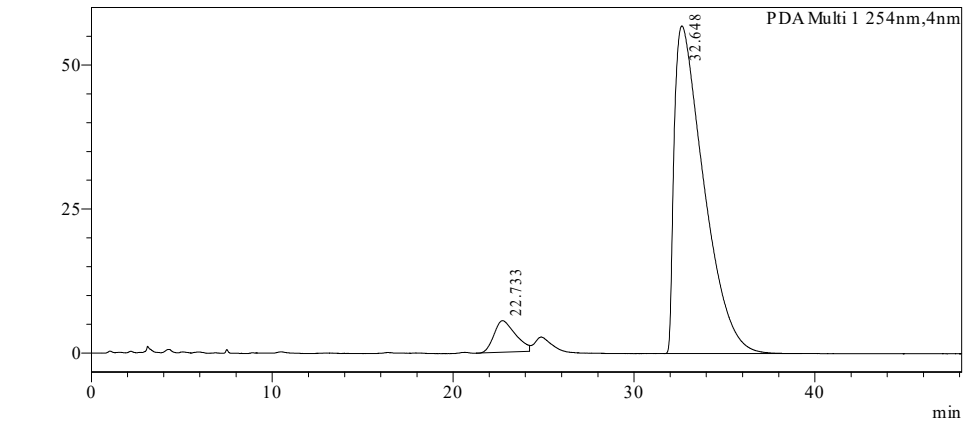


3a

<Sample Information>

Sample Name	: PK1-104 AD-H 0.5%		
Sample ID	: PK1-104 AD-H 0.5%		
Data Filename	: DPL-1-036 0.5% AD-H009.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/19/2023 1:08:51 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/19/2023 1:57:00 PM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

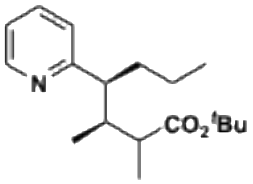
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	22.733	452777	5474	6.550			
2	32.648	6460284	56885	93.450			
Total		6913061	62360				

C:\LabSolutions\Data\Project1\DPL-1-036 0.5% AD-H009.lcd

SHIMADZU LabSolutions

Analysis Report

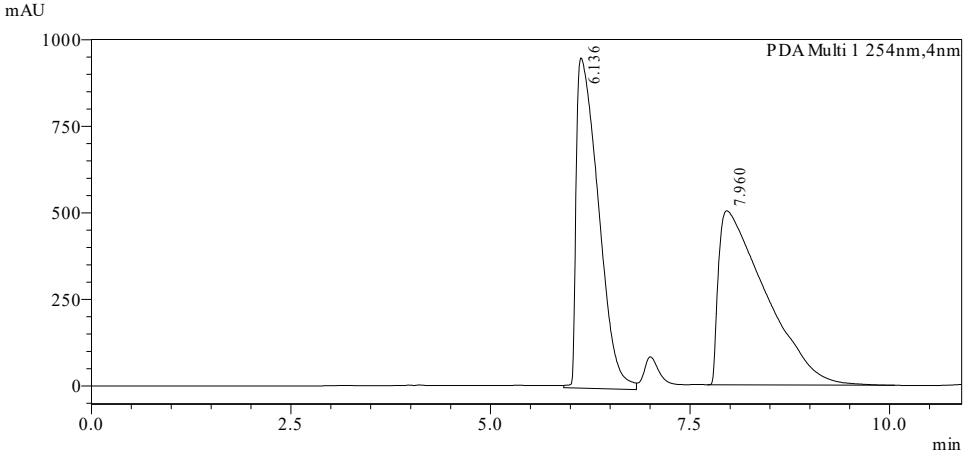


(±) 3b

<Sample Information>

Sample Name	: PK1-129 AD-H 0.3%		
Sample ID	: PK1-129 AD-H 0.3%		
Data Filename	: LNS-1-57.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/19/2023 9:13:16 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/19/2023 9:24:13 PM	Processed by	: Priya Kandiyal

<Chromatogram>



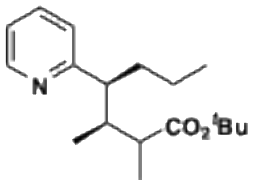
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.136	18451921	954471	47.025			
2	7.960	20786415	502885	52.975			
Total		39238336	1457357				

SHIMADZU LabSolutions

Analysis Report

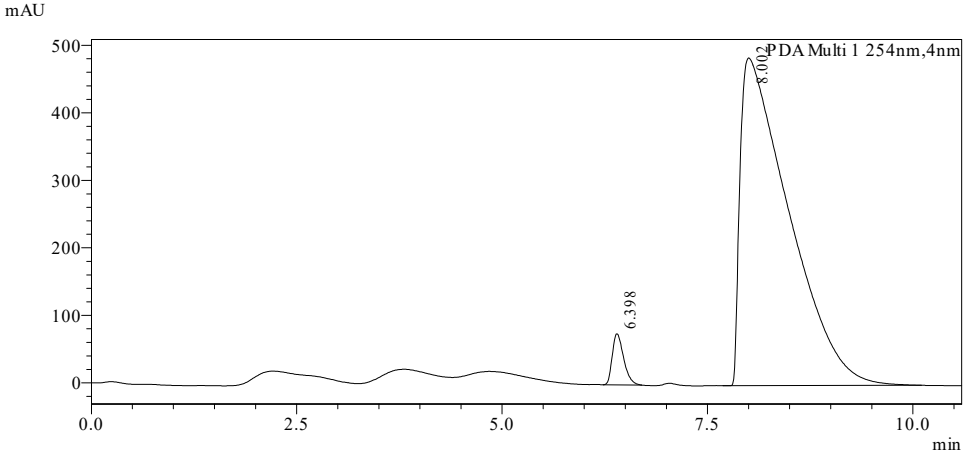


3b

<Sample Information>

Sample Name	: PK1-131 AD-H 0.3%		
Sample ID	: PK1-131 AD-H 0.3%		
Data Filename	: LNS-1-58.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/19/2023 9:25:14 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/19/2023 9:35:51 PM	Processed by	: Priya Kandiyal

<Chromatogram>



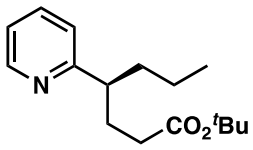
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.398	731214	75842	3.513			
2	8.002	20081441	485618	96.487			
Total		20812656	561460				

SHIMADZU LabSolutions

Analysis Report

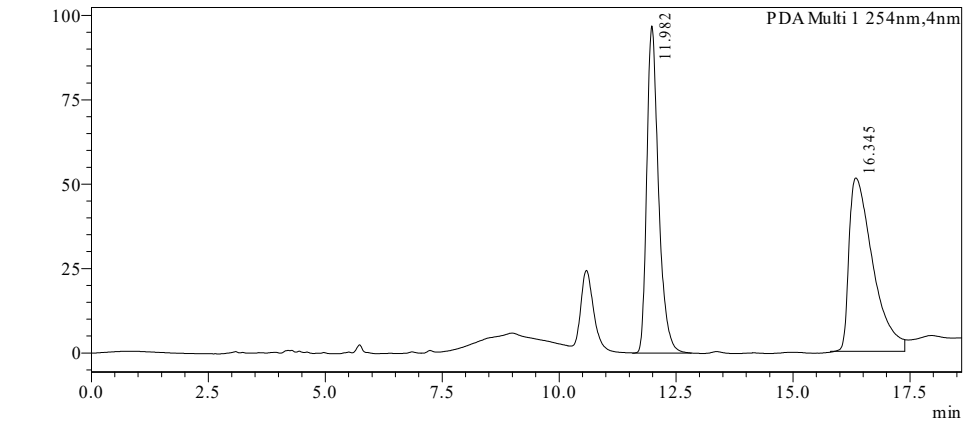


(±) 3c

<Sample Information>

Sample Name	: PK1-151 AD-H 0.5%		
Sample ID	: PK1-151 AD-H 0.5%		
Data Filename	: LNS-1-67.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 2/8/2023 12:15:52 PM	Acquired by	: Priya Kandiyal
Date Processed	: 2/8/2023 12:34:31 PM	Processed by	: Priya Kandiyal

<Chromatogram>



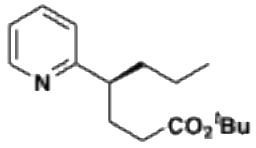
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.982	1690489	96918	48.214			
2	16.345	1815719	51356	51.786			
Total		3506208	148274				

SHIMADZU LabSolutions

Analysis Report

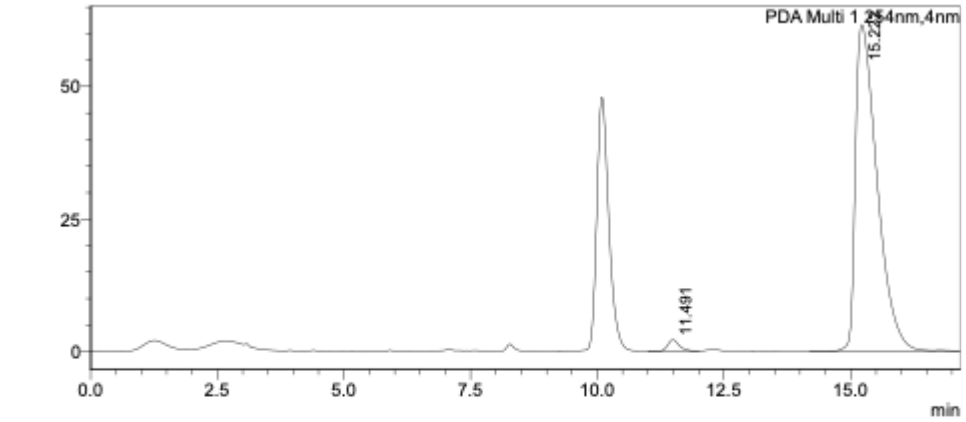


3c

<Sample Information>

Sample Name	: PK1-185 AD-H 0.5%		
Sample ID	: PK1-185 AD-H 0.5%		
Data Filename	: LNS-1-93.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 3/31/2023 1:28:02 PM	Acquired by	: Priya Kandiyal
Date Processed	: 3/31/2023 1:45:15 PM	Processed by	: Priya Kandiyal

<Chromatogram>



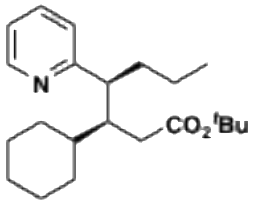
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.491	33441	2121	1.795			
2	15.222	1829981	61586	98.205			
Total		1863422	63707				

SHIMADZU LabSolutions

Analysis Report



(±) 3d

<Sample Information>

Sample Name	: PK1-273 AD-H 0.5%		
Sample ID	: PK1-273 AD-H 0.5%		
Data Filename	: ELP5-186AOD-H0.1%010.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 10 uL		
Date Acquired	: 1/18/2024 6:24:20 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/18/2024 6:44:26 PM	Processed by	: Priya Kandiyal

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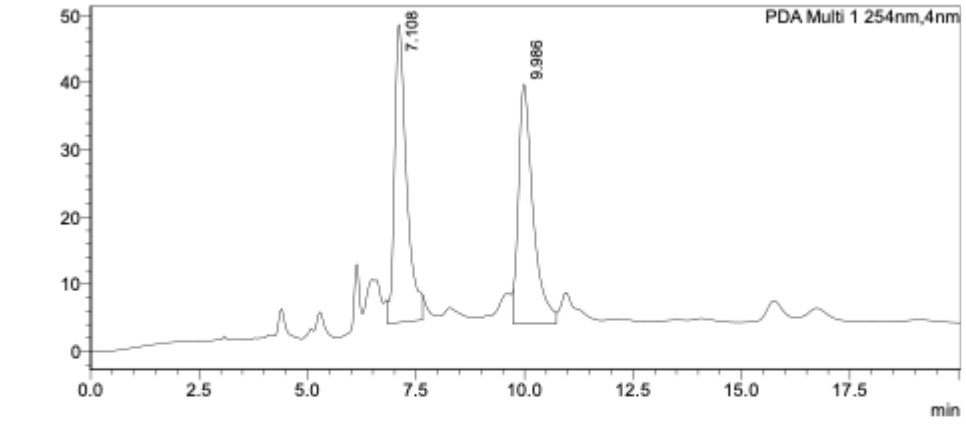


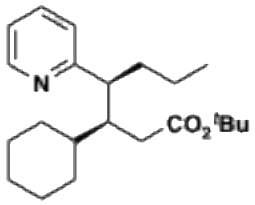
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.108	854504	44246	50.669			
2	9.986	831927	35561	49.331			
Total		1686431	79807				

SHIMADZU LabSolutions

Analysis Report

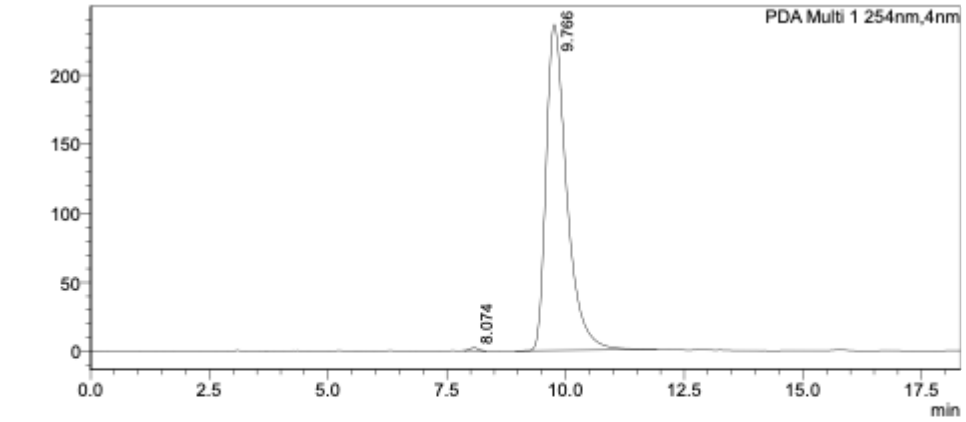


3d

<Sample Information>

Sample Name	: PK1-279 0.5% AD-H		
Sample ID	: PK1-279 0.5% AD-H		
Data Filename	: LL-2-140_ADH5.2.lcd		
Method Filename	: LL_odh.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 8/16/2023 2:58:58 PM	Acquired by	: Leroy Lu
Date Processed	: 8/16/2023 3:17:20 PM	Processed by	: Leroy Lu

<Chromatogram>



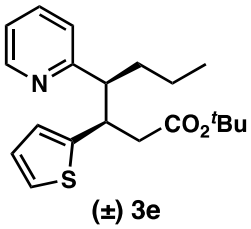
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	8.074	24051	2067	0.336			
2	9.766	7134772	235448	99.664			
Total		7158823	237515				

SHIMADZU LabSolutions

Analysis Report

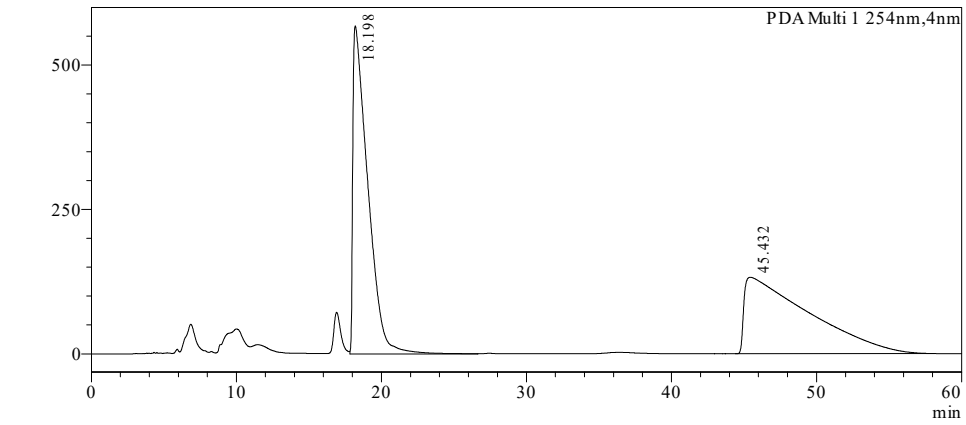


(±) 3e

<Sample Information>

Sample Name	: PK1-270A-3		
Sample ID	: PK1-270A-3		
Data Filename	: LNS-1-142.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 8/18/2023 3:37:15 PM	Acquired by	: Priya Kandiyal
Date Processed	: 8/18/2023 4:37:17 PM	Processed by	: Priya Kandiyal

<Chromatogram>



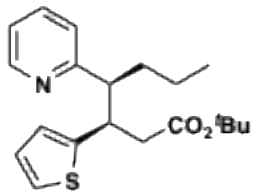
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	18.198	40853342	568029	49.655			
2	45.432	41420473	132555	50.345			
Total		82273815	700584				

SHIMADZU LabSolutions

Analysis Report



3e

<Sample Information>

Sample Name	: PK1-277-1		
Sample ID	: PK1-277-1		
Data Filename	: PK1-277.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 8/17/2023 3:29:05 PM	Acquired by	: Priya Kandiyal
Date Processed	: 12/10/2023 5:24:42 PM	Processed by	: Priya Kandiyal

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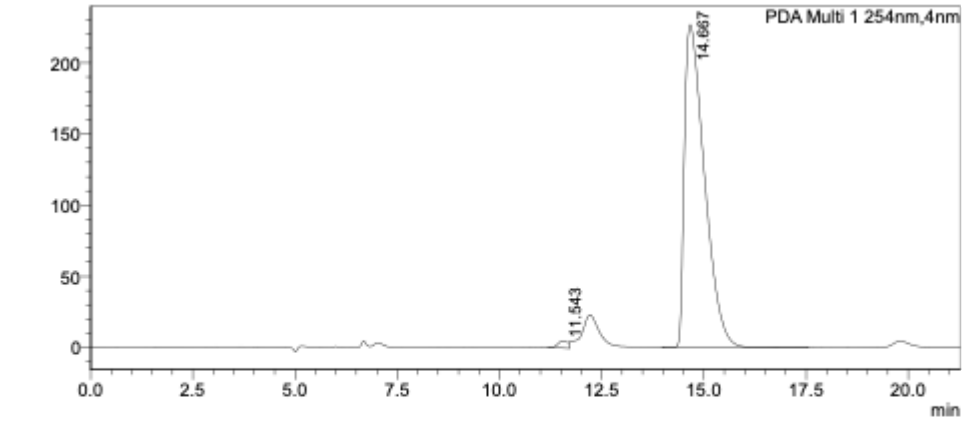


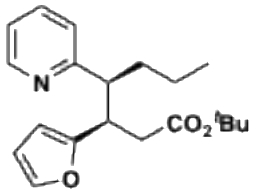
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	11.543	87963	5018	1.113			
2	14.667	7813683	226952	98.887			
Total		7901646	231970				

SHIMADZU LabSolutions

Analysis Report

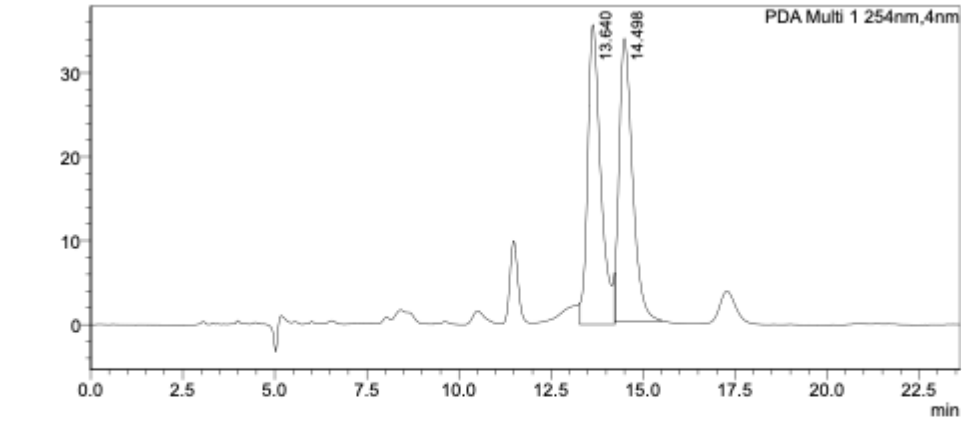


(±) 3f

<Sample Information>

Sample Name	: PK1-271		
Sample ID	: PK1-271		
Data Filename	: PK1-271.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 8/17/2023 3:52:59 PM	Acquired by	: Priya Kandiyal
Date Processed	: 8/17/2023 4:16:38 PM	Processed by	: Priya Kandiyal

<Chromatogram>



<Peak Table>

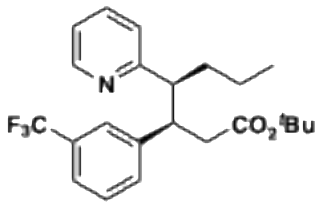
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	13.640	888814	35711	50.786			
2	14.498	861290	33806	49.214			
Total		1750104	69518				

C:\LabSolutions\Data\Project1\PK1-271.lcd

SHIMADZU LabSolutions

Analysis Report



(±) 3g

<Sample Information>

Sample Name	: PK1-291 OD-H 1%		
Sample ID	: PK1-291 OD-H 1%		
Data Filename	: ELP5-186AOD-H0.1%002.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 1/18/2024 1:11:14 PM	Acquired by	: Priya Kandiyal
Date Processed	: 1/18/2024 1:21:22 PM	Processed by	: Priya Kandiyal

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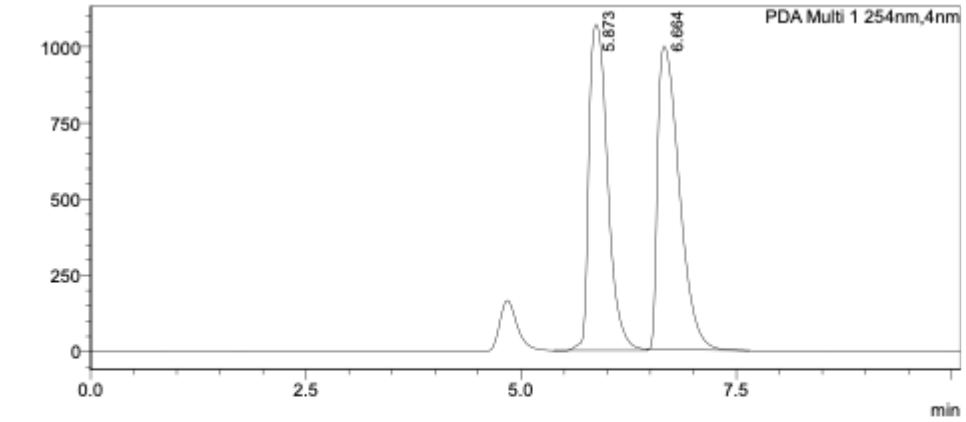


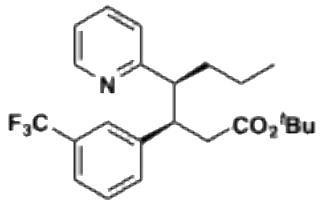
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	5.873	16130719	1067720	48.051			
2	6.664	17438939	994254	51.949			
Total		33569657	2061974				

SHIMADZU LabSolutions

Analysis Report

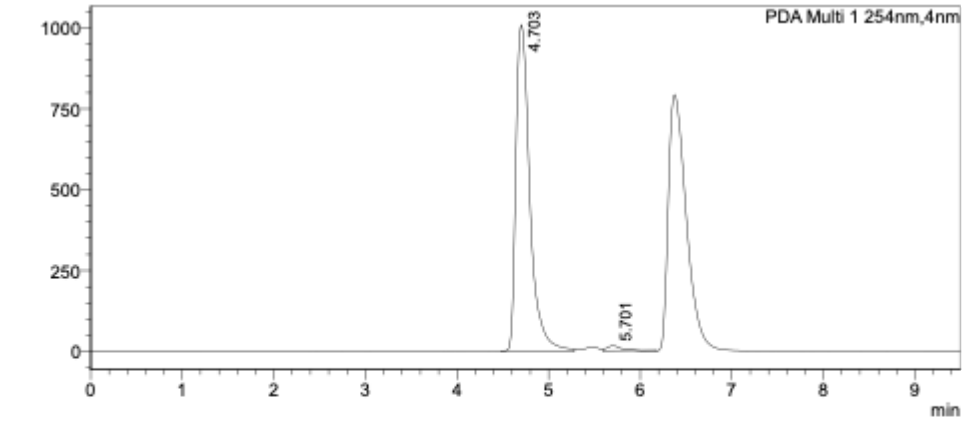


3g

<Sample Information>

Sample Name	: PK1-254		
Sample ID	: PK1-254		
Data Filename	: IL-1-133-ODH-0.1%IPA-4.lcd		
Method Filename	: 1mlpmin10uljinj.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 10 uL		
Date Acquired	: 9/18/2023 3:45:30 PM	Acquired by	: Ivy Liang
Date Processed	: 9/18/2023 3:55:02 PM	Processed by	: Ivy Liang

<Chromatogram>



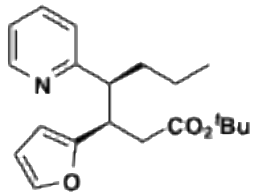
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	4.703	10704483	1008614	98.641			
2	5.701	147479	15708	1.359			
Total		10851962	1024322				

SHIMADZU LabSolutions

Analysis Report

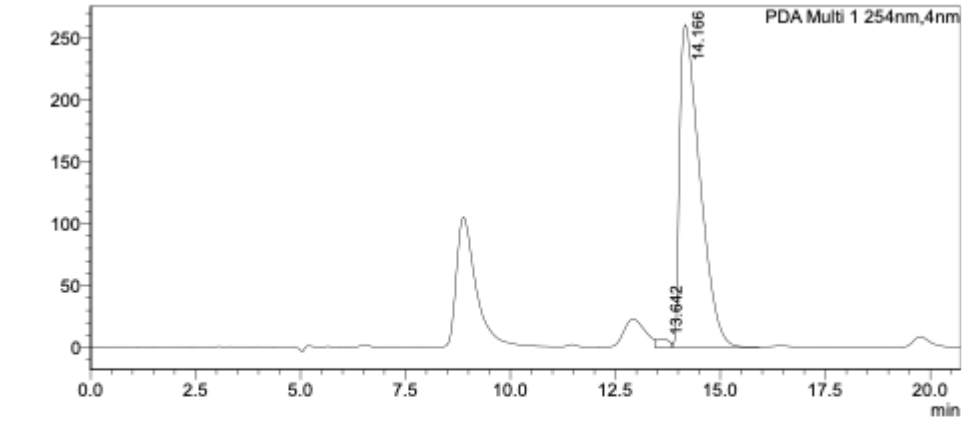


3f

<Sample Information>

Sample Name	: PK1-278		
Sample ID	: PK1-278		
Data Filename	: LNS-1-133.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 8/17/2023 4:17:56 PM	Acquired by	: Priya Kandiyal
Date Processed	: 8/18/2023 4:37:40 PM	Processed by	: Priya Kandiyal

<Chromatogram>



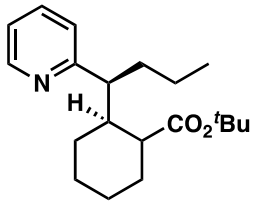
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	13.642	144463	7062	1.634			
2	14.166	8694069	260259	98.366			
Total		8838532	267321				

SHIMADZU LabSolutions

Analysis Report



(±) 3h

<Sample Information>

Sample Name	: PK1-197 AD-H 0.5%		
Sample ID	: PK1-197 AD-H 0.5%		
Data Filename	: LL-2-098_ADH001.lcd		
Method Filename	: LL_odh.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 5/24/2023 12:18:05 PM	Acquired by	: Leroy Lu
Date Processed	: 5/24/2023 12:24:15 PM	Processed by	: Leroy Lu

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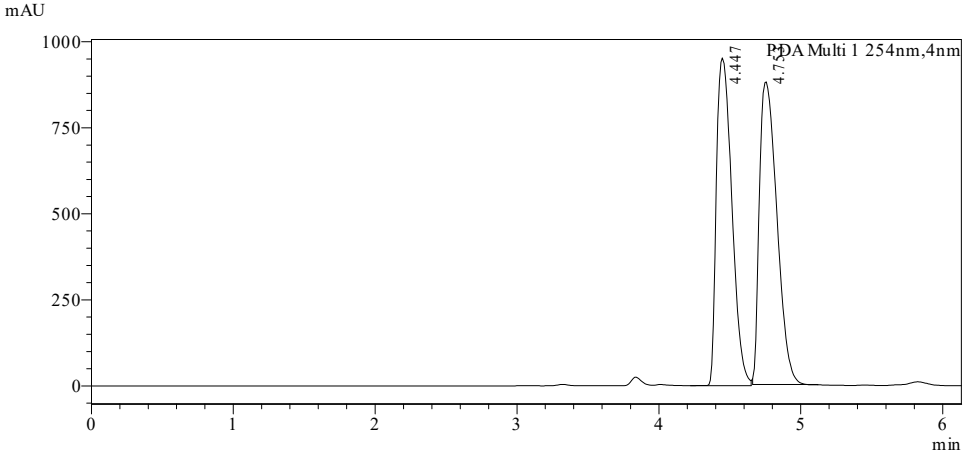


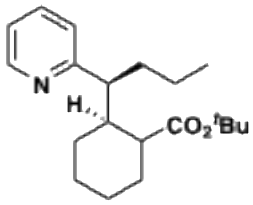
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	4.447	7244951	952852	49.021			
2	4.753	7534472	879447	50.979			
Total		14779423	1832299				

SHIMADZU LabSolutions

Analysis Report



3h

<Sample Information>

Sample Name	: PK1-235 AD-H 0.5%		
Sample ID	: PK1-235 AD-H 0.5%		
Data Filename	: LL-2-098_ADH002.lcd		
Method Filename	: LL_odh.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 5/24/2023 12:25:13 PM	Acquired by	: Leroy Lu
Date Processed	: 5/24/2023 12:31:19 PM	Processed by	: Leroy Lu

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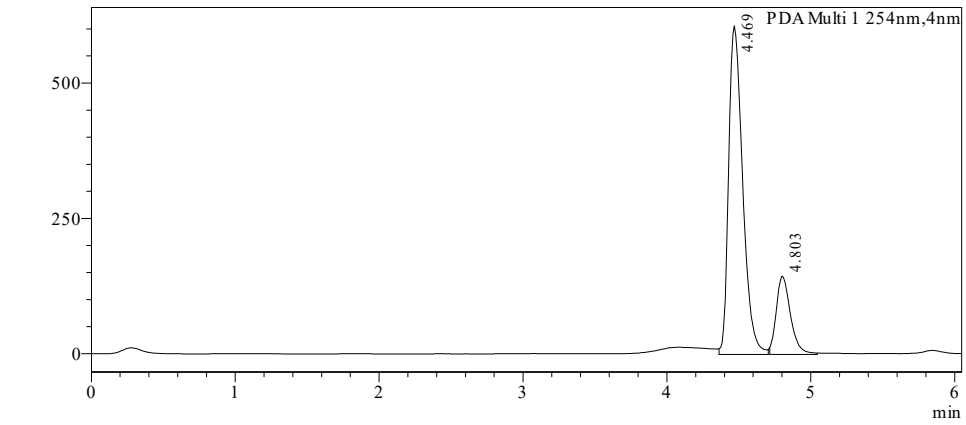


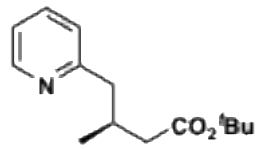
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	4.469	4123462	606820	80.598			
2	4.803	992650	144444	19.402			
Total		5116113	751264				

SHIMADZU LabSolutions

Analysis Report



(±) 4

<Sample Information>

Sample Name	: PK1-241-2 AD-H 0.5%-		
Sample ID	: PK1-241-2 AD-H 0.5%-		
Data Filename	: LNS-1-126.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 6/8/2023 11:55:12 AM	Acquired by	: Priya Kandiyal
Date Processed	: 6/8/2023 12:28:49 PM	Processed by	: Priya Kandiyal

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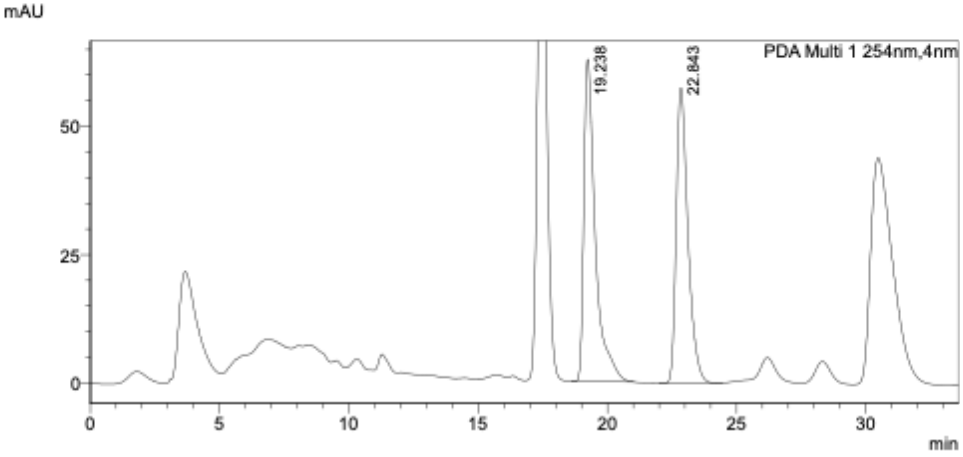


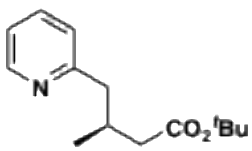
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	19.238	1946749	62790	51.672			
2	22.843	1820797	57560	48.328			
Total		3767546	120350				

SHIMADZU LabSolutions

Analysis Report



4

<Sample Information>

Sample Name	: PK1-242-2 AD-H 0.5%-		
Sample ID	: PK1-242-2 AD-H 0.5%-		
Data Filename	: LNS-1-125.lcd		
Method Filename	: ab.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 6/8/2023 11:26:09 AM	Acquired by	: Priya Kandiyal
Date Processed	: 6/8/2023 11:54:20 AM	Processed by	: Priya Kandiyal

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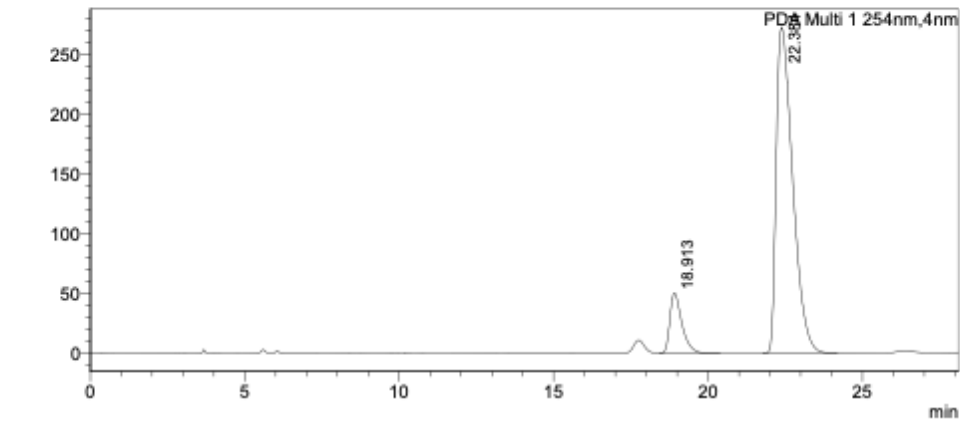


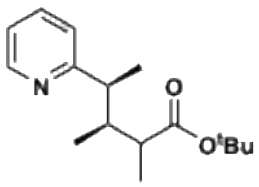
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	18.913	1363060	50369	11.908			
2	22.384	10083463	272133	88.092			
Total		11446523	322502				

SHIMADZU LabSolutions

Analysis Report



(±) 5

<Sample Information>

Sample Name	: DPL-1-113 0.5% AD-H		
Sample ID	:		
Data Filename	: DPL-1-113 0.5% AD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 7/6/2023 11:37:51 AM	Acquired by	: Dyllan Ly
Date Processed	: 7/6/2023 12:19:55 PM	Processed by	: Dyllan Ly

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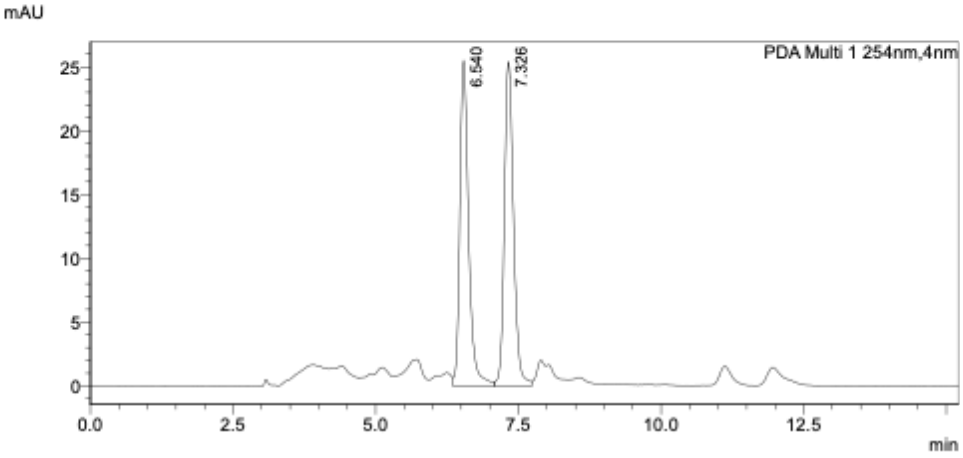


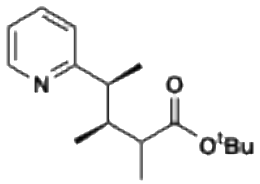
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.540	271898	25513	48.946			
2	7.326	283606	25433	51.054		V	
Total		555504	50946				

SHIMADZU LabSolutions

Analysis Report

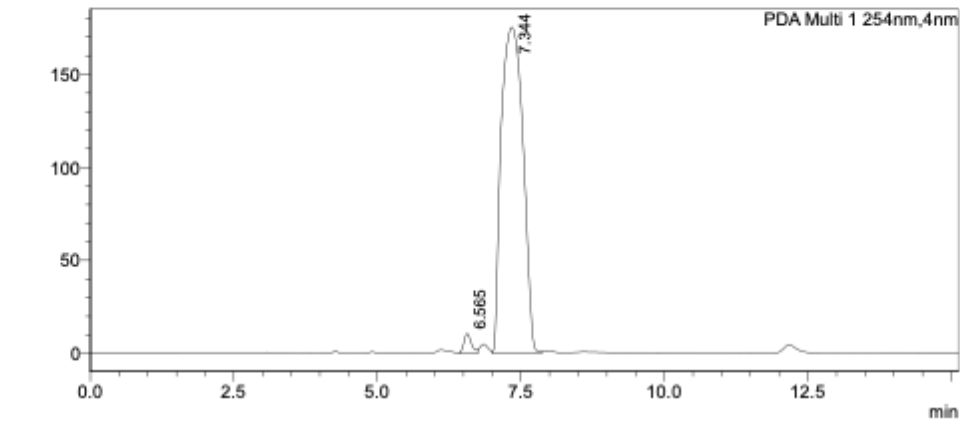


5

<Sample Information>

Sample Name	: DPL-1-117 0.5% AD-H		
Sample ID	:		
Data Filename	: DPL-1-117 0.5% AD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 7/6/2023 11:55:41 AM	Acquired by	: Dyllan Ly
Date Processed	: 7/6/2023 12:10:50 PM	Processed by	: Dyllan Ly

<Chromatogram>



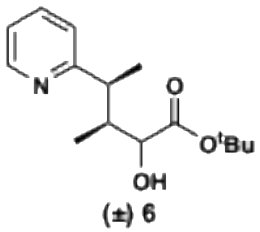
<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.565	97819	10605	2.070			
2	7.344	4628348	175309	97.930			
Total		4726168	185914				

SHIMADZU LabSolutions

Analysis Report

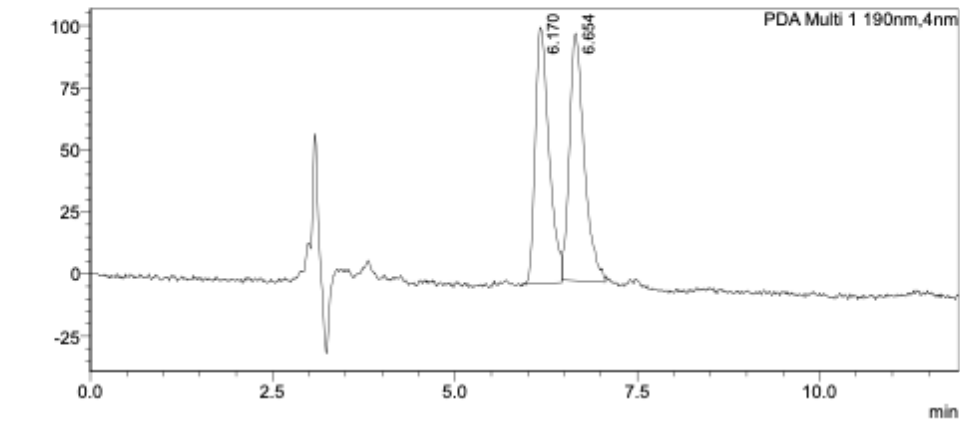


(±) 6

<Sample Information>

Sample Name	: DPL-1-136 4.0% OD-H		
Sample ID	:		
Data Filename	: DPL-1-136 4.0% OD-H.lcd		
Method Filename	: DPL-7-6-2023Method-pressure.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 2/8/2024 11:36:59 AM	Acquired by	: Dyllan Ly
Date Processed	: 2/8/2024 11:48:57 AM	Processed by	: Dyllan Ly

<Chromatogram>



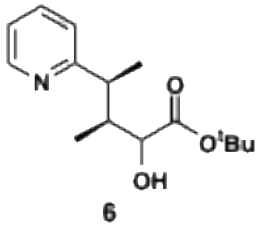
<Peak Table>

PDA Ch1 190nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.170	1355597	103121	49.021			
2	6.654	1409743	99593	50.979			
Total		2765340	202714				

SHIMADZU LabSolutions

Analysis Report

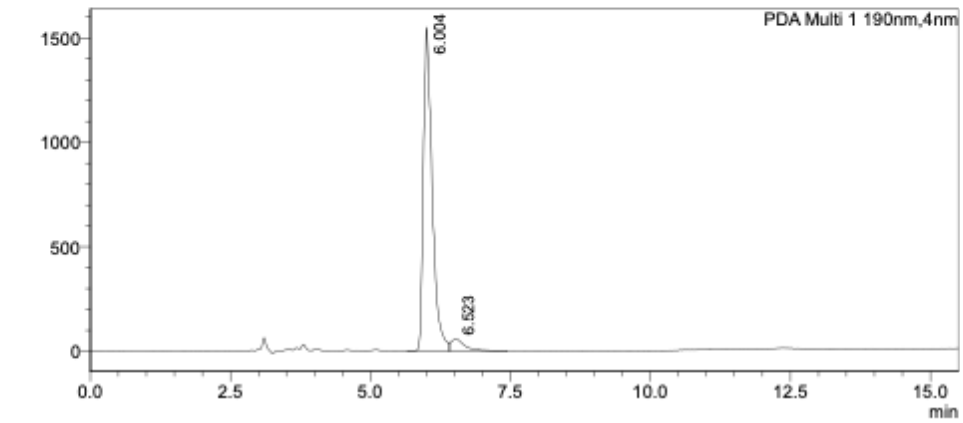


6

<Sample Information>

Sample Name	: DPL-1-137 4.0% OD-H		
Sample ID	:		
Data Filename	: DPL-1-137 4.0% OD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/22/2023 12:36:41 PM	Acquired by	: Dyllan Ly
Date Processed	: 9/22/2023 1:43:51 PM	Processed by	: Dyllan Ly

<Chromatogram>



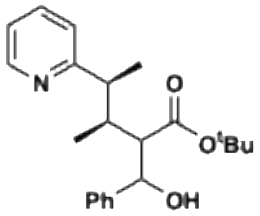
<Peak Table>

PDA Ch1 190nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	6.004	16862802	1549599	94.521			
2	6.523	977410	56540	5.479		V	
Total		17840212	1606139				

SHIMADZU LabSolutions

Analysis Report

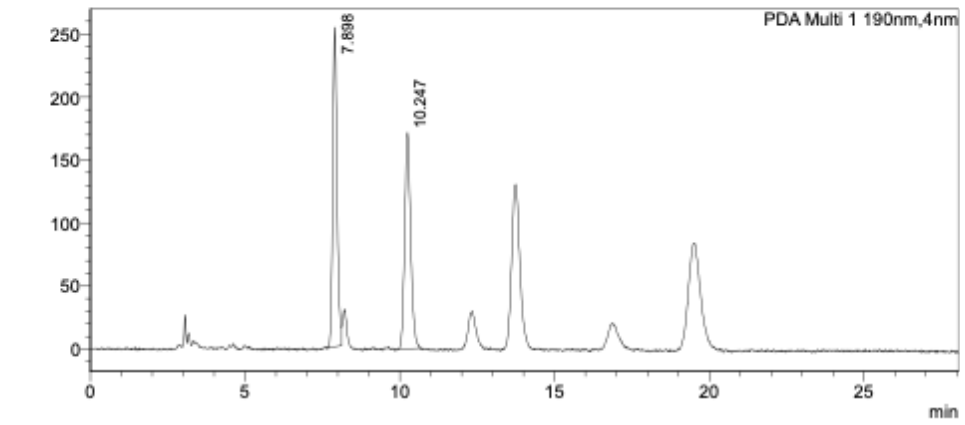


(±) 7

<Sample Information>

Sample Name	: DPL-1-130 5.0% AD-H		
Sample ID	:		
Data Filename	: DPL-1-130 5.0% AD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/15/2023 11:42:49 AM	Acquired by	: Dyllan Ly
Date Processed	: 9/22/2023 11:25:35 AM	Processed by	: Dyllan Ly

<Chromatogram>



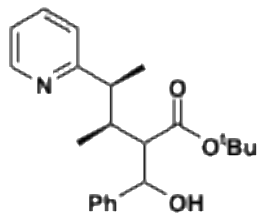
<Peak Table>

PDA Ch1 190nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.898	2407000	253318	51.116			
2	10.247	2301875	171689	48.884			
Total		4708875	425007				

SHIMADZU LabSolutions

Analysis Report

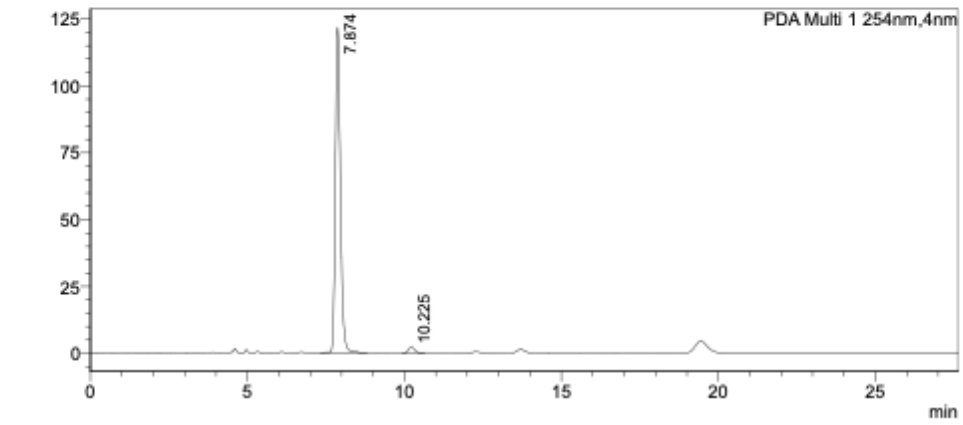


7

<Sample Information>

Sample Name	: DPL-1-128-3 5.0% AD-H		
Sample ID	:		
Data Filename	: DPL-1-128-3 5.0% AD-H.lcd		
Method Filename	: DPL-7-6-2023Method.lcm		
Batch Filename	:		
Vial #	: 1-1	Sample Type	: Unknown
Injection Volume	: 1 uL		
Date Acquired	: 9/15/2023 12:14:34 PM	Acquired by	: Dyllan Ly
Date Processed	: 9/15/2023 3:36:31 PM	Processed by	: Dyllan Ly

<Chromatogram>



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.874	1366191	121850	97.603			
2	10.225	33557	2351	2.397			
Total		1399749	124202				

References

1. Vitaku, E.; Smith, D. T.; Njardarson, J. T. *J. Med. Chem.* **2014**, *57*, 10257–10274.
2. Marshall, J. P.; Federice, E. D.; Bell, J. D.; Cox, P. J.; Njardarson, J. T. *Bioorg. Med. Chem.* **2024**, *92*, 117825.
3. Carey, J. S.; Laffan, D.; Thomson, C.; Williams, M. T. *Org. Biomol. Chem.* **2006**, *4*, 2337–2347.
4. Stivala, C. E; Zakarian, A. *J. Am. Chem. Soc.* **2011**, *133*, 11936–11939.
5. Lu, P.; Jackson, J. J.; Eickhoff, J. A.; Zakarian, A. *J. Am. Chem. Soc.* **2015**, *137*, 656–659.
6. Yu, K.; Lu, P.; Jackson, J. J.; Nguyen, T.; Alvarado, J.; Stivala, C. E.; Ma, Y.; Mack, K. A.; Hayton, T. W.; Collum, D. B.; Zakarian, A. *J. Am. Chem. Soc*. **2017**, *139*, 527–533.
7. Ma, Y.; Stivala, C. E.; Wright, A. M.; Hayton, T.; Liang, J.; Keresztes, I.; Lobkovsky, E.; Collum, D. B.; Zakarian, A. *J. Am. Chem. Soc.* **2013**, *135*, 16853–16864.
8. Ma, Y.; Mack, K. A.; Liang, J.; Keresztes, I.; Collum, D. B.; Zakarian, A. *Angew. Chem. Int. Ed.* **2016**, *55*, 10093–10097.
9. Gladfelder, E.; Lee, H.; Zakarian, A. *J. Am. Chem. Soc*. **2019**, *141*, 15024−15028.
10. Yu, K.; Miao, B.; Wang, W.; Zakarian, A. *Org. Lett*. **2019**, *21*, 1930−1934.
11. Y. Li, E. Paola, Z. Wang, G. Menard, A. Zakarian, *Angew. Chem. Int. Ed.* **2022**, *61*, e202209987.
12. Lu, L.; Sepetov, L. N.; Purcell, L.; Park, J.; Pan, P. Y.; Yu, K.; Zakarian, A. *Org. Lett.* **2025**, *27*, 1234–1238.