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Synthesis of 1,4-Dihydropyridines and Their Fluorescence Properties

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We have successfully synthesized 3,4,5-substituted 1,4-dihydropyridines (1,4-DHPs) from amine hydrochloride salts, aldehydes, and acetals in good yields without the addition of a catalyst. The synthesized 1,4-DHPs exhibit various wavelengths of fluorescence, which could be tuned by changing the substituents at the 3- and 5-positions of the 1,4-DHPs.

Introduction

1,4-Dihydropyridines (1,4-DHPs) are an important class of biologically active organic compounds, for example, the calcium channel blocker amlodipine.[1] The DHP scaffold is also found in nicotinamide adenine dinucleotide phosphate (NADPH), which is an important redox coenzyme in cells, as well as in various natural products, for example, guayulamine A[2] and aspernigrin A[3] (Figure 1).

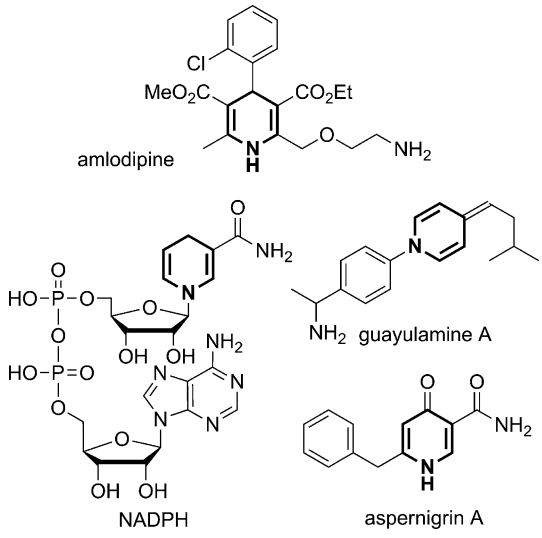

Figure 1. Examples of a drug and natural products bearing the 1,4-dihydropyridine scaffold.

1,4-DHPs also have potential as photoelectronic functional materials. For example, 2,6-unsubstituted 1,4-DHPs exhibit strong blue fluorescence,[4] although 2,6-dimethyl-1,4-DHP (Hantzsch ester) exhibits no fluorescence. On the basis of these phenomena, we hypothesized that the fluorescence properties of 2,6-unsubstituted DHPs could be controlled by installing 1) various electron-donating functional groups at the 1-position and 2) various electron-withdrawing groups (EWGs) at the 3- and 5-positions of DHPs that would dominate the π-conjugation of the DHP scaffold and act as electron-accepting moieties (Figure 2).

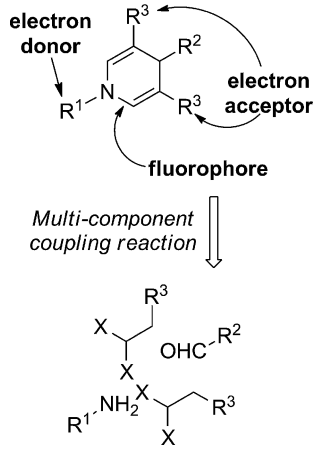

Figure 2. Design and retrosynthetic scheme for fluorescent 2,6-unsubstituted 1,4-DHPs.

A number of 1,4-DHP syntheses have been studied to date, but relatively few methods for the synthesis of 2,6-unsubstituted 1,4-DHPs have been reported.[5,6] Therefore we developed a facile method for synthesizing 1,4-DHPs

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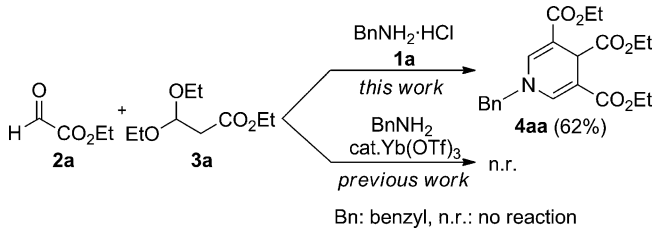
with various functional groups because of their potential as fluorescent probes.[7] In continuation of our efforts towards the synthesis of 1,4-DHPs, we have also reported a facile Yb-catalyzed one-pot synthesis of 1,4-DHPs.[8] This method provides 2,6-unsubstituted 1,4-DHPs with various functional groups. The reactions with aliphatic amines or ammonia catalyzed by Yb scarcely proceeded, and 1,4-DHPs with more EWGs, such as cyano or nitro groups, at the 3- and 5-positions could not be achieved by this method. Recently Jiang et al. reported the palladium-catalyzed synthesis of 1,4-DHPs, including one example of a 3,5-dicyano-1,4-DHP,[9] and Nishiwaki and and Tobe et al. reported the synthesis of 3,5-dinitro-1,4-DHPs.[10] Although both syntheses give 1,4-DHPs in good yields, the substrate scope is limited. To extend the chemical diversity of 1,4-DHPs, we studied the synthesis of 2,6-unsubstituted 1,4-DHP by using aliphatic amines or ammonia. Interestingly, we found that 1,4-DHPs could be easily synthesized without the addition of a catalyst by using the corresponding amine hydrochloride salts instead of amines. In this paper we describe a one-pot synthesis of 3,4,5-trisubstituted 1,4-DHPs by using amine hydrochloride salts or ammonium chloride [Equation (1)]. This method is very simple and applicable to the synthesis of 1,4-DHPs bearing cyano or nitro groups at the 3- and 5-positions, which is otherwise difficult to achieve by using the currently known methods. We further evaluated the fluorescence properties of the synthesized 1,4-DHPs and compared them with related compounds.



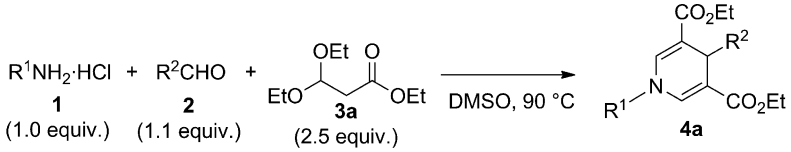
(1)

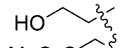
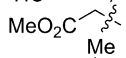
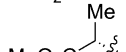
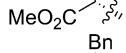
Results and Discussion

As shown in Equation (1), we initially found that the reaction with benzylamine hydrochloride (**1a**),[11] ethyl glyoxylate (**2a**), and ethyl 3,3-diethoxypropionate (**3a**) proceeded smoothly to give the corresponding 1,4-DHP **4aa** due to low Lewis basicity of **1a**. The reaction was also promoted by the hydrochloride of **1a**. The products of 1,4-DHP synthesis using amine hydrochloride salts are shown in Table 1; various 1,4-DHPs bearing electron-rich or -deficient aromatic rings (**4ab**–**4al**) were obtained in moderate-to-satisfactory yields. The reaction was not inhibited by highly polar functional groups, such as the hydroxy group. Heterocyclic moieties such as furan and thiophene rings were also introduced at the 4-position of 1,4-DHP (**4am** and **4an**) by using this method. In our previous method,[8] we were unable to obtain *N*-alkyl-1,4-DHPs, but the reaction described herein with primary and secondary aliphatic amine hydrochlorides gave the desired DHPs (**4ar**–**4av**) in satisfactory yields. Optically active 1,4-DHPs **4ay** and **4az** were obtained by using amino acid hydrochloride salts as the amine components.

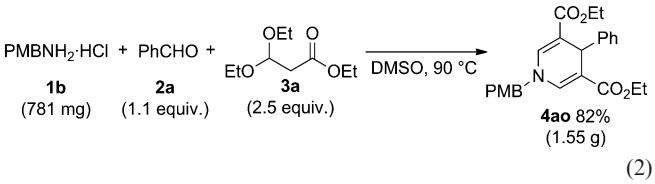
The method reported herein is also useful for practical synthesis. When 781 mg of **1b** were used as the substrate, **4ao** was obtained in 82% yield [1.55 g, Equation (2); 87.0 mg of **1b** were used in Table 1, entry 15].

Table 1. Synthesis of 1,4-DHPs with ethyl 3,3-diethoxypropionate (**3a**).



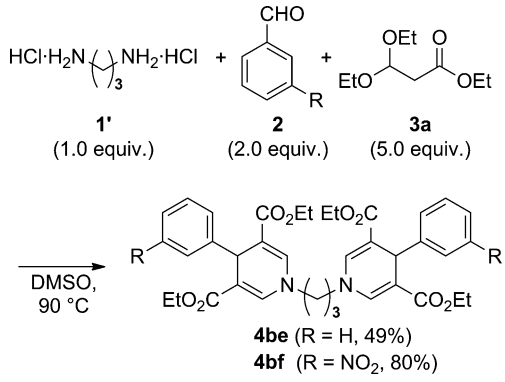
Entry	R^1	R^2	**4a** (yield %)	Entry	R^1	R^2	**4a** (yield %)
1	Bn	CO_2Et	**4aa** (62)	15	PMB	Ph	**4ao** (83)
2	Bn	Ph	**4ab** (66)	16	PMB	4-(OMe)(C_6H_4)	**4ap** (33)
3	Bn	3-(NO_2)(C_6H_4)	**4ac** (80)	17	4-(NMe_2)(C_6H_4)	Ph	**4aq** (26)
4	Bn	4-(NO_2)(C_6H_4)	**4ad** (62)	18	1-Naph-CH_2	1-Naph	**4ar** (73)
5	Bn	2-Cl(C_6H_4)	**4ae** (78)	19	1-Pyrenyl-CH_2	Ph	**4as** (57)
6	Bn	3-Cl(C_6H_4)	**4af** (69)	20	Me	3-(NO_2)(C_6H_4)	**4at** (64)
7	Bn	4-Cl(C_6H_4)	**4ag** (75)	21	^{c}Hex	Ph	**4au** (62)
8	Bn	3-(OH)(C_6H_4)	**4ah** (54)	22	^{i}Pr	Ph	**4av** (51)
9	Bn	4-(CN)(C_6H_4)	**4ai** (50)	23		Ph	**4aw** (62)
10	Bn	2-(OMe)(C_6H_4)	**4aj** (54)	24		Ph	**4ax** (39)
11	Bn	3-(OMe)(C_6H_4)	**4ak** (67)	25		Ph	**4ay** (59) (84 %ee)[a]
12	Bn	4-(OMe)(C_6H_4)	**4al** (59)				
13	Bn	2-furyl	**4am** (47)	26		Ph	**4az** (50) (77 %ee)[a]
14	Bn	3-Th	**4an** (40)				

[a] Determined by chiral HPLC (AD-H). PMB = *p*-methoxybenzyl, Th = thiophenyl, ^{c}Hex = cyclohexyl, Naph = naphthyl.



(2)

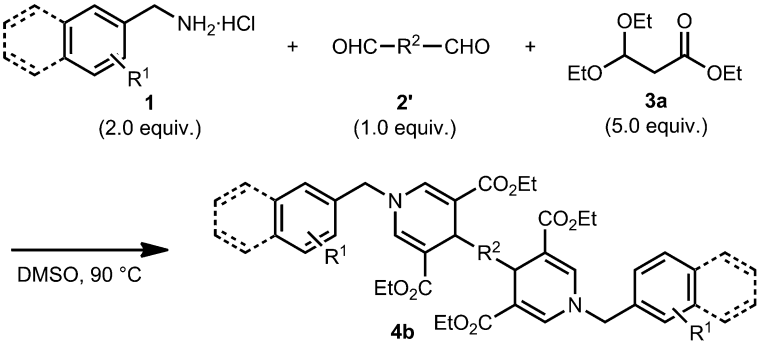
By using this method, bis-DHPs **4b** were also synthesized. The reactions performed with dialdehydes **2′** gave various phenylene-tethered bis-DHPs **4ba**–**4bd** in moderate yields (Table 2). The reaction of diamine hydrochloride **1′** gave alkyl-linked DHPs **4be** and **4bf** in yields of 49 and 80%, respectively [Equation (3)].

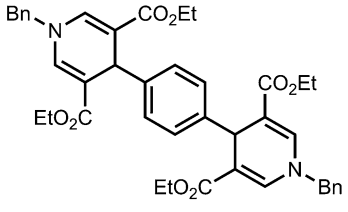
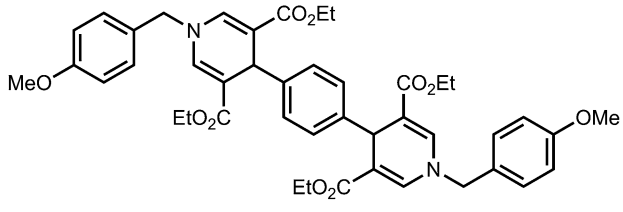
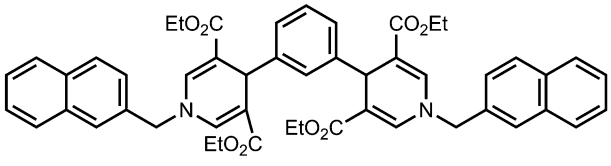
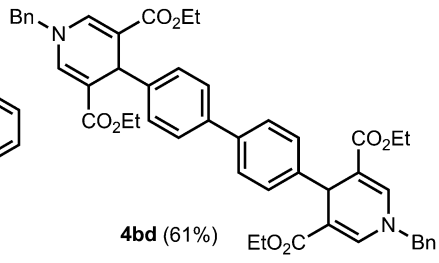


(3)

Ammonium salts were also used for the synthesis of 1-hydro-3,4,5-trisubstituted 1,4-DHPs. Ammonium chloride in DMSO was used and 1-hydro-3,4,5-trisubstituted 1,4-DHP **4ca** was obtained in 52% yield (Table 3, entry 1). When the solvent was changed to 1,4-dioxane, the reaction did not proceed due to the insolubility of ammonium chloride (entry 2). Ammonium acetate also did not provide a satisfactory result (entry 3) and the reaction with ammonium hydrogen carbonate gave a complex mixture (entry 4). Ammonium tetrafluoroborate is soluble in DMSO, and its use in the reaction gave 1,4-DHP **4ca** in 44% yield (entry 5). The reaction also proceeded when 1 equiv. of ammonium tetrafluoroborate was used, but the yield of **4ca** decreased to 20% (entry 6). The reaction with ammonium chloride and **3a** in the absence of benzaldehyde produced 1,4-DHP **5** and its decarboxylated product **6** in yields of 32 and 17%, respectively (entry 7).[12]

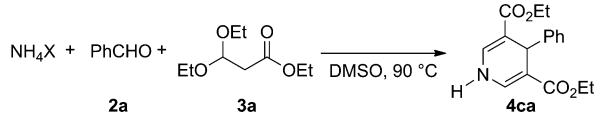
Table 2. Synthesis of 1,3,4,5-tetrasubstituted bis-DHPs with amine hydrochlorides and various dialdehydes.

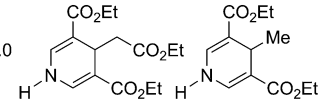


Product (yield)
 **4ba** (48%[a])
 **4bb** (34%)
 **4bc** (60%)
 **4bd** (61%)

[a] Diethyl 1-benzyl-4-(4-formylphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (**4ba′**) was obtained in 13% yield.

Table 3. Synthesis of 1-hydro-3,4,5-trisubstituted 1,4-DHPs with ammonium salts.



Entry	Ammonium salt (equiv.)	**2a** (equiv.)	**3a** (equiv.)	Results (yield)
1	NH_4Cl (15)	1.0	2.5	**4ca** (52%)
2	NH_4Cl (15)	1.0	2.5	n.r.[a]
3	NH_4OAc (15)	1.0	2.5	n.r.
4	NH_4HCO_3 (15)	1.0	2.5	n.d.
5	NH_4BF_4 (15)	1.0	2.5	**4ca** (44%)
6	NH_4BF_4 (1.0)	1.1	2.5	**4ca** (20%)
7	NH_4Cl (6.0)	0	1.0	 **5** (32%) **6** (17%)

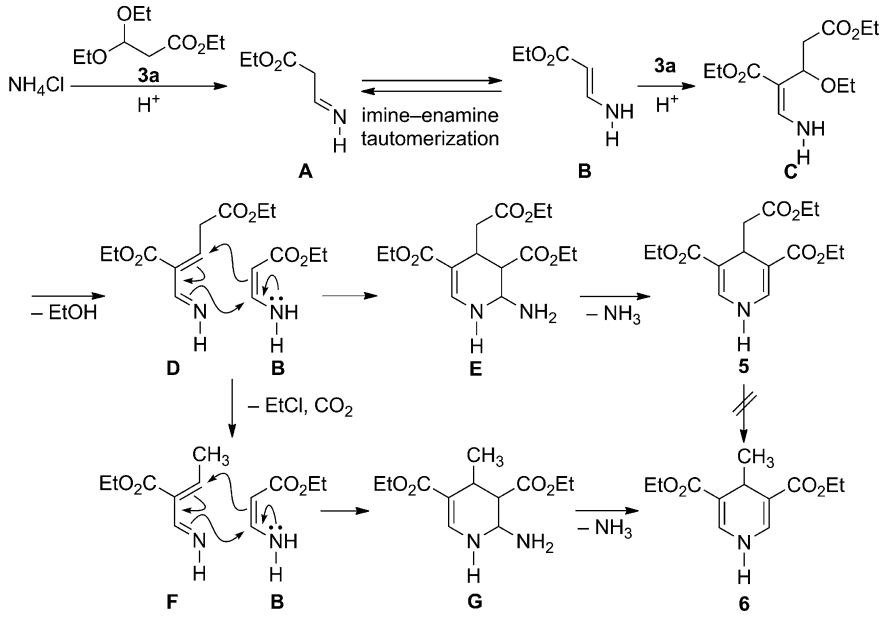
[a] 1,4-Dioxane was used as solvent; n.r.: no reaction, n.d.: not determined.

To clarify the possibility of the de-esterification of **5** to give **6**, we treated **5** with ammonium chloride in DMSO at 90 °C, but **6** was not formed and the starting triester **5** was recovered in 98% yield. A plausible reaction mechanism for the formation of **5** and **6** is shown in Scheme 1. First, in the presence of an acid catalyst, ammonium chloride and activated ethyl 3,3-diethoxypropionate reacts to form imine **A**. This imine intermediate **A** easily tautomerizes into enamine intermediate **B** and reacts with activated aldehyde to form enamine **C**. The subsequent elimination of ethanol gives α,β-unsaturated imine **D**. Michael-type annulation of intermediate **D** and intermediate **B** yields tetrahydropyridine **E**. Elimination of ammonia from **E** affords 1,4-DHP **5**. As shown above, **6** does not seem to form directly from **5**, but rather from α,β-unsaturated imine **D** by alkyl fission[13] of the ester with chloride anions. Subsequent elimination of ammonia from the corresponding tetrahydropyridine **G** to afford the decarboxylated product **6** is plausible.

The reactions of ammonium chloride, benzaldehydes **2**, and **3a** at 90 °C in DMSO gave various 1,4-DHPs **4c** in moderate yields (Table 4).

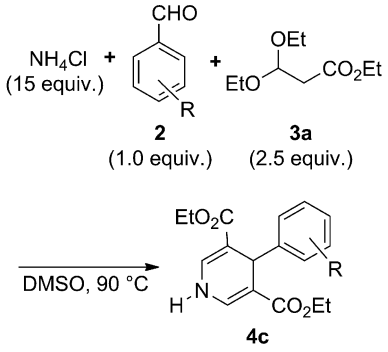
1-Hydro-3,4,5-trisubstituted 1,4-DHPs **4c** are useful intermediates in the synthesis of *N*-substituted 1,4-DHPs. Representative transformations of **4ca** with various *N*-protecting reagents are shown in Equation (4). In addition, **4ca** was readily oxidized to give multisubstituted pyridine **7** in 89% yield.[14,15]

As described above, various 3,4,5-trisubstituted 1,4-DHPs with ethoxycarbonyl groups at the 3- and 5-positions have been synthesized. We next studied the synthesis of 1,4-



Scheme 1. Plausible reaction mechanism for the formation of **5** and **6**.

Table 4. Synthesis of 1-hydro-3,4,5-trisubstituted 1,4-DHPs using ammonium chloride and various benzaldehydes.



Entry	R	Product (yield%)[a]
1	H	**4ca** (55)
2	4-OMe	**4cb** (57)
3	4-OH	**4cc** (40)
4	3-NO_2	**4cd** (51)
5	4-NO_2	**4ce** (67)
6	2-Cl	**4cf** (47)
7	3-Cl	**4cg** (47)
8	4-Cl	**4ch** (44)

[a] Isolated yields based on arylaldehyde **2**.

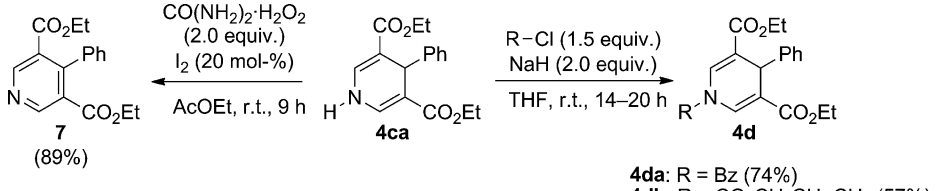
DHPs bearing other EWGs at the 3- and 5-positions. Reactions were performed with various acetals containing cyano, nitro, acetyl, and benzoyl groups. As shown in Table 5, the reactions proceeded to give **4e** in moderate-to-good yields. The synthesis of 1,4-DHPs **4ee**–**4el** with nitro groups at the 3- and 5-positions has scarcely been reported.[10,16,17] The structures of **4ek** and **4er** were identified by single-crystal X-ray structure analysis (see the Supporting Information).[18]

This method was also applied to the reactions of amine hydrochloride salts with 1,1,3,3-tetraethoxypropane (**8**), a highly reactive and unstable malonoaldehyde. 3,5-Diformylated 1,4-DHPs **4f** were obtained in moderate yields by this method (Table 6).

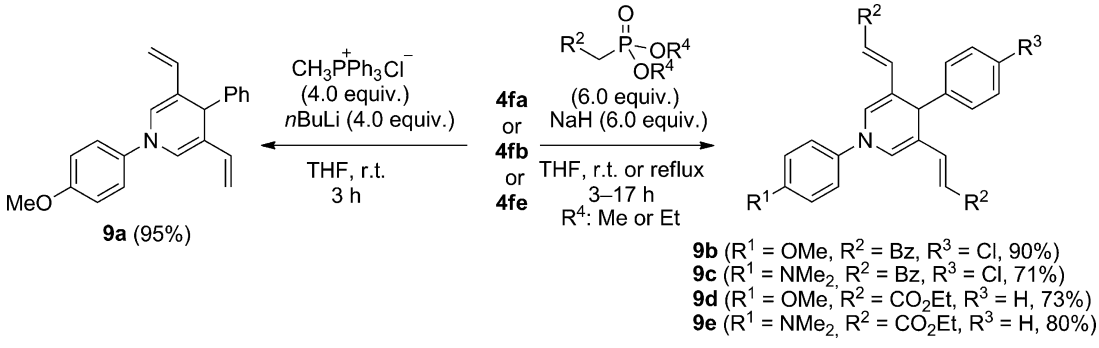
The transformation of 3,5-diformylated 1,4-DHP is useful for the synthesis of extended π-conjugated DHPs. In the reaction of **4fa** with the Wittig reagent shown in Scheme 2, 3,5-dialkenylated 1,4-DHP **9a** was obtained in 95% yield. On the other hand, Horner–Wadsworth–Emmons reaction of **4fb** or **4fe** gave 3,5-bis(substituted-alkenylated) 1,4-DHPs **9b**–**e** in good yields. The structure of **9c** was determined by single-crystal X-ray structure analysis (see the Supporting Information).[18]

The fluorescence of the synthesized DHPs was measured in $CHCl_3$ and DMSO (25 μM) following excitation at the absorption maximum (270–370 nm). The fluorescence properties of 3,5-bis(ethoxycarbonyl)-1,4-DHPs[19] are summarized in Table 7.

The *N*-aryl-substituted DHPs bearing electron-donating groups, such as methoxy or hydroxy, exhibited blue fluorescence with good quantum yields (Table 7, entries 1 and 2). *N*-[4-(Dimethylamino)phenyl]-1,4-DHP gave a lower quantum yield, but a bathochromic effect was observed (Table 7, entry 3). DHPs with a nitro group exhibited no fluorescence (Table 7, entries 4 and 15).[20] DHPs with other EWGs, such as halogen atoms, exhibited weak fluorescence (Table 7, en-

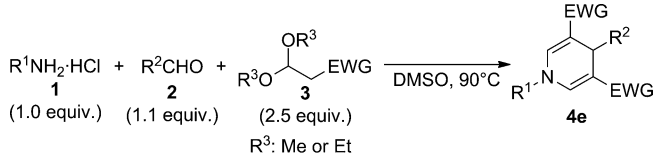


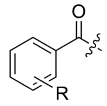
(4)



Scheme 2. Transformations of **4fa**, **4fb**, and **4fe** by using Wittig and Horner–Wadsworth–Emmons reagents.

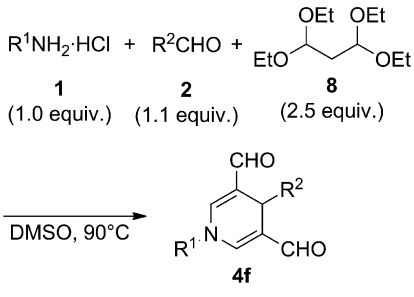
Table 5. Synthesis of 3,4,5-trisubstituted 1,4-DHPs with various electron-deficient acetals.



Entry	R^1	R^2	EWG	**4e** (yield%)
1	4-(OMe)(C_6H_4)	Ph	CN	**4ea** (33)
2	4-(OMe)(C_6H_4)	4-(OMe)(C_6H_4)	CN	**4eb** (30)
3	PMB	Ph	CN	**4ec** (26)
4	H	Ph	CN	**4ed** (48)
5	4-(OMe)(C_6H_4)	Ph	NO_2	**4ee** (44)
6	4-F(C_6H_4)	Ph	NO_2	**4ef** (38)
7	2,4,6-Me_3(C_6H_2)	Ph	NO_2	**4eg** (47)
8	4-(OMe)(C_6H_4)	4-(OMe)(C_6H_4)	NO_2	**4eh** (37)
9	Ph	Ph	NO_2	**4ei** (31)
10	PMB	Ph	NO_2	**4ej** (68)
11	4-(NMe_2)(C_6H_4)	Ph	NO_2	**4ek** (n.r., 40[a])
12	H	Ph	NO_2	**4el** (55)
13	4-(OMe)(C_6H_4)	Ph	Ac	**4em** (33)
14	Ph	4-(Cl)(C_6H_4)	Ac	**4en**(38)
15	PMB	Ph	Ac	**4eo** (72)
16	H	Ph	Ac	**4ep** (59)
				
17	4-(OMe)(C_6H_4)	4-Cl(C_6H_4)	R = H	**4eq** (43)
18	4-(NMe_2)(C_6H_4)	4-Cl(C_6H_4)	R = H	**4er** (42)
19	4-(OMe)(C_6H_4)	4-Cl(C_6H_4)	R = 4-Cl	**4es** (59)
20	4-(OMe)(C_6H_4)	4-Cl(C_6H_4)	R = 4-OMe	**4et** (63)

[a] The reaction was carried out by using *N*,*N*-dimethyl-1,4-phenylenediamine with Yb(OTf)$_3$ as catalyst instead of with the *N*,*N*-dimethyl-1,4-phenylenediamine hydrochloride salt.

Table 6. Synthesis of 3,5-diformyl-1,4-DHPs with 1,1,3,3-tetraethoxypropane (**8**).

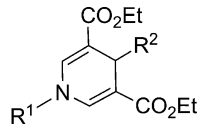


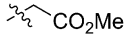
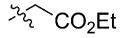
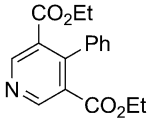
Entry	R^1	R^2	Product (yield%)
1	4-(OMe)(C_6H_4)	Ph	**4fa** (40)
2	4-(OMe)(C_6H_4)	4-Cl(C_6H_4)	**4fb** (25)
3	4-(OMe)(C_6H_4)	CO_2Et	**4fc** (29)
4	4-Cl(C_6H_4)	Ph	**4fd** (30)
5	4-(NMe_2)(C_6H_4)	Ph	**4fe** (39)
6	4-(NMe_2)(C_6H_4)	4-Cl(C_6H_4)	**4ff** (32)
7	PMB	Ph	**4fg** (51)
8	H	4-Cl(C_6H_4)	**4fh** (23)

tries 5–7). The fluorescence quantum yield of *N*-(4-iodophenyl)-1,4-DHP is low because of the heavy atom effect (Table 7, entry 8). The fluorescence quantum yields and substituent effects of the *N*-aryl moiety, with the exception of *N*-[4-(dimethylamino)phenyl]- and *N*-(4-iodophenyl)-1,4-DHP, show a good Hammett correlation (Figure 3). In general, the quantum yield of fluorescence decreases due to a nonradiative transition from the singlet excited state and intersystem crossing between singlet and triplet excited states. These factors could not be estimated from the inductive effect, that is, the substituent effects of the DHPs. The *N*-alkyl- and 1-hydro-DHPs also exhibited blue fluorescence with good quantum yields (Table 7, entries 9–14). Compared with the results of entries 12–14 in Table 7, the introduction of methyl or ethoxycarbonylmethyl groups at the 4-position of DHP did not change the fluorescence properties of DHPs (Table 7, entries 16 and 17). The quantum yields of the DHPs with benzoyl, allyloxycarbonyl, and *p*-tosyl as *N*-protecting groups were drastically lower and the fluorescence was quenched, however, with *N*-*tert*-butyldimethylsilyl-DHP, a moderate quantum yield was obtained (Table 7, entries 18–21). We also examined the fluorescence properties of pyridine **7**, but no fluorescence was observed (Table 7, entry 22). This result shows that the 1,4-dihydropydine scaffold is important for strong florescence.

The fluorescence properties of 1,4-DHPs bearing other EWGs at the 3- and 5-positions were also measured. DHPs with a cyano group at the 3- and 5-positions showed weak

Table 7. Fluorescence properties of 3,5-bis(ethoxycarbonyl)-1,4-DHPs with various functional groups.[a]



Entry	R^1	R^2	λ_{abs} (nm)	λ_{em} (nm)[b]	ε (10^3 $M^{-1}cm^{-1}$)	Φ[c]
1	(4-OMe)(C_6H_4)	Ph	276	430	20	0.79
2	(4-OH)(C_6H_4)	Ph	274	441	13	0.80
3	(4-NMe_2)(C_6H_4)	Ph	287	486	19	0.22
4	(4-NO_2)(C_6H_4)	Ph	370	–	20	0.00
5	(4-F)(C_6H_4)	Ph	276	415	18	0.55
6	(2-Cl)(C_6H_4)	Ph	278	403	14	0.41
7	(4-Br)(C_6H_4)	Ph	290	412	22	0.37
8	(4-I)(C_6H_4)	Ph	296	413	25	0.10
9	PMB	Ph	375	420	6.7	0.62
10		Ph	276	430	11	0.72
11	PMB	(4-OMe)(C_6H_4)	370	419	7.1	0.76
12	H	Ph	354	416	6.4	0.79
13	H	(4-OMe)(C_6H_4)	352	413	5.8	0.73
14	H	(4-Cl)(C_6H_4)	354	414	5.9	0.94
15	H	(4-NO_2)(C_6H_4)	362	421	6.0	0.01
16	H		348	424	5.1	0.72
17	H	Me	348	425	4.3	0.90
18	Bz	Ph	284	–	13	0.00
19	$CO_2CH_2CH=CH_2$	Ph	310	417	5.8	0.08
20	TBS	Ph	356	420	6.8	0.51
21	*p*-Ts	Ph	312	417	5.1	0.01
22			240	–	8.2	0.00

[a] In $CHCl_3$ (25 μM). [b] Excited at λ_{abs} (nm). [c] Relative quantum yields, based on quinine sulfate as the standard (Φ_q = 0.55).

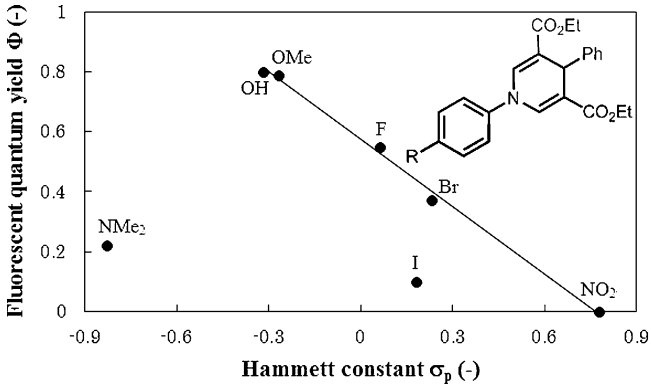


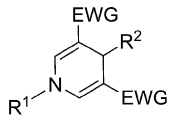
Figure 3. Correlation between the fluorescent quantum yields of the *N*-aryl-1,4-DHPs and the Hammett constants.

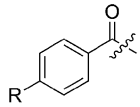
blue fluorescence (Table 8, entries 1–3). Large Stokes shifts were observed when the substituents at the 3- and 5-positions were changed to nitro groups (Table 8, entries 4–8). Notably, DHPs with nitro groups at the 3- and 5-positions exhibited green fluorescence, but DHPs with nitrophenyl groups at the 1- or 4-positions exhibited no fluorescence. In the case of 3,5-diacetyl- and 3,5-diformyl-1,4-DHPs, larger Stokes shifts were observed compared with those of 1,4-DHPs bearing ethoxycarbonyl or cyano groups, but they showed low quantum yields (Table 8, entries 9–14). A benzoyl substituent at the 3- and 5-positions of 1,4-DHPs induced bathochromic effects, especially in the case of a dimethylamino group (Table 8, entries 15–18).

Based on the results in Table 7 and Table 8, DHPs with extended π-conjugation were expected to provide a longer fluorescence wavelength. Indeed, 3,5-dialkenylated 1,4-DHPs produced green fluorescence (Table 9, entries 1–3), and 1,4-DHPs with chalcone moieties at the 3- and 5-positions exhibited orange fluorescence (Table 9, entry 4).

We also measured the fluorescence of **9e** in various solvents. Compound **9e** exhibited blue fluorescence in $CHCl_3$ (Table 9). In less-polar solvents, such as cyclohexane, **9e** exhibited a hypochromic effect, and in other polar solvents (such as ethyl acetate, acetonitrile, and DMSO), it exhibited

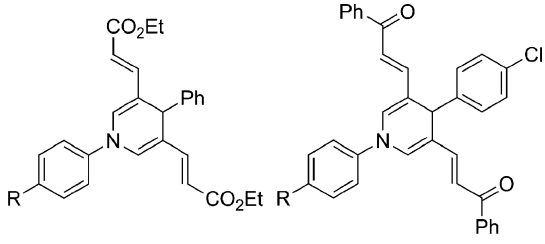
Table 8. Fluorescence properties of 1,4-DHPs with various EWGs at the 3- and 5-positions.[a]



Entry	R^1	R^2	EWG	λ_{abs} (nm)	λ_{em} (nm)[b]	ε (10^3 $M^{-1}cm^{-1}$)	Φ[c]
1	(4-OMe)(C_6H_4)	Ph	CN	260	423	21	0.23
2	(4-OMe)(C_6H_4)	(4-OMe)(C_6H_4)	CN	360	424	5.6	0.29
3	PMB	Ph	CN	360	417	5.6	0.07
4	(4-OMe)(C_6H_4)	Ph	NO_2	342	542	17	0.11
5	Ph	Ph	NO_2	320	497	12	0.11
6	(4-F)(C_6H_4)	Ph	NO_2	318	497	9.5	0.08
7	(4-OMe)(C_6H_4)	(4-OMe)(C_6H_4)	NO_2	324	–	11	0.00
8	PMB	Ph	NO_2	312	496	7.8	0.12
9	(4-OMe)(C_6H_4)	Ph	Ac	284	462	18	0.24
10	PMB	Ph	Ac	271	452	14	0.17
11	H	Ph	Ac	368	447	7.4	0.19
12	(4-OMe)(C_6H_4)	Ph	CHO	278	451	21	0.22
13	(4-OMe)(C_6H_4)	CO_2Et	CHO	277	459	18	0.35
14	PMB	Ph	CHO	262	452	15	0.06
							
15	(4-OMe)(C_6H_4)	(4-Cl)(C_6H_4)	R = H	302	477	13	0.39
16	(4-NMe_2)(C_6H_4)	(4-Cl)(C_6H_4)	R = H	317	534	15	0.06
17	(4-OMe)(C_6H_4)	(4-Cl)(C_6H_4)	R = 4-Cl	304	482	12	0.43
18	(4-OMe)(C_6H_4)	(4-Cl)(C_6H_4)	R = 4-OMe	284	466	22	0.36

[a] In $CHCl_3$ (25 μM). [b] Excited at λ_{abs} [nm]. [c] Relative quantum yields, based on quinine sulfate as the standard (Φ_q = 0.55).

Table 9. Fluorescence properties of 3,5-dialkenylated 1,4-DHPs.[a]



	R = OMe	R = NMe_2	R = OMe	R = NMe_2
Entry:	1	2	3	4
λ_{abs} (nm)	326	334	380	389
λ_{em} (nm)[b]	480	527	544	596
ε (10^3 $M^{-1}cm^{-1}$)	21	25	16	21
Φ[c]	0.30	0.17	0.15	0.01

[a] In $CHCl_3$ (25 μM). [b] Excited at λ_{abs} [nm]. [c] Relative quantum yields, based on quinine sulfate as the standard (Φ_q = 0.55).

a bathochromic effect (Table 10 and Figure 4). These results suggest that the excitation state of **9e** is stabilized by polar solvents.[4e]

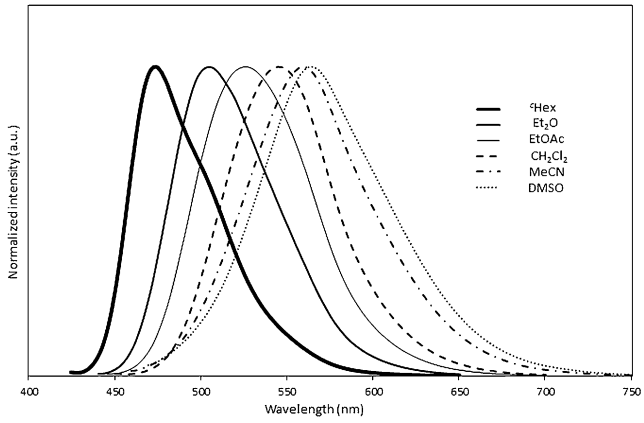
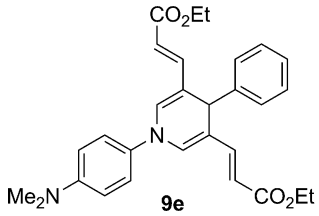


Figure 4. Fluorescence spectra of **9e** in various solvents.

Table 10. Solvatochromism of **9e** in various solvents.[a]

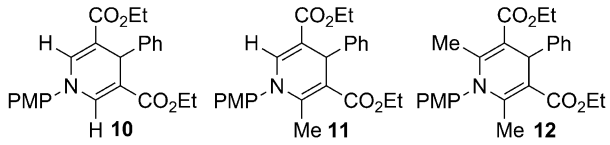


9e

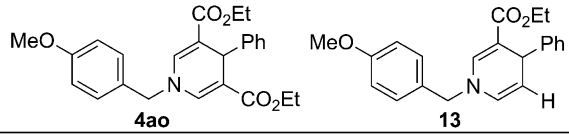
Solvent	cHex	Et_2O	AcOEt	CH_2Cl_2	MeCN	DMSO
λ_{abs} (nm)	419	435	440	445	445	455
λ_{em} (nm)[a]	473	505	526	545	560	565
ε (10^3 $M^{-1}cm^{-1}$)	4.7	16	16	17	17	15
Φ[b]	0.43	0.32	0.18	0.14	0.01	0.01

[a] 25 μM. [b] Excited at λ_{abs} [nm]. [c] Relative quantum yields, based on quinine sulfate as the standard (Φ_q = 0.55).

Table 11. Fluorecence properties of other related 1,4-DHPs.[a]



Entry:	1	2	3
λ_{abs} (nm)	276	360	346
λ_{em} (nm)[b]	430	434	-
ε (10^3 $M^{-1}cm^{-1}$)	20	16	5.6
Φ[c]	0.79	0.03	0.00



Entry:	4	5
λ_{abs} (nm)	375	346
λ_{em} (nm)[b]	420	426
ε (10^3 $M^{-1}cm^{-1}$)	6.7	4.0
Φ[c]	0.62	0.06

[a] In $CHCl_3$ (25 μM). [b] Excited at λ_{abs} [nm]. [c] Relative quantum yields, based on quinine sulfate as the standard (Φ_q = 0.55). PMP = *p*-methoxyphenyl.

Finally, we investigated the fluorescence properties of other related DHPs to clarify the relationship between fluorescence and structure of the DHPs. 2,6-Dihydro-1,4-DHP **10** showed strong blue fluorescence, but the fluorescence of **11** and Hantzsch ester **12**[21] (Table 11, entries 1–3) was quenched. These results suggest that the excitation mode of **10**, which produced strong fluorescence, allows a π–π* transition, whereas **11** and **12** showed almost no fluorescence because the introduction of a freely rotating alkyl chain into the fluorophore enhances the nonradiative internal conversion.[22] Interestingly, the fluorescence of 1,4-dihydronicotinate **13** was weaker than that of 1,4-DHP **4ao** (Table 11, entries 4 and 5), which also suggests that the two ethoxycarbonyl groups play an important role in producing strong fluorescence because of efficient conjugation with the DHP core structure.

Conclusions

Amine or quaternary ammonium hydrochloride salts reacted with aldehydes and acetals to give 1,4-DHPs without the addition of a catalyst. The synthesized 1,4-DHPs tolerated various functional groups and were produced in good yields. 3,4,5-Trisubstituted 1,4-DHPs with various functional groups (such as cyano, nitro, acetyl, formyl, benzoyl, and alkenyl) were also synthesized in satisfactory yields. This synthetic method is also a useful tool for preparing 2,6-unsubstituted 1,4-DHPs. The synthesized 3,4,5-trisubstituted 1,4-DHPs exhibited fluorescence in the range 403–596 nm. We expect that this synthetic strategy and the fluorescence data will benefit medicinal chemistry and materials science.

Experimental Section

General: All reactions were carried out in air except for some reactions that required an inert atmosphere. Column chromatography was performed by using silica gel 60N. 1,1-Diethoxy-2-nitroethane (**3c**),[23] 3,3-dimethoxy-1-phenylpropan-1-one (**3da**),[24] 1-(4-chlorophenyl)-3,3-dimethoxypropan-1-one (**3db**),[24] 3,3-dimethoxy-1-(4-methoxyphenyl)propan-1-one (**3dc**),[24] and diethyl 2-oxo-2-phenylethylphosphonate[25] were prepared according to literature procedures. All other reagents and solvents were purchased from Aldrich Co., Tokyo Kasei Kogyo Co., and Wako Pure Chemical Industries, and used without any purification.

^1H and ^{13}C NMR spectra were recorded in $CDCl_3$ or [D_6]DMSO with JEOL Lambda 500 and JNM-ECX500 spectrometers. Proton chemical shifts are reported relative to Me_4Si ($CDCl_3$) at δ = 0.00 ppm or residual solvent peaks ($CDCl_3$: δ = 7.26 ppm; [D_6]-DMSO: δ = 2.50 ppm). Carbon chemical shifts are reported relative to $CDCl_3$ at δ = 77.00 ppm or [D_6]DMSO at δ = 39.50 ppm. Multiplicities are indicated as br. (broadened), s (singlet), d (doublet), t (triplet), q (quartet), sept (septet), and m (multiplet). IR spectra were recorded with Thermo Fisher Scientific Nicolet6700 and JEOL JIR-WINSPEC 50 FT-IR spectrometers. Bands are characterized as br (broadened), s (strong), m (medium), and w (weak). The enantiomeric excesses were determined by HPLC analysis conducted with a JASCO HPLC instrument (pump: PU-2080; detector: UV-2075, measured at 254 nm; chiral column; mobile phase: 2-propanol/*n*-hexane). High-resolution mass spectra were recorded with JEOL JMS-SX102A (FAB) or LCQ-DECA (ESI) spectrometers. Elemental analysis was performed by the Material Characterization Central Laboratory of Waseda University. X-ray crystallographic analyses were performed with a Rigaku R-AXIS RAPID diffractometer using graphite-monochromated Mo-K_α radiation. Optical rotations were measured with a JASCO DIP-1000 polarimeter.

Fluorescence spectra were recorded with an HITACHI F-2500 spectrofluorimeter. To determine the quantum efficiency of fluores-

cence (Φ), quinine sulfate in H_2O (Φ = 0.55) was used as fluorescence standard. UV/Vis absorption spectra of solutions were recorded with a JASCO V-570 spectrophotometer. The fluorescence quantum efficiencies were calculated according to Equation (5), in which F is the area under the fluorescence band [$F = \Sigma I_{ex}(\lambda)$, with $I_{ex}(\lambda)$ the fluorescence intensity at each emission wavelength], A is the absorbance at the excitation wavelength, and n is the refractive index of the solvent.[26]

$$\Phi_X = \Phi_{st} \cdot \left(\frac{F_x}{F_{st}}\right) \cdot \left(\frac{A_{st}}{A_X}\right) \cdot \left(\frac{{n_X}^2}{{n_{st}}^2}\right) \quad (5)$$

To calculate Φ_X, the following refractive indexes of the solvents were used:

$n_{H_2O} = 1.3334$, $n_{CHCl_3} = 1.4467$, $n_{DMSO} = 1.4775$, $n\ ^cHex = 1.4248$, $n_{Et_2O} = 1.3523$, $n_{AcOEt} = 1.3707$, $n_{DCM} = 1.3334$, $n_{MeCN} = 1.3443$

General Procedure for the One-Pot Synthesis of Dihydropyridine 4a: A mixture of amine hydrochloride salt (1.0 equiv.), ethyl 3,3-diethoxypropionate (2.5 equiv.), and aldehyde (1.1 equiv.) in DMSO (1.5 mL/1 equiv.) was stirred at 90 °C for 6–17 h. After the reaction, the resulting mixture was washed with PBS buffer solution (25 mL) and extracted with CH_2Cl_2 (3× 15 mL). The organic layer was dried with $MgSO_4$. Removal of the solvent in vacuo followed by column chromatography on silica gel (AcOEt/*n*-hexane or $CHCl_3$/MeOH) afforded dihydropyridine **4a**.

Triethyl 1-Benzyl-1,4-dihydropyridine-3,4,5-tricarboxylate (4aa): Yellow powder (120 mg, 62%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.24 (t, J = 7.4 Hz, 3 H), 1.27 (t, J = 7.4 Hz, 6 H), 4.14 (q, J = 7.4 Hz, 2 H), 4.12–4.25 (m, 4 H), 4.57 (s, 2 H), 4.68 (s, 1 H), 7.23 (d, J = 6.8 Hz, 2 H), 7.26 (s, 2 H), 7.32 (t, J = 7.7 Hz, 1 H), 7.38 (dd, J = 6.8, 7.7 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 14.2, 38.3, 58.0, 60.3, 60.9, 104.2, 126.8, 128.1, 129.0, 135.8, 139.2, 166.5, 173.0 ppm. IR (KBr): $\tilde{\nu}$ = 3405 (br), 2981 (w), 2937 (w), 2906 (w), 1731 (s), 1702 (s), 1627 (w), 1581 (w), 1456 (w), 1369 (w), 1278 (m), 1189 (s), 1093 (m), 1078 (m), 1029 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{26}NO_6$ [M + H]$^+$ 388.1760; found 388.1730.

Diethyl 1-Benzyl-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4ab): Yellow powder (130 mg, 66%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.08 (t, J = 7.1 Hz, 6 H), 3.93–4.03 (m, 4 H), 4.49 (s, 2 H), 4.83 (s, 1 H), 7.05 (t, J = 7.1 Hz, 1 H), 7.13 (t, J = 7.7 Hz, 2 H), 7.20–7.23 (m, 6 H, aromatic H), 7.28 (t, J = 7.3 Hz, 1 H), 7.33 (t, J = 7.3 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.3, 58.2, 60.0, 109.0, 126.3, 127.2, 127.8, 128.2, 128.3, 129.1, 136.1, 137.5, 146.5, 166.8 ppm. IR (KBr): $\tilde{\nu}$ = 3440 (br), 3077 (w), 3062 (w), 3029 (w), 2987 (w), 2973 (w), 2954 (w), 2939 (w), 2904 (w), 1693 (s), 1662 (s), 1577 (s), 1494 (w), 1456 (w), 1446 (w), 1417 (m), 1390 (w), 1373 (m), 1365 (w), 1315 (w), 1303 (w), 1284 (m), 1245 (m), 1205 (s), 1187 (s), 1112 (w), 1085 (w), 1024 (w), 991 (w), 755 (w), 736 (w), 717 (w), 698 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{26}NO_4$ [M + H]$^+$ 392.1862; found 392.1869.

Diethyl 1-Benzyl-4-(3-nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ac): Yellow powder (174 mg, 80%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.17 (t, J = 7.9 Hz, 6 H), 4.00–4.13 (m, 4 H), 4.63 (s, 2 H), 5.04 (s, 1 H), 7.32 (s, 2 H), 7.33 (d, J = 7.4 Hz, 2 H), 7.38 (dd, J = 7.4, 7.9 Hz, 2 H), 7.47, (t, J = 7.9 Hz, 1 H), 7.47 (dd, J = 7.9, 7.9 Hz, 1 H), 7.68 (d, J = 7.9 Hz, 1 H), 8.02 (d, J = 7.9 Hz, 1 H), 8.15 (s, 1 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 37.4, 58.2, 60.1, 107.9, 121.4, 123.0, 127.0, 128.3, 128.4, 129.1, 134.5, 135.7, 138.1, 148.2, 148.6, 166.2 ppm. IR (KBr): $\tilde{\nu}$ = 3446 (br), 3070 (w), 3031 (w), 2981 (w), 2929 (w), 2904 (w), 1704 (s), 1685 (s), 1571 (s), 1527 (m), 1419 (m), 1363 (w), 1346 (m), 1307 (w), 1295 (w), 1205 (s), 1178 (s), 1085 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{25}N_2O_6$ [M + H]$^+$ 437.1713; found 437.1716. $C_{24}H_{24}N_2O_6$ (436.46): calcd. C 66.04, H 5.54, N 6.42; found C 66.19, H 5.58, N 6.54.

Diethyl 1-Benzyl-4-(4-nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ad): Yellow powder (185 mg, 62%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.10 (t, J = 7.1 Hz, 6 H), 3.95–4.04 (m, 4 H), 4.56 (s, 2 H), 4.98 (s, 1 H), 7.23 (d, J = 7.3 Hz, 2 H), 7.27 (s, 2 H), 7.32 (t, J = 7.3 Hz, 1 H), 7.36 (dd, J = 7.3, 7.3 Hz, 2 H), 7.37 (d, J = 8.6 Hz, 2 H), 8.01 (d, J = 8.6 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.7, 58.3, 60.2, 107.9, 123.2, 127.1, 128.5, 129.0, 129.1, 135.8, 138.1, 146.4, 153.5, 166.2 ppm. IR (KBr): $\tilde{\nu}$ = 2993 (w), 2904 (w), 1698 (s), 1664 (w), 1581 (s), 1513 (m), 1417 (w), 1373 (w), 1344 (s), 1284 (m), 1240 (m), 1207 (m), 1186 (s), 1081 (s), 1029 (w), 983 (w), 852 (w), 827 (w), 754 (w), 725 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{25}N_2O_6$ [M + H]$^+$ 437.1713; found 437.1718.

Diethyl 1-Benzyl-4-(2-chlorophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ae): Pale-yellow crystal (167 mg, 78%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.10 (t, J = 7.1 Hz, 6 H), 3.98–4.04 (m, 4 H), 4.53 (s, 2 H), 5.35 (s, 1 H), 7.01 (td, J = 7.7, 1.7 Hz, 1 H), 7.08 (td, J = 7.7, 1.3 Hz, 1 H), 7.21 (dd, J = 7.7, 1.3 Hz, 1 H), 7.24 (dd, J = 7.7, 1.7 Hz, 1 H), 7.26–7.28 (m, 4 H, aromatic H), 7.32 (t, J = 7.2 Hz, 1 H), 7.38 (dd, J = 7.5, 7.2 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 34.6, 58.1, 60.0, 108.8, 126.6, 127.2, 127.3, 128.3, 128.9, 129.0, 131.3, 132.7, 135.9, 138.0, 144.5, 166.7 ppm. IR (KBr): $\tilde{\nu}$ = 3064 (w), 2987 (w), 2933 (w), 1702 (s), 1681 (s), 1658 (w), 1573 (s), 1473 (w), 1419 (m), 1388 (w), 1365 (w), 1307 (m), 1284 (w), 1230 (m), 1172 (s), 1078 (m), 1033 (m), 908 (w), 836 (w), 759 (m), 703 (m), 647 (w), 609 (w), 570 (w), 514 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{25}ClNO_4$ [M + H]$^+$ 426.1472; found 426.1459.

Diethyl 1-Benzyl-4-(3-chlorophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4af): Pale-yellow crystal (148 mg, 69%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.08 (t, J = 7.1 Hz, 6 H), 3.91–4.04 (m, 4 H), 4.48 (s, 2 H), 4.82 (s, 1 H), 7.02 (tt, J = 8.0, 1.8 Hz, 1 H), 7.05 (dd, J = 8.0, 7.3 Hz, 1 H), 7.11 (d, J = 7.3 Hz, 1 H), 7.17 (s, 1 H), 7.19 (d, J = 7.8 Hz, 2 H), 7.20 (s, 2 H), 7.25 (t, J = 7.1 Hz, 1 H), 7.32 (dd, J = 7.8, 7.1 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 37.2, 58.2, 60.0, 108.4, 126.4, 127.0, 128.3, 128.29, 128.34, 128.9, 129.1, 133.7, 136.0, 137.8, 148.4, 166.5 ppm. IR (KBr): $\tilde{\nu}$ = 3079 (w), 3064 (w), 2983 (m), 2935 (m), 2906 (w), 2875 (w), 1706 (s), 1689 (s), 1664 (m), 1577 (s), 1471 (m), 1415 (s), 1388 (m), 1365 (m), 1303 (s), 1284 (m), 1228 (s), 1170 (s), 1089 (m), 1078 (s), 1033 (m), 910 (m), 775 (m), 767 (m), 752 (m), 738 (m), 711 (m), 700 (m), 611 (w), 568 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{25}ClNO_4$ [M + H]$^+$ 426.1472; found 426.1459.

Diethyl 1-Benzyl-4-(4-chlorophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ag): Yellow oil (160 mg, 75%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.12 (t, J = 7.1 Hz, 6 H), 3.96–4.05 (m, 4 H), 4.52 (s, 2 H), 4.85 (s, 1 H), 7.13 (d, J = 8.4 Hz, 2 H), 7.17 (d, J = 8.4 Hz, 2 H), 7.22 (d, J = 6.8 Hz, 2 H), 7.24 (s, 2 H), 7.30 (t, J = 7.2 Hz, 1 H), 7.35 (dd, J = 7.2, 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 36.8, 58.2, 60.0, 108.6, 127.1, 127.9, 128.3, 129.0, 129.5, 131.9, 136.0, 137.6, 145.0, 166.5 ppm. IR (KBr): $\tilde{\nu}$ = 3438 (br), 3031 (w), 2981 (w), 2935 (w), 2904 (w), 2360 (w), 1700 (s), 1629 (w), 1583 (m), 1488 (m), 1456 (w), 1411 (m), 1390 (m), 1371 (m), 1303 (m), 1278 (m), 1230 (s), 1187 (s), 1076 (s), 1014 (m), 842 (w), 825 (w), 759 (w), 698 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{23}ClNO_4$ [M – H]$^+$ 424.1316; found 424.1310.

Diethyl 1-Benzyl-4-(3-hydroxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ah): Yellow oil (107 mg, 54%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.13 (t, J = 7.1 Hz, 6 H), 3.99–4.11 (m, 4 H), 4.49 (s, 2 H), 4.84 (s, 1 H), 6.40 (br. s, 1 H), 6.62 (ddd, J = 7.9, 2.6, 0.92 Hz, 1 H), 6.80–6.83 (m, 2 H), 7.04 (t, J = 7.9 Hz, 1 H), 7.24 (d, J = 7.0 Hz, 2 H), 7.27 (s, 2 H), 7.32 (t, J = 7.3 Hz, 1 H), 7.37 (dd, J = 7.3, 7.0 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 37.1, 58.1, 60.2, 108.8, 113.5, 115.4, 120.1, 127.2, 128.2, 128.8, 129.0, 136.0, 137.7, 148.0, 155.9, 167.1 ppm. IR (KBr): $\tilde{\nu}$ = 3396 (br), 3083 (w), 3031 (w), 2983 (w), 2954 (w), 2902 (w), 1691 (s), 1664 (s), 1556 (s), 1477 (w), 1452 (w), 1423 (w), 1380 (w), 1365 (w), 1351 (w), 1311 (m), 1205 (s), 1186 (s), 1083 (w), 1033 (w), 1024 (w), 991 (w), 962 (w), 927 (w), 806 (w), 796 (w), 725 (w), 690 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{26}NO_5$ [M + H]$^+$ 408.1811; found 408.1813.

Diethyl 1-Benzyl-4-(4-cyanophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ai): Yellow oil (105 mg, 50%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.16 (t, J = 7.0 Hz, 6 H), 4.01–4.12 (m, 4 H), 4.60 (s, 2 H), 4.97 (s, 1 H), 7.28 (d, J = 7.3 Hz, 2 H), 7.31 (s, 2 H), 7.38 (d, J = 8.2 Hz, 2 H), 7.39 (t, J = 6.4 Hz, 1 H), 7.40 (dd, J = 7.3, 6.4 Hz, 2 H), 7.50 (d, J = 8.2 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.8, 58.3, 60.1, 108.0, 110.0, 119.0, 127.1, 128.5, 128.7, 129.1, 131.7, 135.8, 138.0, 151.5, 166.3 ppm. IR (KBr): $\tilde{\nu}$ = 3064 (br), 3033 (w), 2983 (w), 2937 (w), 2902 (w), 2873 (w), 2227 (m), 1700 (s), 1627 (w), 2604 (w), 1581 (m), 1454 (w), 1371 (w), 1278 (w), 1232 (m), 1187 (s), 1076 (m), 1022 (w), 773 (w), 700 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{24}N_2NaO_4$ [M + Na]$^+$ 439.1628; found 439.1628.

Diethyl 1-Benzyl-4-(2-methoxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4aj): Pale-yellow crystal (114 mg, 54%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.11 (t, J = 7.1 Hz, 6 H), 3.71 (s, 3 H), 3.94–4.05 (m, 4 H), 4.53 (s, 2 H), 5.22 (s, 1 H), 6.76 (dd, J = 7.5, 7.4 Hz, 1 H), 6.80 (td, J = 7.5, 1.5 Hz, 1 H), 7.09 (dd, J = 7.4, 1.5 Hz, 1 H), 7.19 (dd, J = 7.4, 1.5 Hz, 1 H), 7.24 (s, 2 H), 7.29 (d, J = 6.9 Hz, 2 H), 7.33 (t, J = 7.8 Hz, 2 H), 7.39 (dd, J = 7.8, 6.9 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 32.2, 55.3, 58.1, 60.0, 108.6, 110.1, 120.1, 127.3, 127.5, 128.2, 129.0, 131.0, 135.0, 136.2, 138.0, 157.0, 167.1 ppm. IR (KBr): $\tilde{\nu}$ = 3066 (w), 3027 (w), 2977 (w), 2942 (w), 2898 (w), 1698 (s), 1679 (s), 1571 (s), 1494 (m), 1454 (w), 1419 (m), 1388 (w), 1365 (w), 1303 (m), 1263 (w), 1245 (w), 1199 (s), 1172 (s), 1083 (m), 1029 (m), 989 (w), 854 (w), 779 (w), 750 (m), 723 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{27}NO_5$ [M]$^+$ 421.1889; found 421.1873. $C_{25}H_{27}NO_5$ (421.49): calcd. C 71.24, H 6.46, N 3.32; found C 71.27, H 6.44, N 3.30.

Diethyl 1-Benzyl-4-(3-methoxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ak): Yellow oil (142 mg, 67%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.13 (t, J = 7.1 Hz, 6 H), 3.66 (s, 3 H), 3.96–4.09 (m, 4 H), 4.51 (s, 2 H), 4.86 (s, 1 H), 6.64 (dd, J = 7.4, 2.6 Hz, 1 H), 6.81 (dd, J = 2.6, 1.4 Hz, 1 H), 6.86 (dd, J = 7.9, 1.4 Hz, 1 H), 7.08 (dd, J = 7.9, 7.4 Hz, 1 H), 7.23 (d, J = 6.8 Hz, 2 H), 7.24 (s, 2 H), 7.29 (t, J = 7.4 Hz, 1 H), 7.34 (dd, J = 7.4, 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.2, 54.9, 58.1, 59.9, 108.8, 111.8, 113.8, 120.1, 127.1, 128.2, 128.6, 129.0, 136.1, 137.5, 148.0, 159.3, 166.7 ppm. IR (KBr): $\tilde{\nu}$ = 3064 (w), 3029 (w), 2981 (w), 2937 (w), 2906 (w), 2834 (w), 1700 (s), 1581 (m), 1484 (w), 1454 (w), 1411 (w), 1371 (w), 1276 (w), 1228 (m), 1187 (s), 1076 (m), 1029 (w), 782 (w), 696 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{27}NO_5$ [M]$^+$ 421.1889; found 421.1895.

Diethyl 1-Benzyl-4-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4al): Yellow oil (125 mg, 59%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.15 (t, J = 7.0 Hz, 6 H), 3.72 (s, 3 H), 3.99–4.10 (m, 4 H), 4.54 (s, 2 H), 4.84 (s, 1 H), 6.73 (d, J = 8.6 Hz, 2 H), 7.18 (d, J = 8.6 Hz, 2 H), 7.24 (s, 2 H), 7.25 (d, J = 7.6 Hz, 2 H), 7.32 (t, J = 7.6 Hz, 1 H), 7.38 (dd, J = 7.6, 7.6 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 36.4, 55.0, 58.1, 60.0, 109.1, 113.1, 127.1, 128.2, 129.0, 129.1, 136.2, 137.3, 139.1, 158.0, 166.8 ppm. IR (KBr): $\tilde{\nu}$ = 3372 (br), 2979 (m), 2935 (w), 2904 (w), 2834 (w), 1700 (s), 1608 (m), 1583 (s), 1508 (s), 1454 (m), 1413 (m), 1390 (m), 1371 (m), 1301 (m), 1278 (s), 1234 (s), 1174 (s), 1076 (s), 1031 (m), 975 (w), 904 (w), 846 (w), 827 (m), 752 (m), 700 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{27}NNaO_5$ [M + Na]$^+$ 444.1781; found 444.1781.

Diethyl 1-Benzyl-4-(furan-2-yl)-1,4-dihydropyridine-3,5-dicarboxylate (4am): Yellow crystal (90 mg, 47%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.22 (t, J = 7.1 Hz, 6 H), 4.07–4.20 (m, 4 H), 4.60 (s, 2 H), 5.09 (s, 1 H), 6.06 (d, J = 3.1 Hz, 1 H), 6.25 (dd, J = 3.1, 1.8 Hz, 1 H), 7.25 (d, J = 1.8 Hz, 1 H), 7.27 (s, 2 H), 7.28 (d, J = 7.7 Hz, 2 H), 7.32 (t, J = 7.3 Hz, 1 H), 7.38 (dd, J = 7.7, 7.3 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.3, 31.0, 58.2, 60.1, 105.4, 105.9, 110.3, 126.9, 128.2, 129.0, 136.3, 138.5, 141.0, 157.7, 166.7 ppm. IR (KBr): $\tilde{\nu}$ = 3446 (br), 3079 (w), 3066 (w), 3033 (w), 2985 (w), 2958 (w), 2940 (w), 2908 (w), 1697 (s), 1683 (s), 1664 (s), 1579 (s), 1496 (w), 1456 (w), 1446 (w), 1419 (m), 1373 (m), 1365 (m), 1282 (s), 1241 (w), 1207 (w), 1184 (s), 1112 (w), 1078 (s), 1022 (w), 1010 (w), 933 (w), 950 (w), 804 (m), 732 (m), 694 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{22}H_{23}NNaO_5$ [M + Na]$^+$ 404.1468; found 404.1468.

Diethyl 1-Benzyl-4-(thiophen-3-yl)-1,4-dihydropyridine-3,5-dicarboxylate (4an): Yellow crystal (81 mg, 40%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.11 (t, J = 7.1 Hz, 6 H), 3.98–4.09 (m, 4 H), 4.48 (s, 2 H), 4.98 (s, 1 H), 6.89 (d, J = 2.9 Hz, 1 H), 6.92 (dd, J = 4.9, 1.1 Hz, 1 H), 7.04 (tt, J = 4.9, 2.9 Hz, 1 H), 7.15 (d, J = 7.0 Hz, 2 H), 7.17 (s, 2 H), 7.25 (t, J = 7.6 Hz, 1 H), 7.30 (dd, J = 7.6, 7.0 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 32.1, 58.2, 60.0, 108.4, 121.2, 124.6, 127.0, 127.7, 128.2, 129.0, 136.2, 137.6, 147.3, 166.8 ppm. IR (KBr): $\tilde{\nu}$ = 3122 (w), 3102 (w), 3029 (w), 2983 (w), 2935 (w), 2896 (w), 1695 (s), 1681 (s), 1573 (s), 1494 (w), 1456 (w), 1419 (m), 1388 (w), 1378 (w), 1357 (w), 1311 (m), 1278 (m), 1189 (s), 1170 (s), 1078 (m), 1027 (w), 784 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{22}H_{23}NNaO_4S$ [M + Na]$^+$ 420.1237; found 420.1240.

Diethyl 1-(4-Methoxybenzyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4ao): Yellow solid (351 mg, 83%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.16 (t, J = 7.4 Hz, 6 H), 3.82 (s, 3 H), 3.99–4.11 (m, 4 H), 4.51 (s, 2 H), 4.89 (s, 1 H), 6.93 (d, J = 8.3 Hz, 2 H), 7.12 (t, J = 7.4 Hz, 1 H), 7.20 (dd, J = 7.4, 6.8 Hz, 2 H), 7.21 (d, J = 8.3 Hz, 2 H), 7.26 (s, 2 H), 7.26 (d, J = 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.4, 55.3, 57.8, 60.3, 109.0, 114.5, 126.3, 127.8, 128.1, 128.2, 128.7, 137.5, 146.6, 159.6, 166.9 ppm. IR (neat): $\tilde{\nu}$ = 3056 (w), 2987 (w), 2929 (w), 2838 (w), 1700 (m), 1683 (m), 1615 (w), 1572 (m), 1513 (m), 1443 (m), 1420 (m), 1387 (m), 1365 (m), 1306 (m), 1290 (m), 1246 (m), 1201 (m), 1170 (s), 1103 (m), 1078 (m), 1026 (m), 985 (m), 947 (m), 927 (m), 916 (m), 835 (m), 814 (m), 804 (m), 753 (m), 723 (m), 698 (m), 622 (w), 608 (m), 540 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{27}NNaO_5$ [M + Na]$^+$ 444.1787; found 444.1774.

Diethyl 1-(4-Methoxybenzyl)-4-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ap): Yellow oil (75 mg, 33%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.17 (t, J = 7.3 Hz, 6 H), 3.75 (s, 3 H), 3.82 (s, 3 H), 4.00–4.10 (m, 4 H), 4.50 (s, 2 H), 4.83 (s, 1 H), 6.74 (d, J = 9.0 Hz, 2 H), 6.93 (d, J = 8.3 Hz, 2 H), 7.17 (d, J = 9.0 Hz, 2 H), 7.21 (d, J = 8.3 Hz, 2 H), 7.24 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.5, 36.7, 55.4, 55.6, 58.1, 60.2, 109.4, 113.5, 114.7, 128.4, 128.9, 129.4, 137.5, 139.5, 158.3, 159.9, 167.3 ppm. IR (neat): $\tilde{\nu}$ = 2975 (w), 2925 (w), 2900 (w), 2833 (w),

1727 (m), 1698 (s), 1613 (w), 1574 (m), 1515 (m), 1247 (s), 1178 (s), 1074 (s), 1019 (m), 975 (w), 916 (w), 826 (w), 757 (w), 614 (w) cm^{-1}. HRMS (ESI): calcd. for $C_{23}H_{29}NNaO_7$ $[M + Na]^+$ 454.1842; found 454.1824.

Diethyl 1-[4-(Dimethylamino)phenyl]-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4aq): Orange solid (55 mg, 26%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.18 (t, J = 7.4 Hz, 6 H), 2.98 (s, 6 H), 4.02–4.15 (m, 4 H), 4.95 (s, 1 H), 6.74 (d, J = 10.2 Hz, 2 H), 7.14–7.17 (m, 3 H), 7.26 (t, J = 7.4 Hz, 2 H), 7.39 (d, J = 7.9 Hz, 2 H), 7.54 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.5, 40.6, 60.0, 109.6, 112.9, 122.8, 126.4, 127.9, 128.3, 130.1, 136.8, 146.5, 149.3, 167.0 ppm. IR (neat): $\tilde{\nu}$ = 2979 (w), 2905 (w), 1698 (s), 1663 (w), 1580 (m), 1567 (w), 1519 (m), 1489 (w), 1477 (w), 1450 (w), 1343 (m), 1325 (w), 1272 (m), 1229 (s), 1189 (s), 1105 (w), 1062 (w), 1024 (m), 943 (w), 906 (w), 865 (w), 836 (w), 821 (m), 777 (w), 750 (m), 727 (w), 711 (w), 698 (m), 646 (w), 612 (w), 567 (w), 542 (m) cm^{-1}. HRMS (ESI): calcd. for $C_{25}H_{28}N_2O_4$ $[M]^+$ 420.2049; found 420.2032.

Diethyl 4-(Naphthalen-1-yl)-1-[(naphthalen-2-yl)methyl]-1,4-dihydropyridine-3,5-dicarboxylate (4ar): Yellow crystal (247 mg, 73%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.14 (t, J = 7.0 Hz, 6 H), 3.97–4.08 (m, 4 H), 5.09 (s, 2 H), 5.10 (s, 1 H), 7.36–7.38 (m, 1 H), 7.39 (s, 2 H), 7.47–7.53 (m, 4 H), 7.57–7.66 (m, 5 H), 7.73–7.75 (m, 1 H), 7.91 (d, J = 7.9 Hz, 1 H), 7.95–7.98 (m, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.7, 56.3, 60.1, 109.1, 122.6, 125.2, 125.5 (2 C), 126.3, 126.4, 126.9, 127.0, 127.3, 127.4, 127.9, 129.2, 129.4, 130.9, 131.2, 132.4, 133.4, 134.0, 137.5 (2 C), 144.2, 166.9 ppm. IR (KBr): $\tilde{\nu}$ = 3058 (w), 2981 (w), 2950 (w), 2935 (w), 2900 (w), 1697 (s), 1664 (s), 1577 (s), 1508 (m), 1475 (w), 1457 (w), 1442 (w), 1415 (s), 1388 (s), 1371 (s), 1319 (m), 1282 (s), 1243 (s), 1186 (s), 1076 (s), 1029 (w), 1014 (w), 983 (w), 927 (w), 914 (w), 856 (w), 786 (s), 771 (w), 748 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{32}H_{29}NO_4$ $[M]^+$ 491.2097; found 491.2086.

Diethyl 4-Phenyl-1-[(pyren-1-yl)methyl]-1,4-dihydropyridine-3,5-dicarboxylate (4as): Yellow solid (146 mg, 57%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.01 (t, J = 7.4 Hz, 6 H), 3.85–3.98 (m, 4 H), 4.84 (s, 1 H), 5.01 (s, 2 H), 6.97 (t, J = 7.4 Hz, 1 H), 7.03 (dd, J = 7.4, 7.4 Hz, 2 H), 7.18 (d, J = 7.4 Hz, 2 H), 7.25 (s, 2 H), 7.71 (d, J = 7.7 Hz, 1 H), 7.85–7.91 (m, 4 H), 7.98 (dd, J = 9.1, 6.8 Hz, 2 H), 8.05 (dd, J = 7.7, 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.5, 56.1, 59.9, 109.1, 121.6, 124.4, 124.8, 124.9, 125.5, 125.7, 126.1, 126.2, 127.2, 127.7, 127.8 (2 C), 128.19, 128.23 (2 C), 128.4, 130.4, 131.1, 131.5, 137.4, 146.4, 166.8 ppm. IR (neat): $\tilde{\nu}$ = 2976 (br), 1686 (s), 1650 (m), 1566 (s), 1489 (w), 1452 (w), 1410 (m), 1389 (w), 1365 (m), 1302 (m), 1280 (m), 1246 (w), 1223 (m), 1172 (s), 1146 (s), 1091 (m), 1070 (s), 1027 (m), 977 (w), 955 (w), 911 (m), 839 (m), 828 (m), 753 (m), 719 (m), 703 (s), 681 (m), 664 (w), 625 (w), 602 (w), 543 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{34}H_{29}NNaO_4$ $[M + Na]^+$ 538.1989; found 538.1990.

Diethyl 1-Methyl-4-(3-nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4at): Yellow oil (116 mg, 64%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.16 (t, J = 7.1 Hz, 6 H), 3.28 (s, 3 H), 4.00–4.09 (m, 4 H), 4.99 (s, 1 H), 7.21 (s, 2 H), 7.38 (dd, J = 7.9, 7.4 Hz, 1 H), 7.67 (d, J = 7.9 Hz, 1 H), 7.99 (dd, J = 7.4, 2.3 Hz, 1 H), 8.10 (t, J = 2.3 Hz, 1 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 37.1, 41.5, 60.0, 107.4, 121.4, 123.0, 128.5, 134.5, 138.7, 148.1, 148.7, 166.2 ppm. IR (KBr): $\tilde{\nu}$ = 3432 (br), 2985 (w), 2937 (w), 2904 (w), 2366 (w), 1700 (s), 1633 (w), 1579 (m), 1529 (s), 1475 (w), 1444 (w), 1369 (m), 1348 (m), 1280 (m), 1214 (s), 1189 (w), 1095 (w), 1070 (s), 1027 (w), 927 (w), 829 (w), 809 (w), 761 (m), 721 (w), 686 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{18}H_{21}N_2O_6$ $[M + H]^+$ 361.1400; found 361.1417.

Diethyl 1-Cyclohexyl-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4au): Orange solid (119 mg, 62%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.18 (t, J = 7.4 Hz, 6 H), 1.24–1.42 (m, 3 H), 1.54 (q, J = 12.4, 3.4 Hz, 1 H), 1.59 (q, J = 12.4, 3.4 Hz, 1 H) , 1.71 (d, J = 10.9 Hz, 1 H), 1.92 (d, J = 12.3 Hz, 2 H), 1.98 (d, J = 11.8 Hz, 1 H), 3.24 (tt, J = 11.8, 3.4 Hz, 1 H), 4.01–4.13 (m, 4 H), 4.89 (s, 1 H), 7.12 (t, J = 7.4 Hz, 1 H), 7.22 (dd, J = 8.0, 7.4 Hz, 2 H), 7.28 (d, J = 8.0 Hz, 2 H), 7.29 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 25.0, 25.5, 32.5, 37.8, 59.9, 63.6, 108.4, 126.2, 127.8, 128.1, 135.9, 147.0, 167.1 ppm. IR (neat): $\tilde{\nu}$ = 2979 (w), 2929 (br), 2854 (w), 1693 (s), 1661 (w), 1581 (s), 1467 (w), 1446 (w), 1416 (w), 1389 (w), 1366 (w), 1354 (w), 1294 (w), 1277 (w), 1267 (w), 1244 (w), 1198 (s), 1184 (s), 1156 (s), 1140 (s), 1094 (m), 1070 (s), 1026 (m), 907 (w), 891 (w), 862 (w), 835 (w), 814 (w), 757 (w), 749 (m), 719 (m), 696 (m), 673 (w), 626 (w), 605 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{23}H_{30}NO_4$ $[M + H]^+$ 384.2175; found 384.2164.

Diethyl 1-Isopropyl-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4av): Yellow solid (88 mg, 51%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.11 (t, J = 7.4 Hz, 6 H), 1.30 (d, J = 6.8 Hz, 6 H), 3.63 (sept, J = 6.8 Hz, 1 H), 3.94–4.06 (m, 4 H), 4.82 (s, 1 H), 7.05 (t, J = 7.4 Hz, 1 H), 7.15 (dd, J = 7.4, 6.8 Hz, 1 H), 7.32 (d, J = 6.8 Hz, 2 H), 7.22 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 22.0, 37.9, 55.5, 59.9, 108.6, 126.2, 127.8, 128.1, 135.4, 146.9, 167.1 ppm. IR (neat): $\tilde{\nu}$ = 2981 (w), 1689 (s), 1574 (s), 1433 (m), 1391 (w), 1365 (m), 1301 (m), 1273 (w), 1246 (w), 1246 (w), 1181 (s), 1147 (s), 1094 (w), 1071 (s), 1026 (s), 927 (w), 907 (w), 870 (w), 833 (m), 760 (w), 748 (s), 723 (s), 696 (s), 648 (w), 615 (w), 573 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{20}H_{26}NO_4$ $[M + H]^+$ 344.1862; found 344.1856.

Diethyl 1-(2-Hydroxyethyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4aw): Brown solid (108 mg, 62%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.18 (t, J = 7.4 Hz, 6 H), 1.79 (br. s, 1 H), 3.52 (t, J = 5.1 Hz, 2 H), 3.80–3.89 (br. s, 2 H), 4.01–4.14 (m, 4 H), 4.87 (s, 1 H), 7.13 (t, J = 7.4 Hz, 1 H), 7.23 (dd, J = 7.4, 6.8 Hz, 2 H), 7.25 (s, 2 H), 7.32 (d, J = 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.3, 56.5, 60.0, 61.6, 108.7, 126.3, 127.9, 128.2, 137.8, 146.7, 167.1 ppm. IR (KBr): $\tilde{\nu}$ = 3465 (br), 3066 (w), 2986 (w), 2872 (w), 1696 (m), 1664 (m), 1561 (m), 1491 (w), 1450 (w), 1417 (w), 1390 (w), 1363 (w), 1301 (m), 1254 (w), 1281 (m), 1170 (s), 1080 (m), 1046 (s), 1028 (s), 939 (w), 907 (w), 869 (w), 837 (w), 781 (w), 754 (m), 720 (w), 703 (w), 652 (w), 606 (w), 588 (w), 537 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{19}H_{23}NNaO_5$ $[M + Na]^+$ 368.1474; found 368.1464.

Diethyl 1-[(Methoxycarbonyl)methyl]-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4ax): Orange solid (73 mg, 39%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.17 (t, J = 7.4 Hz, 6 H), 3.82 (s, 3 H), 4.00–4.11 (m, 4 H), 4.14 (s, 2 H), 4.86 (s, 1 H), 7.12 (s, 2 H), 7.13 (t, J = 7.4 Hz, 1 H), 7.24 (dd, J = 7.4, 6.8 Hz, 1 H), 7.40 (d, J = 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.2, 52.7, 55.0, 60.1, 109.7, 126.4, 127.8, 128.4, 137.3, 146.3, 166.7, 168.8 ppm. IR (neat): $\tilde{\nu}$ = 3066 (w), 2982 (w), 2949 (w), 1750 (m), 1701 (m), 1678 (m), 1574 (m), 1490 (w), 1454 (w), 1437 (w), 1425 (w), 1414 (w), 1387 (w), 1364 (m), 1305 (m), 1242 (w), 1179 (s), 1083 (w), 1030 (w), 1120 (w), 1000 (w), 986 (w), 943 (w), 924 (w), 864 (w), 839 (w), 825 (w), 755 (m), 718 (w), 698 (m), 656 (w), 609 (w), 602 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{20}H_{24}NO_6$ $[M + H]^+$ 374.1604; found 374.1591.

Diethyl 1-[(*S*)-1-(Methoxycarbonyl)ethyl]-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4ay): Yellow oil (114 mg, 59%). $[\alpha]_D^{19}$ = –12.9 (c = 0.01, $CHCl_3$, 84% *ee*). The *ee* was determined by HPLC analysis using a chiral column (CHIRALPAK AD-H, hexane/2-propanol = 9:1, flow rate: 1.0 mL/min, detection at 254 nm, room

temp.): t_R = 15.8 (major), 19.0 min (minor). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.11 (td, J = 7.4, 2.3 Hz, 6 H), 1.59 (d, J = 7.4 Hz, 3 H), 3.74 (s, 3 H), 3.94–4.07 (m, 4 H), 4.15 (d, J = 7.4 Hz, 1 H), 4.81 (s, 1 H), 7.04–7.07 (m, 1 H), 7.14–7.19 (m, 4 H), 7.25–7.27 (m, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 16.6, 37.7, 52.9, 60.1, 60.7, 109.7, 109.7, 126.3, 127.8, 128.3, 135.4, 135.9, 146.3, 166.8, 171.0 ppm. IR (neat): $\tilde{\nu}$ = 2981 (w), 1743 (m), 1695 (s), 1583 (m), 1491 (w), 1453 (w), 1420 (w), 1371 (m), 1277 (m), 1169 (s), 1032 (m), 973 (w), 899 (w), 836 (w), 752 (m), 718 (w), 698 (m), 609 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{26}NO_6$ [M + H]$^+$ 388.1760; found 388.1771.

Diethyl 1-[(*S*)-1-(Methoxycarbonyl)-2-phenylethyl]-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4az): Orange-yellow oil (116 mg, 50%). $[\alpha]_D^{19}$ = –119 (c = 0.01, $CHCl_3$, 77% *ee*). The *ee* was determined by HPLC analysis using a chiral column (CHIRALPAK AD-H, hexane/2-propanol = 9:1, flow rate: 1.0 mL/min, detection at 254 nm, room temp.): t_R = 18.6 (major), 21.3 min (minor). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.07 (t, J = 7.4 Hz, 3 H), 1.09 (t, J = 7.4 Hz, 3 H), 3.10 (dd, J = 14.5, 11.1 Hz, 1 H), 3.38 (dd, J = 14.5, 5.1 Hz, 1 H), 3.74 (s, 3 H), 3.88–4.06 (m, 4 H), 4.25 (dd, J = 11.1, 5.1 Hz, 1 H), 4.72 (s, 1 H), 6.93–6.95 (m, 2 H), 7.00–7.09 (m, 4 H), 7.14–7.18 (m, 3 H), 7.22–7.30 (m, 3 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 36.6, 37.7, 52.9, 60.0, 66.8, 109.2, 109.9, 126.1, 127.3, 127.7, 128.3, 128.9, 129.0, 135.1, 135.3, 137.0, 146.3, 166.6, 170.0 ppm. IR (neat): $\tilde{\nu}$ = 2980 (w), 1741 (m), 1696 (s), 1584 (s), 1492 (w), 1421 (w), 1371 (m), 1278 (m), 1166 (s), 1073 (s), 1023 (w), 899 (w), 837 (w), 751 (m), 718 (w), 697 (m), 596 (w), 567 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{27}H_{30}NO_6$ [M + H]$^+$ 464.2073; found 464.2079,

Diethyl 1-Benzyl-4-{4-[1-benzyl-3,5-bis(ethoxycarbonyl)-1,4-dihydropyridin-4-yl]phenyl}-1,4-dihydropyridine-3,5-dicarboxylate (4ba): Yellow solid (169 mg, 48%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.12 (t, J = 7.4 Hz, 12 H), 3.96–4.08 (m, 8 H), 4.55 (s, 4 H), 4.84 (s, 2 H), 7.12 (s, 4 H), 7.24 (s, 4 H), 7.26 (d, J = 6.8 Hz, 4 H), 7.34 (t, J = 7.4 Hz, 2 H), 7.39 (dd, J = 7.4, 6.8 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 36.8, 58.1, 59.8, 109.1, 127.1, 127.8, 128.2, 129.0, 136.2, 137.4, 144.4, 166.9 ppm. IR (neat): $\tilde{\nu}$ = 2980 (w), 1693 (s), 1655 (w), 1615 (w), 1576 (m), 1497 (w), 1475 (w), 1445 (w), 1417 (w), 1386 (w), 1364 (w), 1304 (w), 1277 (m), 1221 (m), 1203 (w), 1159 (s), 1092 (w), 1068 (m), 963 (w), 928 (w), 902 (w), 864 (w), 819 (w), 805 (w), 748 (w), 739 (w), 721 (w), 701 (m), 639 (w), 602 (w), 573 (w) cm^{-1}. HRMS (ESI): calcd. for $C_{42}H_{44}N_2NaO_8$ [M + Na]$^+$ 727.2995; found 727.2987.

Diethyl 1-Benzyl-4-(4-formylphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ba′): Yellow oil (28 mg, 13%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.09 (t, J = 7.4 Hz, 6 H), 3.93–4.07 (m, 4 H), 4.53 (s, 2 H), 4.93 (s, 1 H), 7.19–7.38 (m, 4 H), 7.29–7.38 (m, 5 H), 7.67 (d, J = 8.5 Hz, 2 H), 9.87 (s, 1 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.9, 58.4, 60.2, 108.3, 127.2, 128.5, 129.0, 129.2, 129.6, 134.8, 135.9, 138.0, 153.2, 166.5, 192.1 ppm. IR (neat): $\tilde{\nu}$ = 2980 (br), 1692 (s), 1603 (m), 1578 (s), 1497 (w), 1454 (w), 1411 (w), 1389 (m), 1370 (m), 1304 (m), 1277 (m), 1227 (s), 1164 (s), 1073 (s), 1018 (s), 976 (m), 908 (m), 806 (m), 770 (m), 731 (s), 699 (m), 646 (m), 619 (m), 575 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{25}NNaO_5$ [M + Na]$^+$ 442.1625; found 442.1625.

Diethyl 4-{4-[3,5-Bis(ethoxycarbonyl)-1-(4-methoxybenzyl)-1,4-dihydropyridin-4-yl]phenyl}-1-(4-methoxybenzyl)-1,4-dihydropyridine-3,5-dicarboxylate (4bb): Yellow solid (131 mg, 34%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.13 (t, J = 7.1 Hz, 12 H), 3.82 (s, 6 H), 3.97–4.08 (m, 8 H), 4.49 (s, 4 H), 4.82 (s, 2 H), 6.93 (d, J = 8.5 Hz, 4 H), 7.09 (s, 4 H), 7.20 (d, J = 8.5 Hz, 4 H), 7.22 (s, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 36.9, 55.3, 57.8, 59.9, 109.1, 114.5, 127.8, 128.1, 128.7, 137.4, 144.5, 159.6, 167.1 ppm. IR (KBr): $\tilde{\nu}$ = 2977 (w), 2937 (w), 2902 (w), 2838 (w), 1698 (s), 1681 (s), 1614 (w), 1579 (s), 1513 (m), 1417 (w), 1367 (w), 1307 (m), 1282 (w), 1251 (m), 1234 (m), 1174 (s), 1083 (w), 1033 (w), 908 (w), 817 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{44}H_{48}N_2O_{10}$ [M]$^+$ 764.3309; found 764.3319.

Tetraethyl 4,4′-(1,3-Phenylene)bis[1-(naphthalen-2-ylmethyl)-1,4-dihydropyridine-3,5-dicarboxylate] (4bc): Yellow oil (242 mg, 60%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.04 (t, J = 7.4 Hz, 12 H), 3.92–4.01 (m, 8 H), 4.87 (s, 2 H), 5.02 (s, 4 H), 6.97–7.04 (m, 3 H), 7.30 (s, 4 H), 7.30–7.31 (m, 1 H), 7.44 (d, J = 6.8 Hz, 2 H), 7.51 (dd, J = 7.4, 8.2 Hz, 2 H), 7.56 (dd, J = 6.8, 7.9 Hz, 2 H), 7.62 (dd, J = 7.4, 8.2 Hz, 2 H), 7.86 (d, J = 7.9 Hz, 2 H), 7.91 (d, J = 8.2 Hz, 4 H) ppm. ^{13}C NMR(125 MHz, $CDCl_3$): δ = 14.1, 37.5, 56.0, 59.9, 109.4, 122.5, 125.5, 126.1 126.3, 126.6, 127.0, 127.5, 128.2, 129.1, 129.2, 130.8, 131.1, 133.9, 137.4, 146.0, 167.0 ppm. IR (KBr): $\tilde{\nu}$ = 2981 (w), 2935 (w), 2902 (w), 2873 (w), 1700 (s), 1579 (m), 1511 (w), 1415 (w), 1371 (w), 1307 (w), 1278 (w), 1230 (w), 1193 (s), 1157 (w), 1078 (m), 1024 (m), 792 (w), 757 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{50}H_{48}N_2O_8$ [M]$^+$ 804.3411; found 804.3395.

Tetraethyl 4,4′-(Biphenyl-4,4′-diyl)bis(1-benzyl-1,4-dihydropyridine-3,5-dicarboxylate) (4bd): Yellow solid (71 mg, 61%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.18 (t, J = 7.4 Hz, 12 H), 4.01–4.13 (m, 8 H), 4.60 (s, 4 H), 4.93 (s, 2 H), 7.29–7.30 (m, 12 H), 7.35–7.43 (m, 10 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.0, 58.3, 60.1, 109.1, 126.6, 127.2, 128.4, 128.5, 129.2, 136.2, 137.6, 145.3, 167.0 ppm. IR (neat): $\tilde{\nu}$ = 2978 (br), 2929 (br), 2360 (w), 2341 (w), 1694 (s), 1578 (m), 1495 (w), 1454 (w), 1389 (w), 1369 (m), 1303 (w), 1276 (m), 1226 (m), 1164 (s), 1071 (s), 1020 (m), 975 (m), 904 (m), 838 (m), 817 (m), 732 (m), 698 (m), 618 (w), 578 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{48}H_{47}N_2O_8$ [M – H]$^+$ 779.3332; found 779.3332.

Tetraethyl 1,1′-(Propane-1,3-diyl)bis(4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate) (4be): Yellow solid (83 mg, 49%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.18 (t, J = 6.8 Hz, 12 H), 2.10–2.16 (tt, J = 7.4, 7.4 Hz, 2 H), 3.50 (t, J = 7.4 Hz, 4 H), 4.01–4.14 (m, 8 H), 4.91 (s, 2 H), 7.19 (s, 4 H), 7.25–7.31 (m, 10 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 30.9, 37.2, 51.8, 60.2, 109.4, 126.5, 128.0, 128.1, 136.8, 146.3, 166.8 ppm. IR (KBr): $\tilde{\nu}$ = 2976 (br), 1693 (s), 1577 (m), 1490 (w), 1453 (w), 1412 (w), 1370 (m), 1306 (w), 1276 (m), 1167 (s), 1066 (s), 1029 (s), 900 (m), 859 (w), 837 (m), 751 (s), 717 (m), 697 (s), 601 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{37}H_{41}N_2O_8$ [M – H]$^+$ 641.2863; found 641.2874.

Tetraethyl 1,1′-(Propane-1,3-diyl)bis[4-(3-nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate] (4bf): Yellow solid (146 mg, 80%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.16 (t, J = 6.8 Hz, 12 H), 2.20–2.26 (tt, J = 7.4, 7.4 Hz, 2 H), 3.64 (t, J = 7.4 Hz, 4 H), 4.00–4.13 (m, 8 H), 5.04 (s, 2 H), 7.28 (s, 4 H), 7.45 (dd, J = 7.9, 7.9 Hz, 2 H), 7.73 (dt, J = 7.4, 1.1 Hz, 2 H), 8.04 (ddd, J = 7.9, 2.3, 1.1 Hz, 2 H), 8.13 (t, J = 2.3 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 30.5, 37.4, 51.8, 60.4, 108.6, 121.7, 123.0, 128.8, 134.5, 137.4, 148.4, 148.5, 166.1 ppm. IR (neat): $\tilde{\nu}$ = 2980 (br), 1692 (s), 1578 (m), 1524 (s), 1461 (w), 1413 (w), 1371 (m), 1345 (m), 1277 (m), 1166 (s), 1067 (s), 1028 (m), 926 (w), 885 (w), 828 (w), 806 (w), 759 (s), 740 (m), 720 (m), 683 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{37}H_{39}N_4O_{12}$ [M – H]$^+$ 731.2564; found 731.2579.

Diethyl 4-Phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4ca): Red-brown oil (83 mg, 55%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 1.19 (t, J = 7.0 Hz, 6 H), 4.00–4.13 (m, 4 H), 4.89 (s, 1 H), 6.56 (br. s, 1 H), 7.15 (t, J = 7.4 Hz, 1 H), 7.26 (dd, J = 7.4, 7.4 Hz, 2 H), 7.30 (d, J = 5.1 Hz, 2 H), 7.35 (d, J = 7.4 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.6, 60.0, 108.5, 126.4, 127.9, 128.3,

133.6, 146.9, 167.1 ppm. IR (neat): ṽ = 3321 (br), 2980 (w), 1686 (m), 1601 (m), 1474 (m), 1392 (w), 1370 (m), 1285 (m), 1242 (w), 1177 (s), 1064 (s), 1019 (w), 911 (w), 843 (w), 828 (w), 752 (m), 709 (w), 696 (m), 646 (w), 609 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{19}NNaO_4$ $[M + Na]^+$ 324.1205; found 324.1206.

Diethyl 4-(4-Methoxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4cb): Orange oil (94 mg, 57%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.20 (t, J = 7.0 Hz, 6 H), 3.75 (s, 3 H), 4.01–4.14 (m, 4 H), 4.84 (s, 1 H), 6.70 (br. s, 1 H), 6.78 (d, J = 9.1 Hz, 2 H), 7.25 (d, J = 9.1 Hz, 2 H), 7.29 (d, J = 5.5 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 36.7, 55.1, 59.9, 108.6, 129.2, 133.4, 139.5, 158.1, 167.2 ppm. IR (neat): ṽ = 3321 (br), 2979 (w), 2836 (w), 1689 (m), 1604 (m), 1506 (m), 1464 (m), 1392 (w), 1371 (m), 1286 (m), 1237 (m), 1172 (s), 1066 (s), 1032 (w), 909 (w), 849 (w), 825 (m), 787 (w), 738 (m), 705 (w), 647 (w), 624 (w), 573 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{18}H_{21}NNaO_5$ $[M + Na]^+$ 354.1312; found 354.1311.

Diethyl 4-(4-Hydroxyphenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4cc): Yellow crystal (32 mg, 40%). ^1H NMR (500 MHz, [D_6]-DMSO): δ = 1.12 (t, J = 6.8 Hz, 6 H), 3.93–4.05 (m, 4 H), 4.60 (s, 1 H), 6.60 (d, J = 9.1 Hz, 2 H), 6.96 (d, J = 9.1 Hz, 2 H), 7.30 (d, J = 2.8 Hz, 2 H), 9.07 (br. s, 1 H), 9.12 (s, 1 H) ppm. ^{13}C NMR (125 MHz, [D_6]DMSO): δ = 14.2, 35.9, 59.2, 106.4, 114.6, 128.6, 134.5, 138.2, 155.7, 166.5 ppm. IR (neat): ṽ = 3317 (m), 3096 (w), 2964 (w), 1673 (m), 1650 (m), 1590 (w), 1495 (m), 1463 (w), 1450 (m), 1396 (m), 1377 (m), 1289 (m), 1249 (m), 1197 (s), 1169 (m), 1105 (m), 1096 (m), 1012 (m), 924 (w), 909 (m), 853 (m), 838 (m), 825 (m), 805 (m), 776 (w), 748 (m), 707 (m), 655 (m), 634 (m), 565 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{19}NNaO_5$ $[M + Na]^+$ 340.1161; found 340.1149.

Diethyl 4-(3-Nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4cd): Yellow oil (89 mg, 51%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.20 (t, J = 6.8 Hz, 6 H), 4.02–4.15 (m, 4 H), 5.04 (s, 1 H), 6.94 (br. s, 1 H), 7.41 (d, J = 5.7 Hz, 2 H), 7.43 (dd, J = 7.9, 7.4 Hz, 1 H), 7.74 (d, J = 7.4 Hz, 1 H), 8.03 (d, J = 7.9 Hz, 1 H), 8.18 (s, 1 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.8, 60.3, 107.5, 121.6, 123.2, 128.6, 134.3, 134.8, 148.3, 149.0, 166.7 ppm. IR (neat): ṽ = 3322 (br), 3103 (w), 2981 (w), 1686 (m), 1602 (w), 1525 (m), 1473 (m), 1392 (w), 1372 (m), 1348 (m), 1286 (m), 1243 (w), 1178 (s), 1065 (s), 1018 (m), 915 (w), 885 (w), 826 (w), 806 (w), 760 (m),739 (m), 712 (m), 675 (m), 645 (w), 610 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{19}N_2O_6$ $[M + H]^+$ 347.1243; found 347.1246.

Diethyl 4-(4-Nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ce): Yellow oil (113 mg, 67%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.19 (t, J = 7.0 Hz, 6 H), 4.02–4.16 (m, 4 H), 5.04 (s, 1 H), 6.78 (br. s, 1 H), 7.38 (d, J = 5.8 Hz, 2 H), 7.52 (d, J = 8.5 Hz, 2 H), 8.12 (d, J = 8.5 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 38.0, 60.3, 107.5, 123.3, 129.2, 134.2, 146.5, 154.0, 166.5 ppm. IR (neat): ṽ = 3324 (br), 2981 (w), 1693 (m), 1604 (m), 1516 (m), 1475 (m), 1392 (w), 1370 (w), 1343 (s), 1285 (m), 1241 (w), 1180 (s), 1108 (w), 1068 (s), 1015 (w), 912 (w), 826 (w), 754 (w), 714 (m), 647 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{18}N_2NaO_6$ $[M + Na]^+$ 369.1057; found 369.1057.

Diethyl 4-(2-Chlorophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4cf): Yellow solid (79 mg, 47%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.17 (t, J = 6.8 Hz, 6 H), 4.01–4.12 (m, 4 H), 5.37 (s, 1 H), 6.77 (br. s, 1 H), 7.07 (t, J = 7.4 Hz, 1 H), 7.17 (dd, J = 7.9, 7.4 Hz, 1 H), 7.27 (dd, J = 7.9, 7.4 Hz, 1 H), 7.33 (d, J = 5.1 Hz, 2 H), 7.38 (d, J = 7.9 Hz, 1 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 34.9, 60.1, 108.2, 126.8, 127.5, 129.1, 131.6, 132.7, 134.3, 144.9, 167.1 ppm. IR (neat): ṽ = 3323 (br), 3106 (w), 2980 (w), 1681 (m), 1600 (m), 1471 (m), 1440 (m), 1392 (w), 1370 (m), 1289 (m), 1245 (m), 1177 (s), 1068 (s), 1037 (m), 1021 (m), 908 (m), 841 (w), 830 (w), 754 (m), 728 (s), 703 (m), 646 (m), 610 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{19}ClNO_4$ $[M + H]^+$ 336.1003; found 336.0997.

Diethyl 4-(3-Chlorophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4cg): Yellow solid (79 mg, 47%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.20 (t, J = 6.8 Hz, 6 H), 4.02–4.16 (m, 4 H), 4.88 (s, 1 H), 6.86 (br. s, 1 H), 7.13 (d, J = 7.9 Hz, 1 H), 7.18 (dd, J = 7.9, 7.4 Hz, 1 H), 7.25 (d, J = 7.4 Hz, 1 H), 7.30 (s, 1 H), 7.33 (d, J = 5.1 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 37.5, 60.2, 107.8, 126.6, 128.5, 129.1, 134.0, 148.8, 167.0 ppm. IR (neat): ṽ = 3301 (br), 2977 (w), 2905 (w), 1702 (m), 1665 (s), 1601 (m), 1572 (w), 1500 (m), 1473 (m), 1443 (w), 1429 (w), 1394 (w), 1370 (m), 1290 (m), 1239 (m), 1181 (s), 1118 (m), 1079 (m), 1060 (s), 1017 (m), 916 (m), 868 (m), 791 (m), 770 (s), 719 (m), 687 (m), 667 (m), 650 (m), 614 (m), 598 (m), 531 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{18}ClNNaO_4$ $[M + Na]^+$ 358.0816; found 358.0817.

Diethyl 4-(4-Chlorophenyl)-1,4-dihydropyridine-3,5-dicarboxylate (4ch): Yellow oil (73 mg, 44%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.25 (t, J = 7.4 Hz, 6 H), 4.07–4.19 (m, 4 H), 4.92 (s, 1 H), 6.92 (br. s, 1 H), 7.26 (d, J = 8.2 Hz, 2 H), 7.32 (d, J = 8.2 Hz, 2 H), 7.35 (d, J = 5.1 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 37.1, 60.1, 107.9, 128.0, 129.6, 132.0, 133.8, 145.4, 167.0 ppm. IR (neat): ṽ = 3320 (br), 2980 (w), 2359 (w), 2342 (w), 1697 (s), 1603 (m), 1486 (s), 1392 (w), 1370 (m), 1284 (m), 1243 (w), 1180 (s), 1067 (s), 1014 (m), 1601 (m), 1474 (m), 1392 (w), 1370 (m), 1284 (m), 1243 (w), 1180 (s), 1067 (s), 1014 (m), 910 (w), 844 (w), 821 (w), 759 (w), 727 (w), 669 (w), 621 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{18}ClNNaO_4$ $[M + Na]^+$ 358.0817; found 358.0816.

General Procedure for the Synthesis of *N*-Protected 1,4-DHPs 4d: A solution of 1,4-DHP **4ca** (1.2 mmol, 1.0 equiv.) in THF (6 mL) was added dropwise to a suspension of NaH (2.0 equiv.) in THF (2 mL) at 0 °C. After the evolution of H_2 gas was complete, the protecting reagent (1.5 equiv.) was added to the reaction mixture. The solution was warmed to ambient temperature and stirred for 24 h and the resulting mixture was acidified by using satd. aq. NH_4Cl. The aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL), dried with $MgSO_4$, filtered, and the solvents evaporated. Removal of the solvent in vacuo followed by column chromatography on silica gel (AcOEt/*n*-hexane) afforded *N*-protected 1,4-DHPs **4d**.

Diethyl 1-Benzoyl-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4da): Colorless oil (349 mg, 74%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.16 (t, J = 6.8 Hz, 6 H), 4.03–4.16 (m, 4 H), 4.96 (s, 1 H), 7.20 (t, J = 7.4 Hz, 1 H), 7.29 (t, J = 7.4 Hz, 2 H), 7.36 (d, J = 7.9 Hz, 2 H), 7.51 (t, J = 7.4 Hz, 2 H), 7.59 (t, J = 7.4 Hz, 1 H), 7.66 (d, J = 8.5 Hz, 2 H), 8.11 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 38.8, 60.7, 115.5, 127.0, 128.2, 128.4, 128.9, 129.0, 131.1, 131.7, 132.6, 143.6, 165.6, 167.9 ppm. IR (neat): ṽ = 3062 (w), 2984 (w), 1713 (m), 1692 (s), 1662 (m), 1614 (m), 1599 (m), 1578 (w), 1491 (w), 1477 (w), 1446 (w), 1377 (m), 1347 (m), 1224 (s), 1145 (m), 1114 (m), 1075 (s), 1016 (m), 962 (m), 933 (m), 899 (m), 870 (m), 837 (m), 789 (m), 777 (w), 751 (m), 713 (s), 697 (s), 667 (m), 643 (m), 622 (m), 564 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{23}NNaO_5$ $[M + Na]^+$ 428.1474; found 428.1485.

1-Allyl 3,5-Diethyl 4-Phenylpyridine-1,3,5(4*H*)-tricarboxylate (4db): Colorless oil (213 mg, 57%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.20 (t, J = 6.8 Hz, 6 H), 4.05–4.17 (m, 4 H), 4.85 (d, J = 6.2 Hz, 2 H), 4.87 (s, 1 H), 5.36 (dd, J = 1.1, 10.2 Hz, 1 H), 5.44 (dd, J = 1.1, 17.0 Hz, 1 H), 6.02 (ddt, J = 6.2, 10.2, 17.0 Hz, 1 H), 7.16 (dd, J = 7.9, 7.4 Hz, 1 H), 7.24 (t, J = 7.4 Hz, 2 H), 7.28 (d, J = 7.9 Hz, 2 H), 8.04 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0,

38.2, 60.6, 68.6, 115.0, 120.0, 126.8, 128.1, 128.6, 130.0, 130.9, 143.8, 150.5, 165.7 ppm. IR (neat): $\tilde{\nu}$ = 2981 (w), 1744 (m), 1709 (s), 1674 (m), 1617 (m), 1492 (w), 1454 (w), 1380 (m), 1366 (m), 1346 (m), 1264 (m), 1210 (s), 1076 (m), 1019 (m), 977 (m), 901 (m), 862 (m), 840 (m), 750 (m), 715 (m), 697 (m), 544 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{23}NNaO_6$ $[M + Na]^+$ 408.1423; found 408.1426.

Diethyl 1-(*tert*-Butyldimethylsilyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (4dc): Colorless oil (125 mg, 34%). ^1H NMR (500 MHz, $CDCl_3$): δ = 0.31 (s, 6 H), 0.91 (s, 9 H), 1.08 (t, J = 6.8 Hz, 6 H), 3.91–4.04 (m, 4 H), 4.77 (s, 1 H), 7.03 (t, J = 7.4 Hz, 1 H), 7.13 (dd, J = 7.9, 7.4 Hz, 2 H), 7.21 (d, J = 7.9 Hz, 2 H), 7.25 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = –6.0, 14.1, 18.7, 25.9, 37.4, 59.9, 110.3, 126.1, 127.7, 128.4, 137.0, 147.0, 167.3 ppm. IR (neat): $\tilde{\nu}$ = 2932 (w), 2903 (w), 2860 (w), 1697 (m), 1655 (w), 1613 (m), 1581 (m), 1494 (w), 1471 (w), 1365 (w), 1312 (m), 1284 (m), 1255 (m), 1211 (s), 1186 (s), 1073 (s), 1041 (s), 1002 (m), 921 (m), 886 (m), 859 (m), 835 (m), 809 (s), 772 (m), 753 (m), 719 (m), 701 (m), 680 (m), 638 (w), 590 (m), 536 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{23}H_{33}NNaO_4Si$ $[M + Na]^+$ 438.2077; found 438.2079.

Diethyl 4-Phenyl-1-(*p*-tosyl)-1,4-dihydropyridine-3,5-dicarboxylate (4dd): White solid (228 mg, 60%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.18 (t, J = 6.8 Hz, 6 H), 2.50 (s, 3 H), 4.02–4.15 (m, 4 H), 4.76 (s, 1 H), 6.88 (d, J = 7.9 Hz, 2 H), 7.06 (dd, J = 7.9, 7.4 Hz, 2 H), 7.08 (t, J = 7.4 Hz, 1 H), 7.42 (d, J = 8.5 Hz, 2 H), 7.78 (s, 2 H), 7.81 (d, J = 8.5 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 21.7, 37.9, 60.8, 115.6, 126.8, 127.2, 127.9, 128.3, 129.4, 130.5, 134.3, 143.4, 145.7, 165.2 ppm. IR (neat): $\tilde{\nu}$ = 3074 (w), 2973 (w), 1698 (s), 1659 (w), 1606 (m), 1492 (w), 1466 (w), 1445 (w), 1383 (m), 1297 (m), 1271 (m), 1213 (m), 1188 (m), 1176 (s), 1137 (m), 1112 (m), 1083 (m), 1044 (s), 1015 (m), 927 (w), 901 (m), 888 (m), 864 (w), 841 (m), 818 (m), 799 (w), 776 (w), 759 (w), 749 (m), 738 (m), 716 (m), 701 (m), 661 (s), 644 (m), 617 (w), 570 (s), 543 (s) cm^{-1}. HRMS (FAB): calcd. for $C_{24}H_{26}NO_6S$ $[M + H]^+$ 456.1481; found 456.1495.

1-(4-Methoxyphenyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarbonitrile (4ea): White-yellow solid (52 mg, 33%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.84 (s, 3 H), 4.48 (s, 1 H), 6.95 (d, J = 9.1 Hz, 2 H), 6.96 (s, 2 H), 7.11 (d, J = 9.1 Hz, 2 H), 7.36–7.39 (m, 3 H), 7.43–7.46 (m, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 40.5, 55.7, 90.1, 115.3, 118.0, 123.0, 127.9, 128.6, 129.3, 135.1, 138.4, 141.2, 159.0 ppm. IR (neat): $\tilde{\nu}$ = 2205 (s), 1670 (m), 1595 (w), 1578 (m), 1511 (s), 1466 (w), 1454 (w), 1440 (w), 1431 (w), 1340 (m), 1305 (w), 1292 (m), 1253 (s), 1172 (m), 1137 (w), 1119 (w), 1069 (m), 1024 (m), 896 (m), 836 (m), 810 (m), 762 (s), 702 (s), 664 (m), 650 (w), 584 (m), 533 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{20}H_{16}N_3O$ $[M + H]^+$ 314.1293; found 314.1296.

1,4-Bis(4-methoxyphenyl)-1,4-dihydropyridine-3,5-dicarbonitrile (4eb): Yellow solid (52 mg, 30%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.82 (s, 3 H), 3.83 (s, 3 H), 4.42 (s, 1 H), 6.94–6.96 (m, 6 H), 7.10 (d, J = 8.5 Hz, 2 H), 7.28 (d, J = 8.5 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.7, 55.3, 55.6, 90.3, 114.6, 115.3, 118.1, 123.0, 129.1, 133.8, 135.1, 138.1, 159.0, 159.7 ppm. IR (neat): $\tilde{\nu}$ = 3088 (w), 2955 (w), 2918 (w), 2836 (w), 2359 (w), 2206 (m), 2031 (w), 1668 (m), 1610 (m), 1575 (m), 1511 (s), 1460 (m), 1444 (m), 1425 (w), 1343 (m), 1305 (m), 1291 (m), 1250 (s), 1240 (s), 1194 (m), 1170 (s), 1145 (m), 1111 (m), 1068 (m), 1030 (m), 967 (w), 931 (m), 906 (m), 824 (s), 806 (m), 781 (m), 712 (w), 643 (m), 623 (m), 579 (m), 529 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{17}N_3NaO_2$ $[M + Na]^+$ 366.1218; found 366.1213.

1-(4-Methoxybenzyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarbonitrile (4ec): Yellow solid (42 mg, 26%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.85 (s, 3 H), 4.39 (s, 1 H), 4.40 (s, 2 H), 6.66 (s, 2 H), 6.95 (d, J = 8.5 Hz, 2 H), 7.15 (d, J = 8.5 Hz, 2 H), 7.27 (d, J = 7.4 Hz, 2 H), 7.32 (t, J = 7.4 Hz, 1 H), 7.39 (dd, J = 7.4, 7.4 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 40.5, 55.4, 57.9, 88.9, 114.9, 118.2, 126.0, 127.8, 128.4, 129.1, 129.2, 139.0, 141.5, 160.2 ppm. IR (neat): $\tilde{\nu}$ = 3070 (w), 2933 (w), 2837 (w), 2359 (w), 2204 (m), 1989 (w), 1668 (m), 1610 (m), 1578 (s), 1535 (w), 1512 (s), 1454 (m), 1404 (s), 1355 (m), 1304 (m), 1247 (s), 1210 (m), 1177 (m), 1128 (m), 1078 (w), 1028 (m), 971 (w), 893 (m), 818 (m), 755 (s), 699 (s), 672 (m), 639 (m), 615 (m), 551 (m), 533 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{17}N_3NaO$ $[M + Na]^+$ 350.1269; found 350.1264.

4-Phenyl-1,4-dihydropyridine-3,5-dicarbonitrile (4ed): Yellow solid (148 mg, 48%). ^1H NMR (500 MHz, [D$_6$]DMSO): δ = 4.55 (s, 1 H), 7.25 (s, 2 H), 7.37 (d, J = 6.8 Hz, 2 H), 7.39 (dd, J = 7.4, 6.8 Hz, 1 H), 7.49 (t, J = 7.4 Hz, 2 H), 9.62 (br. s, 1 H) ppm. ^{13}C NMR (125 MHz, [D$_6$]DMSO): δ = 39.4, 85.4, 119.3, 127.8, 127.8, 128.9, 137.6, 143.6 ppm. IR (neat): $\tilde{\nu}$ = 3327 (br), 3085 (w), 2208 (s), 2185 (w), 1672 (m), 1647 (w), 1602 (m), 1466 (s), 1354 (w), 1340 (w), 1275 (m), 1251 (w), 1223 (w), 1211 (w), 1159 (w), 1135 (w), 1075 (m), 1029 (w), 906 (m), 851 (w), 824 (w), 753 (m), 669 (s), 671 (m), 642 (s), 616 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{13}H_{10}N_3$ $[M + H]^+$ 208.0875; found 208.0872.

1-(4-Methoxyphenyl)-3,5-dinitro-4-phenyl-1,4-dihydropyridine (4ee): Red-brown solid (78 mg, 44%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.88 (s, 3 H), 5.72 (s, 1 H), 7.03 (d, J = 8.2 Hz, 2 H), 7.27–7.34 (m, 5 H), 7.41 (d, J = 8.2 Hz, 2 H), 8.13 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.7, 55.8, 115.5, 123.5, 128.2, 128.5, 128.6, 134.1, 134.5, 134.5, 139.9, 159.8 ppm. IR (neat): $\tilde{\nu}$ = 3092 (w), 2930 (w), 2838 (w), 1680 (m), 1605 (m), 1584 (w), 1507 (s), 1484 (s), 1457 (w), 1440 (w), 1386 (w), 1338 (m), 1305 (m), 1255 (s), 1215 (s), 1180 (s), 1119 (w), 1070 (m), 1023 (m), 963 (w), 927 (w), 915 (m), 897 (w), 876 (w), 849 (w), 839 (m), 827 (w), 809 (w), 775 (m), 747 (w), 732 (s), 713 (w), 701 (m), 641 (w), 629 (w), 581 (w), 535 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{18}H_{16}N_3O_5$ $[M + H]^+$ 354.1090; found 354.1093.

1-(4-Fluorophenyl)-3,5-dinitro-4-phenyl-1,4-dihydropyridine (4ef): Brown solid (64 mg, 38%). ^1H NMR (500 MHz, $CDCl_3$): δ = 5.71 (s, 1 H), 7.23–7.28 (m, 3 H), 7.31–7.34 (m, 2 H), 7.38–7.41 (m, 4 H), 8.13 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.7, 117.5, 117.7, 124.0 (d, $^3J_{CF}$ = 9.5 Hz), 128.4 (d, $^2J_{CF}$ = 19.1 Hz), 128.7, 133.5, 134.85, 137.6 (d, $^4J_{CF}$ = 2.4 Hz), 139.7, 162.1 (d, $^1J_{CF}$ = 250.3 Hz) ppm. IR (neat): $\tilde{\nu}$ = 3092 (br), 1676 (m), 1616 (w), 1595 (w), 1553 (w), 1491 (s), 1381 (w), 1333 (m), 1294 (m), 1256 (s), 1221 (s), 1158 (m), 1113 (m), 1068 (m), 1013 (w), 906 (m), 896 (m), 828 (s), 782 (m), 732 (s), 701 (m), 644 (w), 575 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{13}FN_3O_4$ $[M + H]^+$ 342.0890; found 342.0902.

1-Mesityl-3,5-dinitro-4-phenyl-1,4-dihydropyridine (4eg): Yellow solid (86 mg, 47%). ^1H NMR (500 MHz, $CDCl_3$): δ = 2.25 (s, 3 H), 2.36 (s, 3 H), 2.41 (s, 3 H), 5.78 (s, 1 H), 7.03 (s, 1 H), 7.04 (s, 1 H), 7.27 (t, J = 7.5 Hz, 1 H), 7.35 (dd, J = 10.0, 7.5 Hz, 2 H), 7.48 (d, J = 10.0 Hz, 2 H), 7.77 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 17.8, 18.2, 21.0, 39.9, 128.2, 128.6, 128.7, 130.0, 130.3, 133.8, 134.7, 135.5, 140.1, 140.4 ppm. IR (neat): $\tilde{\nu}$ = 3108 (w), 2920 (w), 1736 (w), 1674 (m), 1596 (m), 1485 (s), 1374 (w), 1334 (m), 1250 (s), 1227 (s), 1111 (m), 1063 (m), 908 (m), 890 (m), 859 (m), 829 (m), 775 (m), 735 (m), 722 (s), 697 (m), 648 (w), 590 (w), 570 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{20}H_{19}NaN_3O_4$ $[M + Na]^+$ 388.1273; found 388.1258.

1,4-Bis(4-methoxyphenyl)-3,5-dinitro-1,4-dihydropyridine (4eh): Orange solid (71 mg, 37%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 3.78 (s, 3 H), 3.88 (s, 3 H), 5.67 (s, 1 H), 6.85 (d, J = 8.5 Hz, 2 H), 7.04 (d, J = 8.5 Hz, 2 H), 7.31 (d, J = 8.8 Hz, 2 H), 7.32 (d, J = 8.8 Hz, 2 H), 8.11 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 38.9, 55.3, 55.8, 114.0, 115.5, 123.5, 129.6, 132.3, 133.8, 134.6, 134.6, 159.4, 159.7 ppm. IR (neat): $\tilde{\nu}$ = 3069 (w), 2968 (w), 1887 (w), 1670 (m), 1607 (w), 1586 (w), 1509 (s), 1485 (s), 1462 (m), 1448 (w), 1342 (m), 1304 (m), 1247 (s), 1225 (s), 1171 (s), 1110 (m), 1069 (m), 1026 (m), 945 (m), 914 (m), 901 (m), 827 (s), 814 (m), 801 (m), 781 (m), 756 (m), 741 (m), 726 (m), 645 (m), 634 (m), 608 (m), 542 (s) cm^{-1}. HRMS (FAB): calcd. for $C_{19}H_{17}N_3NaO_6$ [M + Na]$^+$ 406.1015; found 406.1010.

3,5-Dinitro-1,4-diphenyl-1,4-dihydropyridine (4ei): Yellow solid (50 mg, 31%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 5.64 (s, 1 H), 7.16–7.19 (m, 1 H), 7.23–7.26 (m, 2 H), 7.31–7.34 (m, 4 H), 7.37–7.40 (m, 1 H), 7.42–7.50 (m, 2 H), 8.14 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.8, 121.5, 128.2, 128.5, 128.6, 128.6, 130.5, 133.5, 134.9, 139.8, 141.3 ppm. IR (neat): $\tilde{\nu}$ = 3055 (br), 1676 (m), 1588 (m), 1489 (s), 1332 (m), 1256 (s), 1228 (s), 1112 (m), 1070 (m), 895 (m), 826 (w), 766 (m), 727 (s), 693 (s), 637 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{14}N_3O_4$ [M + H]$^+$ 324.0984; found 324.0996.

1-(4-Methoxybenzyl)-3,5-dinitro-4-phenyl-1,4-dihydropyridine (4ej): Orange solid (126 mg, 68%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 3.90 (s, 3 H), 4.70 (s, 2 H), 5.64 (s, 1 H), 6.99–7.00 (m, 2 H), 7.20–7.25 (m, 2 H), 7.27–7.28 (m, 5 H), 7.88 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.7, 55.4, 58.9, 115.2, 125.3, 128.1, 128.4, 128.5, 129.4, 133.7, 134.5, 140.1, 160.6 ppm. IR (neat): $\tilde{\nu}$ = 3096 (w), 2916 (br), 1670 (m), 1584 (m), 1473 (m), 1383 (w), 1335 (w), 1244 (s), 1172 (s), 1114 (s), 1073 (m), 1026 (m), 918 (m), 885 (w), 830 (m), 694 (m), 659 (w), 633 (w), 599 (w), 562 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{19}H_{18}N_3O_5$ [M + H]$^+$ 368.1246; found 368.1234.

***N*,*N*-Dimethyl-4-[3,5-dinitro-4-phenylpyridin-1(4*H*)-yl]aniline (4ek):** Black crystal (73 mg, 40%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 3.03 (s, 6 H), 5.72 (s, 1 H), 6.76 (d, J = 8.8 Hz, 2 H), 7.22 (d, J = 8.8 Hz, 2 H), 7.27–7.27 (m, 1 H), 7.32–7.34 (m, 2 H), 7.41–7.43 (m, 2 H), 8.19 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.8, 40.4, 112.8, 123.2, 128.1, 128.5, 128.6, 130.4, 134.1, 134.6, 140.1, 150.4 ppm. IR (neat): $\tilde{\nu}$ = 3102 (w), 2892 (br), 1677 (m), 1601 (m), 1568 (w), 1521 (m), 1483 (s), 1454 (m), 1363 (w), 1329 (m), 1255 (s), 1198 (s), 1120 (s), 1068 (s), 948 (m), 926 (m), 911 (m), 894 (m), 871 (m), 818 (s), 771 (m), 738 (m), 729 (s), 695 (s), 635 (m), 573 (m), 531 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{19}H_{18}N_4O_4$ [M + Na]$^+$ 389.1226; found 389.1220.

3,5-Dinitro-4-phenyl-1,4-dihydropyridine (4el): Brown solid (67 mg, 55%). ^{1}H NMR (500 MHz, [D$_6$]DMSO): δ = 5.51 (s, 1 H), 7.22–7.25 (m, 1 H), 7.31–7.32 (m, 4 H), 8.17 (s, 2 H), 10.5 (s, 1 H) ppm. ^{13}C NMR (125 MHz, [D$_6$]DMSO): δ = 39.9, 127.6, 128.3, 128.3, 132.2, 133.8, 141.5 ppm. IR (neat): $\tilde{\nu}$ = 3345 (br), 3096 (w), 2961 (w), 1670 (m), 1619 (w), 1489 (s), 1470 (s), 1299 (s), 1240 (m), 1200 (m), 1166 (s), 1074 (s), 967 (w), 918 (s), 884 (m), 820 (m), 739 (m), 719 (m), 696 (s), 646 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{11}H_8N_3O_4$ [M – H]$^-$ 246.0515; found 246.0518.

1,1′-[1-(4-Methoxyphenyl)-4-phenyl-1,4-dihydropyridine-3,5-diyl]diethanone (4em): Yellow solid (57 mg, 33%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 2.18 (s, 6 H), 3.86 (s, 3 H), 5.23 (s, 1 H), 7.01 (d, J = 9.1 Hz, 2 H), 7.13 (t, J = 7.4 Hz, 1 H), 7.24 (dd, J = 8.5, 7.4 Hz, 2 H), 7.27 (d, J = 9.1 Hz, 2 H), 7.36 (d, J = 8.5 Hz, 2 H), 7.45 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 25.5, 35.6, 55.6, 115.2, 120.3, 123.5, 126.5, 128.2 (2 C), 136.6, 137.1, 145.5, 158.7, 195.2 ppm. IR (neat): $\tilde{\nu}$ = 3070 (w), 3010 (w), 1662 (w), 1636 (s), 1593 (m), 1566 (m), 1509 (s), 1452 (m), 1439 (m), 1427 (m), 1389 (w), 1372 (w), 1331 (m), 1294 (m), 1239 (s), 1210 (s), 1178 (s), 1117 (m), 1089 (m), 1053 (m), 1028 (m), 969 (m), 936 (m), 922 (m), 879 (m), 842 (m), 828 (m), 804 (m), 773 (m), 751 (m), 718 (w), 693 (m), 673 (m), 648 (w), 613 (m), 569 (m), 556 (m), 534 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{22}H_{21}NNaO_3$ [M + Na]$^+$ 370.1419; found 370.1402.

1,1′-[4-(4-Chlorophenyl)-1-phenyl-1,4-dihydropyridine-3,5-diyl]diethanone (4en): Yellow oil (375 mg, 38%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 2.21 (s, 6 H), 5.21 (s, 1 H), 7.19 (d, J = 8.5 Hz, 2 H), 7.30 (d, J = 8.5 Hz, 2 H), 7.35 (d, J = 8.5 Hz, 2 H), 7.39 (t, J = 7.4 Hz, 1 H), 7.52 (dd, J = 8.5, 7.4 Hz, 2 H), 7.55 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 25.4, 35.2, 120.7, 121.5, 127.2, 128.3, 129.6, 130.2, 132.2, 136.7, 143.1, 143.9, 194.9 ppm. IR (neat): $\tilde{\nu}$ = 3070 (w), 1639 (s), 1593 (m), 1569 (m), 1493 (m), 1485 (m), 1460 (w), 1428 (w), 1407 (w), 1341 (m), 1325 (m), 1303 (m), 1287 (m), 1237 (m), 1210 (s), 1085 (m), 1013 (m), 971 (m), 932 (m), 904 (w), 882 (m), 849 (w), 830 (w), 817 (w), 806 (m), 761 (m), 721 (w), 692 (s), 654 (w), 612 (m), 602 (m), 565 (m), 548 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{18}ClNNaO_2$ [M + Na]$^+$ 374.0924; found 374.0917.

1,1′-[1-(4-Methoxybenzyl)-4-phenyl-1,4-dihydropyridine-3,5-diyl]diethanone (4eo): Yellow solid (130 mg, 72%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 2.11 (s, 6 H), 3.84 (s, 3 H), 4.60 (s, 2 H), 5.18 (s, 1 H), 6.95 (d, J = 8.8 Hz, 2 H), 7.11 (t, J = 7.4 Hz, 1 H), 7.18 (s, 2 H), 7.19 (dd, J = 7.4, 7.4 Hz, 2 H), 7.22 (d, J = 8.8 Hz, 2 H), 7.26 (d, J = 7.4 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 25.5, 35.7, 55.4, 58.1, 114.7, 119.4, 126.4, 127.5, 128.1, 128.2, 128.7, 137.9, 145.7, 159.8 ppm. IR (neat): $\tilde{\nu}$ = 2960 (w), 1642 (m), 1625 (m), 1610 (m), 1585 (w), 1562 (m), 1512 (m), 1491 (w), 1466 (w), 1411 (m), 1367 (m), 1330 (w), 1315 (w), 1304 (m), 1284 (m), 1247 (m), 1221 (m), 1169 (s), 1116 (m), 1088 (m), 1076 (m), 1023 (m), 954 (m), 939 (m), 884 (m), 873 (m), 850 (m), 839 (m), 817 (m), 753 (m), 721 (w), 698 (m), 677 (m), 642 (m), 603 (m), 569 (m), 553 (m), 533 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{23}H_{23}NNaO_3$ [M + Na]$^+$ 384.1576; found 384.1564.

1,1′-(4-Phenyl-1,4-dihydropyridine-3,5-diyl)diethanone (4ep): Yellow solid (71 mg, 59%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 2.17 (s, 6 H), 5.19 (s, 1 H), 6.66 (br. s, 1 H), 7.12 (t, J = 7.4 Hz, 1 H), 7.22 (dd, J = 7.9, 7.4 Hz, 2 H), 7.28 (d, J = 5.1 Hz, 2 H), 7.33 (d, J = 7.9 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 25.4, 35.6, 119.1, 126.4, 128.2, 128.2, 134.2, 146.0, 195.4 ppm. IR (neat): $\tilde{\nu}$ = 3275 (w), 3183 (w), 3082 (w), 1640 (m), 1624 (m), 1474 (m), 1377 (m), 1322 (m), 1292 (m), 1259 (w), 1191 (s), 1098 (m), 1074 (m), 1019 (w), 969 (m), 933 (m), 898 (m), 833 (w), 823 (w), 748 (m), 694 (s), 657 (m), 597 (m), 557 (m), 547 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{15}H_{15}NNaO_2$ [M + Na]$^+$ 264.1000; found 264.1002.

[4-(4-Chlorophenyl)-1-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-diyl]bis(phenylmethanone) (4eq): Yellow crystal (217 mg, 43%). ^{1}H NMR (500 MHz, $CDCl_3$): δ = 3.78 (s, 3 H), 5.65 (s, 1 H), 6.90 (d, J = 8.8 Hz, 2 H), 7.08 (d, J = 8.8 Hz, 2 H), 7.20 (s, 2 H), 7.25 (d, J = 8.2 Hz, 2 H), 7.38 (dd, J = 7.4, 7.4 Hz, 4 H), 7.44 (d, J = 8.2 Hz, 2 H), 7.45 (t, J = 7.4 Hz, 2 H), 7.52 (d, J = 7.4 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 36.4, 55.7, 115.2, 119.7, 123.1, 128.3, 128.4, 128.5, 129.6, 131.2, 132.3, 136.4, 139.0, 140.0, 144.3, 158.6, 194.3 ppm. IR (neat): $\tilde{\nu}$ = 3060 (w), 2923 (w), 2832 (w), 1653 (w), 1613 (m), 1596 (m), 1576 (m), 1560 (m), 1511 (m), 1484 (m), 1442 (m), 1410 (w), 1339 (m), 1310 (m), 1291 (m), 1278 (m), 1228 (s), 1181 (m), 1144 (m), 1108 (m), 1089 (m), 1064 (m), 1038 (m), 1012 (m), 999 (m), 977 (m), 966 (m), 947 (m), 924 (m), 902 (m), 854 (m), 824 (m), 781 (m), 767 (m), 726 (m), 697 (s),

650 (s), 607 (m), 588 (m), 570 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{32}H_{24}ClNNaO_3$ $[M + Na]^+$ 528.1342; found 528.1320.

{4-(4-Chlorophenyl)-1-[4-(dimethylamino)phenyl]-1,4-dihydropyridine-3,5-diyl}bis(phenylmethanone) (4er): Orange crystal (220 mg, 42%). ^1H NMR (500 MHz, $CDCl_3$): δ = 2.93 (s, 6 H), 5.66 (s, 1 H), 6.56 (d, J = 9.1 Hz, 2 H), 7.02 (d, J = 9.1 Hz, 2 H), 7.19 (s, 2 H), 7.25 (d, J = 8.5 Hz, 2 H), 7.36 (t, J = 7.4 Hz, 4 H), 7.43 (dd, J = 6.8, 7.4 Hz, 2 H), 7.45 (d, J = 8.5 Hz, 2 H), 7.51 (d, J = 6.8 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 36.2, 40.4, 112.8, 119.3, 123.0, 128.2, 128.4, 128.5, 129.6, 131.0, 132.1, 132.5, 139.1, 140.7, 144.5, 149.6, 194.3 ppm. IR (neat): $\tilde{\nu}$ = 2859 (w), 2361 (w), 1659 (m), 1625 (m), 1577 (m), 1557 (m), 1517 (m), 1483 (m), 1445 (m), 1409 (w), 1359 (m), 1343 (m), 1315 (m), 1278 (m), 1246 (m), 1225 (s), 1175 (m), 1147 (m), 1110 (m), 1103 (m), 1076 (m), 1065 (m), 1026 (m), 1011 (m), 1000 (m), 978 (m), 945 (m), 910 (w), 893 (m), 845 (m), 829 (w), 813 (m), 779 (m), 742 (m), 729 (m), 722 (m), 711 (m), 692 (m), 651 (m), 605 (m), 582 (m), 550 (m), 534 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{33}H_{27}ClN_2NaO_2$ $[M + Na]^+$ 541.1659; found 541.1639.

[4-(4-Chlorophenyl)-1-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-diyl]bis[(4-chlorophenyl)methanone] (4es): Yellow crystal (339 mg, 59%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.80 (s, 3 H), 5.59 (s, 1 H), 6.93 (d, J = 9.1 Hz, 2 H), 7.09 (d, J = 9.1 Hz, 2 H), 7.15 (s, 2 H), 7.26 (d, J = 8.5 Hz, 2 H), 7.36 (d, J = 8.5 Hz, 4 H), 7.40 (d, J = 8.5 Hz, 2 H), 7.46 (d, J = 8.5 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 36.4, 55.6, 115.3, 119.6, 123.1, 128.6, 128.7, 129.5, 129.8, 132.5, 136.2, 137.2, 137.5, 139.9, 144.0, 158.8, 192.9 ppm. IR (neat): $\tilde{\nu}$ = 3066 (w), 2928 (w), 2836 (w), 1660 (w), 1622 (m), 1586 (m), 1566 (m), 1510 (m), 1484 (m), 1448 (w), 1430 (w), 1398 (w), 1333 (w), 1310 (m), 1285 (m), 1227 (s), 1182 (m), 1171 (m), 1142 (m), 1101 (m), 1087 (m), 1058 (m), 1027 (m), 1012 (m), 982 (m), 952 (w), 942 (w), 907 (w), 887 (w), 846 (m), 827 (s), 788 (s), 755 (s), 720 (m), 688 (m), 673 (m), 628 (w), 601 (m), 584 (m), 558 (w), 535 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{32}H_{22}Cl_3NNaO_3$ $[M + Na]^+$ 596.0563; found 596.0557.

[4-(4-Chlorophenyl)-1-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-diyl]bis[(4-methoxyphenyl)methanone] (4et): Yellow solid (355 mg, 63%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.79 (s, 3 H), 3.82 (s, 6 H), 5.65 (s, 1 H), 6.88 (d, J = 8.5 Hz, 4 H), 6.91 (d, J = 9.1 Hz, 2 H), 7.11 (d, J = 9.1 Hz, 2 H), 7.20 (s, 2 H), 7.23 (d, J = 8.5 Hz, 2 H), 7.41 (d, J = 8.5 Hz, 2 H), 7.55 (d, J = 8.5 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 37.0, 55.4, 55.6, 113.6, 115.1, 119.5, 122.9, 128.5, 129.5, 130.6, 131.4, 132.1, 136.5, 138.9, 144.4, 158.4, 162.2, 193.4 ppm. IR (neat): $\tilde{\nu}$ = 2933 (w), 2836 (w), 1655 (w), 1625 (m), 1597 (m), 1572 (m), 1508 (s), 1487 (m), 1461 (m), 1441 (w), 1416 (w), 1333 (w), 1304 (m), 1277 (m), 1225 (s), 1165 (s), 1145 (m), 1108 (m), 1063 (m), 1026 (m), 974 (m), 897 (w), 834 (m), 806 (m), 791 (m), 754 (m), 705 (w), 683 (m), 634 (m), 603 (m), 533 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{34}H_{28}ClNNaO_5$ $[M + Na]^+$ 588.1554; found 588.1536.

1-(4-Methoxyphenyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarbaldehyde (4fa): Yellow solid (385 mg, 40%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.87 (s, 3 H), 5.07 (s, 1 H), 7.02 (d, J = 9.1 Hz, 2 H), 7.15 (t, J = 7.4 Hz, 1 H), 7.20 (s, 2 H), 7.25 (dd, J = 7.4, 7.4 Hz, 2 H), 7.30 (d, J = 9.1 Hz, 2 H), 7.36 (d, J = 7.4 Hz, 2 H), 9.33 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 33.8, 55.7, 115.3, 122.9, 123.4, 126.8, 128.0, 128.3, 135.8, 144.2, 144.3, 159.0, 188.5 ppm. IR (neat): $\tilde{\nu}$ = 3003 (w), 2957 (w), 2827 (w), 2725 (w), 1651 (m), 1591 (w), 1567 (m), 1511 (m), 1454 (m), 1429 (w), 1381 (w), 1333 (m), 1307 (m), 1289 (m), 1253 (m), 1203 (m), 1180 (m), 1143 (s), 1075 (m), 1031 (m), 1253 (m), 1180 (m), 971 (m), 944 (m), 932 (m), 921 (m), 897 (m), 837 (s), 810 (m), 785 (w), 757 (s), 731 (m), 692 (s), 654 (m), 637 (m), 578 (m), 560 (m), 542 (s) cm^{-1}. HRMS (FAB): calcd. for $C_{20}H_{17}NNaO_3$ $[M + Na]^+$ 342.1106; found 342.1117.

4-(4-Chlorophenyl)-1-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-dicarbaldehyde: (4fb): Orange crystal (270 mg, 25%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.87 (s, 3 H), 5.05 (s, 1 H), 7.03 (d, J = 9.1 Hz, 2 H), 7.21 (s, 2 H), 7.22 (d, J = 8.5 Hz, 2 H), 7.29 (d, J = 9.1 Hz, 2 H), 7.30 (d, J = 8.5 Hz, 2 H), 9.33 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 33.4, 55.7, 115.4, 122.6, 123.4, 128.4, 129.5, 132.6, 135.7, 142.7, 144.5, 159.2, 188.4 ppm. IR (neat): $\tilde{\nu}$ = 3017 (w), 2829 (w), 1655 (s), 1592 (w), 1569 (m), 1510 (m), 1483 (m), 1465 (w), 1425 (w), 1406 (w), 1324 (m), 1283 (m), 1251 (m), 1202 (m), 1176 (m), 1145 (s), 1103 (m), 1088 (m), 1070 (m), 1029 (m), 1010 (m), 976 (w), 950 (m), 929 (m), 913 (m), 896 (m), 833 (m), 824 (m), 814 (m), 785 (m), 734 (m), 714 (m), 698 (m), 640 (w), 629 (w), 578 (m), 561 (m), 540 (s) cm^{-1}. HRMS (FAB): calcd. for $C_{20}H_{16}ClNNaO_3$ $[M + Na]^+$ 376.0716; found 376.0701.

Ethyl 3,5-Diformyl-1-(4-methoxyphenyl)-1,4-dihydropyridine-4-carboxylate (4fc): Orange crystal (276 mg, 29%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.27 (t, J = 7.4 Hz, 3 H), 3.86 (s, 3 H), 4.17 (q, J = 7.4 Hz, 2 H), 4.73 (s, 1 H), 7.00 (d, J = 8.5 Hz, 2 H), 7.26 (d, J = 8.5 Hz, 2 H), 7.26 (s, 2 H), 9.44 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.0, 35.1, 55.6, 61.5, 115.2, 117.9, 123.5, 135.4, 145.4, 159.1, 171.6, 188.2 ppm. IR (neat): $\tilde{\nu}$ = 2981 (w), 2909 (w), 2847 (w), 1723 (m), 1670 (m), 1639 (m), 1612 (w), 1595 (w), 1573 (m), 1514 (m), 1467 (m), 1444 (m), 1433 (w), 1367 (w), 1339 (m), 1327 (m), 1309 (m), 1254 (m), 1213 (m), 1193 (m), 1155 (m), 1114 (m), 1025 (m), 957 (m), 942 (m), 902 (m), 881 (w), 837 (s), 790 (m), 773 (m), 749 (m), 722 (m), 700 (m), 576 (m), 546 (s) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{17}NNaO_5$ $[M + Na]^+$ 338.1004; found 338.0993.

1-(4-Chlorophenyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarbaldehyde (4fd): Orange solid (98 mg, 30%). ^1H NMR (500 MHz, $CDCl_3$): δ = 5.06 (s, 1 H), 7.15–7.18 (m, 1 H), 7.25 (s, 2 H), 7.25–7.28 (m, 2 H), 7.32–7.35 (m, 4 H), 7.49–7.52 (m, 2 H), 9.34 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 33.9, 122.7, 123.7, 127.0, 128.1, 128.4, 130.5, 133.4, 141.0, 143.0, 143.7, 188.5 ppm. IR (neat): $\tilde{\nu}$ = 3058 (w), 2817 (w), 1666 (s), 1655 (s), 1591 (m), 1570 (m), 1492 (m), 1452 (w), 1419 (w), 1384 (w), 1332 (m), 1301 (m), 1270 (w), 1250 (m), 1200 (s), 1147 (s), 1091 (m), 1076 (w), 1062 (m), 1012 (w), 976 (w), 949 (m), 902 (w), 887 (m), 877 (m), 836 (m), 758 (m), 721 (m), 697 (s), 653 (m), 632 (w), 566 (m), 536 (m), 529 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{19}H_{14}ClNNaO_2$ $[M + Na]^+$ 346.0611; found 346.0619.

1-[4-(Dimethylamino)phenyl]-4-phenyl-1,4-dihydropyridine-3,5-dicarbaldehyde (4fe): Yellow solid (64 mg, 39%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.02 (s, 6 H), 5.09 (s, 1 H), 6.77 (d, J = 9.1 Hz, 2 H), 7.15 (t, J = 7.4 Hz, 1 H), 7.17 (s, 2 H), 7.21 (d, J = 9.1 Hz, 2 H), 7.26 (dd, J = 7.4, 6.8 Hz, 2 H), 7.37 (d, J = 6.8 Hz, 2 H), 9.33 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 33.4, 40.5, 112.9, 122.6, 123.2, 126.8, 128.0, 128.3, 131.9, 144.4, 144.9, 150.0, 188.6 ppm. IR (neat): $\tilde{\nu}$ = 3026 (w), 2811 (w), 1659 (m), 1645 (s), 1608 (w), 1577 (m), 1560 (m), 1521 (m), 1489 (m), 1447 (m), 1414 (m), 1376 (w), 1340 (m), 1314 (m), 1282 (m), 1256 (m), 1244 (m), 1201 (m), 1141 (m), 1060 (m), 1026 (m), 999 (m), 943 (m), 900 (m), 893 (m), 883 (m), 857 (w), 832 (m), 811 (m), 759 (m), 745 (m), 726 (m), 697 (s), 656 (m), 573 (m), 551 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{20}N_2NaO_2$ $[M + Na]^+$ 355.1422; found 355.1421.

4-(4-Chlorophenyl)-1-[4-(dimethylamino)phenyl]-1,4-dihydropyridine-3,5-dicarbaldehyde (4ff): Yellow solid (350 mg, 32%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.02 (s, 6 H), 5.05 (s, 1 H), 6.77 (d, J = 9.1 Hz, 2 H), 7.18 (s, 2 H), 7.20 (d, J = 9.1 Hz, 2 H), 7.22 (d, J = 8.5 Hz, 2 H), 7.31 (d, J = 8.5 Hz, 2 H), 9.31 (s, 2 H) ppm. ^{13}C

NMR (125 MHz, $CDCl_3$): δ = 33.4, 40.5, 112.9, 122.3, 123.2, 128.4, 129.5, 131.7, 132.5, 142.9, 145.1, 150.0, 188.4 ppm. IR (neat): $\tilde{\nu}$ = 2808 (w), 1648 (s), 1580 (m), 1561 (m), 1518 (m), 1483 (m), 1443 (m), 1409 (m), 1339 (m), 1312 (m), 1281 (m), 1254 (m), 1239 (m), 1201 (s), 1139 (s), 1105 (m), 1087 (m), 1062 (m), 1010 (m), 949 (m), 927 (m), 898 (m), 877 (m), 858 (m), 817 (s), 747 (m), 727 (m), 716 (m), 697 (m), 628 (w), 570 (m), 545 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{19}ClN_2NaO_2$ $[M + Na]^+$ 389.1033; found 389.1050.

1-(4-Methoxybenzyl)-4-phenyl-1,4-dihydropyridine-3,5-dicarbaldehyde (4fg): Orange solid (171 mg, 51%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.84 (s, 3 H), 4.65 (s, 2 H), 5.03 (s, 1 H), 6.91 (s, 2 H), 6.96–6.99 (m, 2 H), 7.11–7.14 (m, 1 H), 7.19–7.27 (m, 6 H), 9.23 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 33.7, 55.4, 58.1, 114.8, 122.3, 126.6, 126.7, 127.9, 128.2, 129.0, 144.4, 145.1, 160.1, 188.3 ppm. IR (neat): $\tilde{\nu}$ = 3030 (w), 2960 (w), 2821 (w), 2731 (w), 1653 (m), 1614 (w), 1586 (w), 1565 (s), 1512 (m), 1493 (m), 1451 (m), 1407 (m), 1387 (m), 1367 (m), 1309 (w), 1297 (m), 1242 (m), 1218 (m), 1199 (m), 1176 (m), 1146 (s), 1079 (m), 1030 (m), 989 (m), 940 (m), 926 (m), 915 (m), 896 (m), 831 (m), 812 (m), 761 (m), 743 (w), 729 (m), 709 (m), 696 (s), 655 (m), 606 (m), 560 (m), 532 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{21}H_{19}NNaO_3$ $[M + Na]^+$ 356.1263; found 356.1253.

4-(4-Chlorophenyl)-1,4-dihydropyridine-3,5-dicarbaldehyde (4fh): Brown crystal (84 mg, 23%). ^1H NMR (500 MHz, $CDCl_3$): δ = 5.02 (s, 1 H), 7.04 (s, 3 H), 7.21 (d, J = 8.5 Hz, 2 H), 7.27 (d, J = 8.5 Hz, 2 H), 9.29 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 33.5, 121.6, 128.4, 129.5, 141.2, 143.0, 148.5, 188.5 ppm. IR (neat): $\tilde{\nu}$ = 3308 (br), 3090 (w), 1645 (s), 1594 (m), 1485 (m), 1437 (s), 1408 (m), 1368 (s), 1284 (w), 1263 (m), 1241 (m), 1185 (w), 1146 (s), 1089 (s), 1016 (m), 974 (m), 948 (m), 906 (s), 839 (m), 813 (m), 716 (m), 673 (s), 629 (m), 618 (m), 534 (s) cm^{-1}. HRMS (FAB): calcd. for $C_{13}H_{11}ClNO_2$ $[M + H]^+$ 248.0478; found 248.0478.

Diethyl 4-[(Ethoxycarbonyl)methyl]-1,4-dihydropyridine-3,5-dicarboxylate (5): Yellow oil (38 mg, 32%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.22 (t, J = 6.8 Hz, 3 H), 1.29 (t, J = 6.8 Hz, 6 H), 2.52 (d, J = 5.1 Hz, 2 H), 4.04 (q, J = 6.8 Hz, 2 H), 4.20 (q, J = 6.8 Hz, 2 H), 4.21 (q, J = 6.8 Hz, 2 H), 4.23 (t, J = 5.1 Hz, 1 H), 6.82 (br. s, 1 H), 7.29 (d, J = 5.1 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 14.3, 34.9, 40.6, 60.0, 60.1, 105.7, 135.7, 167.0, 172.2 ppm. IR (neat): $\tilde{\nu}$ = 3331 (br), 3107 (w), 2980 (w), 1694 (s), 1602 (m), 1476 (m), 1368 (m), 1284 (m), 1180 (s), 1066 (s), 1022 (m), 856 (w), 765 (m), 754 (m), 702 (w), 609 (w), 543 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{15}H_{22}NO_6$ $[M + H]^+$ 312.1447; found 312.1453.

Diethyl 4-(2-Ethoxy-2-oxoethyl)-1-(4-methoxybenzyl)-1,4-dihydropyridine-3,5-dicarboxylate (5′): Yellow oil (91 mg, 42%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.16 (t, J = 6.8 Hz, 3 H), 1.26 (t, J = 7.4 Hz, 6 H), 2.48 (d, J = 5.1 Hz, 2 H), 3.80 (s, 3 H), 3.98 (q, J = 6.8 Hz, 2 H), 4.19 (q, J = 7.4 Hz, 4 H), 4.21 (t, J = 5.1 Hz, 1 H), 4.42 (s, 2 H), 6.89 (d, J = 8.8 Hz, 2 H), 7.16 (d, J = 8.8 Hz, 2 H), 7.17 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.1, 14.3, 29.6, 40.8, 55.3, 57.6, 59.9, 60.1, 106.3, 114.4, 127.9, 128.7, 139.4, 159.6, 166.8, 171.7 ppm. IR (neat): $\tilde{\nu}$ = 2975 (w), 1930 (w), 2900 (w), 2836 (w), 1693 (s), 1609 (w), 1579 (m), 1505 (m), 1460 (w), 1416 (w), 1371 (w), 1297 (w), 1278 (m), 1252 (m), 1223 (m), 1173 (s), 1070 (m), 1029 (m), 975 (w), 901 (w), 822 (w), 737 (w), 598 (w), 544 (w) cm^{-1}. HRMS (ESI): calcd. for $C_{26}H_{29}NNaO_6$ $[M + Na]^+$ 474.1893; found 474.1889.

Diethyl 4-Methyl-1,4-dihydropyridine-3,5-dicarboxylate (6): Yellow oil (16 mg, 17%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.03 (d, J = 6.8 Hz, 3 H), 1.21 (t, J = 6.8 Hz, 6 H), 3.71 (q, J = 6.8 Hz, 1 H), 4.06–4.17 (m, 4 H), 6.85 (br. s, 1 H), 7.12 (d, J = 5.1 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.3, 23.2, 26.2, 59.9, 108.7, 134.4, 167.5 ppm. IR (neat): $\tilde{\nu}$ = 3325 (br), 3105 (w), 2979 (w), 1686 (m), 1602 (m), 1531 (w), 1476 (m), 1447 (m), 1377 (m), 1285 (m), 1255 (m), 1180 (s), 1102 (s), 1090 (s), 1045 (s), 914 (w), 808 (w), 763 (m), 732 (m), 702 (m), 614 (w), 563 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{12}H_{17}NNaO_4$ $[M + Na]^+$ 262.1049; found 262.1050.

Diethyl 1-(4-Methoxybenzyl)-4-methyl-1,4-dihydropyridine-3,5-dicarboxylate (6′): Yellow oil (27 mg, 15%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.09 (d, J = 6.2 Hz, 3 H), 1.27 (t, J = 7.4 Hz, 6 H), 3.79 (q, J = 6.2 Hz, 1 H), 3.81 (s, 3 H), 4.13–4.23 (m, 4 H), 4.42 (s, 2 H), 6.90 (d, J = 8.5 Hz, 2 H), 7.09 (s, 2 H), 7.14 (d, J = 8.5 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.4, 23.7, 26.2, 55.3, 57.6, 59.9, 109.6, 114.4, 128.36, 128.38, 138.1, 159.5, 167.3 ppm. IR (neat): $\tilde{\nu}$ = 2949 (w), 2933 (w), 2903 (w), 2867 (w), 2836 (w), 1698 (s), 1607 (w), 1579 (m), 1515 (m), 1449 (w), 1377 (w), 1305 (m), 1274 (m), 1248 (s), 1181 (s), 1095 (s), 1047 (m), 904 (w), 813 (w), 755 (w) cm^{-1}. HRMS (ESI): calcd. for $C_{20}H_{25}NNaO_5$ $[M + Na]^+$ 382.1630; found 382.1619.

Procedure for the Oxidation of 1,4-DHP 4ca: A mixture of 1,4-DHP **4ca** (60.0 mg, 0.20 mmol), urea hydrogen peroxide (UHP; 38.0 mg, 0.40 mmol), and iodine (10.0 mg, 0.04 mmol) in EtOAc (1 mL) was stirred at room temperature for 9 h. The resulting mixture was washed with satd. aq. $Na_2S_2O_3$ (20 mL) and extracted with EtOAc (3× 15 mL). The combined organic layer was dried with $MgSO_4$, filtered, and the solvents evaporated. Removal of the solvent in vacuo followed by column chromatography on silica gel (AcOEt/*n*-hexane) afforded pyridine **7** (53.0 mg, 89%).

Diethyl 4-Phenylpyridine-3,5-dicarboxylate (7): Yellow oil (53 mg, 89%). ^1H NMR (500 MHz, $CDCl_3$): δ = 0.97 (t, J = 6.8 Hz, 6 H), 4.07 (q, J = 6.8 Hz, 4 H), 7.19–7.20 (m, 2 H), 7.39–7.41 (m, 3 H), 9.08 (s, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 13.6, 61.6, 127.8 (2 C), 128.2, 128.2, 136.8, 149.2, 152.2, 166.0 ppm. IR (neat): $\tilde{\nu}$ = 2987 (w), 2918 (w), 2849 (w), 1718 (s), 1579 (w), 1548 (w), 1456 (w), 1446 (w), 1415 (w), 1392 (w), 1366 (w), 1314 (m), 1295 (m), 1279 (m), 1226 (w), 1185 (s), 1119 (m), 1107 (m), 1079 (w), 1043 (w), 1018 (m), 920 (w), 856 (w), 797 (m), 773 (m), 754 (m), 743 (m), 700 (w), 629 (w), 588 (w), 573 (w), 553 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{17}H_{17}NNaO_4$ $[M + Na]^+$ 322.1048; found 322.1050.

Procedure for the Wittig Reaction with 1,4-DHP 4fa: *n*BuLi in hexane (0.60 mL, 1.60 mmol) was added dropwise to a stirred solution of methyltriphenylphosphonium iodide (0.65 g, 1.60 mmol) in THF (6 mL) at 0 °C. After 15 min, 1,4-DHP **4fa** (0.13 g, 0.40 mmol) was added to the prepared solution and stirred for 3 h at room temperature. The resulting mixture was quenched with water (10 mL) and the aqueous layer was extracted with Et_2O (3× 15 mL), dried with $MgSO_4$, filtered, and the solvents evaporated. Removal of the solvent in vacuo followed by column chromatography on silica gel (AcOEt/*n*-hexane) afforded 3,5-dialkenylated 1,4-DHP **9a** (0.12 g, 95%).

1-(4-Methoxyphenyl)-4-phenyl-3,5-divinyl-1,4-dihydropyridine (9a): Yellow solid (120 mg, 95%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.82 (s, 3 H), 4.76 (s, 1 H), 4.84 (dd, J = 1.1, 10.8 Hz, 2 H), 5.19 (dd, J = 1.1, 17.0 Hz, 2 H), 6.29 (dd, J = 10.8, 17.0 Hz, 2 H), 6.60 (s, 2 H), 6.93 (d, J = 9.1 Hz, 2 H), 7.13 (t, J = 7.4 Hz, 1 H), 7.16 (d, J = 9.1 Hz, 2 H), 7.24 (dd, J = 6.8, 7.4 Hz, 2 H), 7.35 (d, J = 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 38.9, 55.6, 109.0, 114.8, 116.6, 121.3, 126.3, 127.9, 128.0, 128.1, 135.4, 137.8, 145.5, 156.8 ppm. IR (neat): $\tilde{\nu}$ = 3018 (w), 2938 (br), 2857 (br), 2171 (w), 2163 (w), 2036 (w), 2022 (w), 2008 (w), 1656 (m), 1610 (m), 1593 (w), 1580 (w), 1509 (s), 1489 (m), 1464 (w), 1451 (w), 1433 (w), 1339 (w), 1319 (w), 1282 (m), 1257 (m), 1243 (s), 1209 (m), 1178 (m), 1119 (w), 1077 (w), 1058 (m), 1027 (m), 997 (m), 951 (w), 877

(m), 865 (m), 830 (s), 810 (m), 777 (m), 758 (m), 703 (m), 640 (w), 624 (m), 598 (m), 532 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{22}H_{21}NO$ $[M]^+$ 315.1623; found 315.1628.

General Procedure for the Synthesis of 3,5-Substituted-Alkenylated 1,4-DHPs 9: A solution of Horner–Wadsworth–Emmons reagent (6.0 equiv.) in THF (6 mL) was added dropwise to a suspension of NaH (6.0 equiv.) in THF (6 mL) at 0 °C. After stirring for 15 min, 1,4-DHP **4f** (1.0 equiv.) was added to the reaction mixture and the solution was heated at reflux for 3–17 h. The resulting mixture was quenched with satd. aq. NH_4Cl. The aqueous layer was extracted with CH_2Cl_2 (3× 15 mL), dried with $MgSO_4$, filtered, and the solvents evaporated. Removal of the solvent in vacuo followed by column chromatography on silica gel (AcOEt/*n*-hexane) afforded 3,5-substituted-alkenylated 1,4-DHP **9**.

(2*E*,2′*E*)-3,3′-[4-(4-Chlorophenyl)-1-(4-methoxyphenyl)-1,4-dihydropyridine-3,5-diyl]bis(1-phenylprop-2-en-1-one) (9b): Red solid (94 mg, 90%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.86 (s, 3 H), 4.95 (s, 1 H), 6.97 (d, J = 15.3 Hz, 2 H), 6.98 (s, 2 H), 6.99 (d, J = 8.5 Hz, 2 H), 7.23 (d, J = 8.5 Hz, 2 H), 7.31 (d, J = 8.5 Hz, 2 H), 7.42 (d, J = 8.5 Hz, 2 H), 7.45 (d, J = 15.3 Hz, 2 H), 7.48 (dd, J = 7.4, 7.4 Hz, 4 H), 7.55 (t, J = 7.4 Hz, 2 H), 7.86 (d, J = 7.4 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.5, 55.7, 115.2, 117.0, 118.3, 122.5, 128.2, 128.5, 128.8, 129.2, 132.3, 133.0, 135.4, 136.2, 138.8, 142.6, 144.0, 158.5, 190.0 ppm. IR (neat): $\tilde{\nu}$ = 3057 (w), 1650 (m), 1597 (m), 1582 (m), 1533 (s), 1508 (s), 1488 (m), 1446 (m), 1430 (m), 1396 (w), 1344 (m), 1299 (m), 1280 (m), 1248 (m), 1204 (s), 1171 (s), 1090 (m), 1064 (m), 1034 (m), 1016 (s), 971 (m), 848 (m), 828 (m), 773 (m), 716 (m), 693 (m), 675 (m), 617 (w), 559 (m), 540 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{36}H_{28}ClNNaO_3$ $[M + Na]^+$ 580.1655; found 580.1681.

(2*E*,2′*E*)-3,3′-{4-(4-Chlorophenyl)-1-[4-(dimethylamino)phenyl]-1,4-dihydropyridine-3,5-diyl}bis(1-phenylprop-2-en-1-one) (9c): Red solid (121 mg, 71%). ^1H NMR (500 MHz, $CDCl_3$): δ = 3.00 (s, 6 H), 4.95 (s, 1 H), 6.76 (d, J = 8.5 Hz, 2 H), 6.95 (d, J = 14.7 Hz, 2 H), 6.97 (s, 2 H), 7.16 (d, J = 8.5 Hz, 2 H), 7.31 (d, J = 8.5 Hz, 2 H), 7.42 (d, J = 8.5 Hz, 2 H), 7.47 (d, J = 14.7 Hz, 2 H), 7.47 (dd, J = 6.8, 7.4 Hz, 4 H), 7.55 (t, J = 7.4 Hz, 2 H), 7.86 (d, J = 6.8 Hz, 4 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 39.5, 40.6, 113.0, 116.7, 117.9, 122.3, 128.2, 128.5, 128.8, 129.2, 132.2, 132.4, 132.9, 136.0, 138.9, 142.8, 144.2, 149.5, 190.0 ppm. IR (neat): $\tilde{\nu}$ = 3068 (w), 2821 (w), 1650 (m), 1597 (w), 1582 (m), 1518 (s), 1487 (m), 1445 (m), 1398 (w), 1342 (s), 1302 (s), 1281 (s), 1208 (s), 1167 (s), 1105 (m), 1091 (m), 1077 (m), 1033 (m), 1017 (s), 998 (m), 976 (m), 955 (m), 934 (m), 903 (m), 850 (m), 812 (m), 772 (m), 749 (m), 730 (m), 716 (m), 691 (s), 674 (m), 642 (m), 619 (m), 597 (m), 550 (m), 529 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{37}H_{31}ClN_2NaO_2$ $[M + Na]^+$ 593.1972; found 593.1976.

Diethyl (2*E*,2′*E*)-3,3′-[1-(4-Methoxyphenyl)-4-phenyl-1,4-dihydropyridine-3,5-diyl]diacrylate (9d): Yellow solid (67 mg, 73%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.26 (t, J = 7.4 Hz, 6 H), 3.85 (s, 3 H), 4.08–4.20 (m, 4 H), 4.67 (s, 1 H), 5.88 (d, J = 15.3 Hz, 2 H), 6.85 (s, 2 H), 6.97 (d, J = 8.8 Hz, 2 H), 7.17 (t, J = 7.4 Hz, 1 H), 7.20 (d, J = 8.8 Hz, 2 H), 7.28 (d, J = 15.3 Hz, 2 H), 7.28 (dd, J = 7.4, 7.4 Hz, 2 H), 7.34 (d, J = 7.4 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.3, 39.3, 55.6, 60.0, 113.5, 115.1, 116.2, 122.3, 127.0, 127.8, 128.5, 133.7, 136.6, 143.6, 143.9, 158.1, 167.5 ppm. IR (neat): $\tilde{\nu}$ = 2982 (w), 1697 (m), 1642 (w), 1609 (m), 1561 (m), 1510 (m), 1469 (w), 1452 (w), 1435 (w), 1402 (w), 1365 (w), 1344 (m), 1301 (m), 1286 (m), 1244 (m), 1215 (m), 1153 (s), 1076 (m), 1060 (m), 1032 (s), 978 (m), 907 (m), 850 (m), 816 (m), 789 (m), 768 (m), 703 (m), 659 (m), 611 (w), 581 (m), 545 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{28}H_{29}NNaO_5$ $[M + Na]^+$ 482.1943; found 482.1950.

Diethyl (2*E*,2′*E*)-3,3′-{1-[4-(Dimethylamino)phenyl]-4-phenyl-1,4-dihydropyridine-3,5-diyl}diacrylate (9e): Orange solid (148 mg, 80%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.26 (t, J = 7.4 Hz, 6 H), 2.99 (s, 6 H), 4.08–4.20 (m, 4 H), 4.67 (s, 1 H), 5.86 (d, J = 15.3 Hz, 2 H), 6.76 (d, J = 9.1 Hz, 2 H), 6.83 (s, 2 H), 7.14 (d, J = 9.1 Hz, 2 H), 7.17 (t, J = 7.4 Hz, 1 H), 7.27 (d, J = 15.3 Hz, 2 H), 7.27 (dd, J = 7.4, 6.8 Hz, 2 H), 7.35 (d, J = 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.3, 39.3, 40.7, 60.0, 112.9, 113.1, 115.8, 122.3, 126.9, 127.8, 128.5, 132.9, 134.3, 143.8, 144.0, 149.2, 167.6 ppm. IR (neat): $\tilde{\nu}$ = 2982 (w), 1696 (m), 1635 (w), 1603 (m), 1550 (m), 1519 (m), 1491 (w), 1389 (w), 1363 (w), 1339 (m), 1303 (m), 1277 (m), 1239 (m), 1209 (m), 1146 (s), 1076 (m), 1065 (m), 1036 (m), 977 (m), 955 (m), 875 (w), 849 (m), 819 (m), 758 (m), 730 (w), 699 (m), 656 (m), 611 (w), 582 (w), 556 (m), 542 (m) cm^{-1}. HRMS (FAB): calcd. for $C_{29}H_{32}N_2NaO_4$ $[M + Na]^+$ 495.2260; found 495.2241.

Diethyl 1-(4-Methoxyphenyl)-2-methyl-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (11): Brown oil (140 mg, quant.). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.10 (t, J = 7.4 Hz, 3 H), 1.13 (t, J = 7.4 Hz, 3 H), 2.05 (s, 3 H), 3.76 (s, 3 H), 3.95–4.07 (m, 4 H), 4.99 (s, 1 H), 6.88 (d, J = 8.8 Hz, 2 H), 7.08 (t, J = 7.4 Hz, 1 H), 7.09 (d, J = 8.8 Hz, 2 H), 7.19 (dd, J = 7.4, 7.4 Hz, 2 H), 7.25 (s, 1 H), 7.31 (d, J = 7.4 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.2, 14.2, 17.8, 38.9, 55.5, 59.9, 59.9, 106.4, 107.8, 114.8, 126.3, 127.9, 128.0, 128.7, 135.4, 139.4, 146.1, 146.9, 159.2, 166.9, 168.0 ppm. IR (neat): $\tilde{\nu}$ = 2978 (w), 1692 (s), 1655 (w), 1574 (m), 1509 (s), 1453 (w), 1369 (w), 1336 (w), 1285 (w), 1227 (s), 1200 (s), 1179 (s), 1060 (s), 1028 (m), 931 (w), 902 (w), 834 (m), 805 (m), 754 (m), 725 (w), 697 (m), 648 (w), 618 (w), 580 (w), 536 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{25}H_{27}NO_5$ $[M]^+$ 421.1889; found 421.1885.

Diethyl 1-(4-Methoxyphenyl)-2,6-dimethyl-4-phenyl-1,4-dihydropyridine-3,5-dicarboxylate (12): Yellow solid (35 mg, 8%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.25 (t, J = 7.4 Hz, 6 H), 2.07 (s, 6 H), 3.84 (s, 3 H), 4.14 (q, J = 7.4 Hz, 4 H), 5.14 (s, 1 H), 6.93 (d, J = 8.5 Hz, 2 H), 7.03 (d, J = 8.5 Hz, 2 H), 7.17 (t, J = 7.4 Hz, 1 H), 7.28 (dd, J = 7.4, 6.8 Hz, 2 H), 7.38 (d, J = 6.8 Hz, 2 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.3, 18.6, 38.8, 55.5, 59.9, 105.7, 114.4, 126.1, 127.5, 128.0, 131.1, 133.0, 147.1, 147.7, 159.3, 168.1 ppm. IR (neat): $\tilde{\nu}$ = 2981 (w), 1686 (s), 1649 (w), 1581 (m), 1510 (m), 1478 (w), 1455 (w), 1443 (w), 1381 (w), 1365 (w), 1348 (w), 1323 (w), 1296 (w), 1281 (m), 1248 (m), 1192 (s), 1140 (w), 1080 (m), 1028 (m), 915 (w), 862 (w), 836 (w), 812 (w), 782 (w), 756 (w), 737 (w), 696 (m), 650 (w), 617 (w), 563 (w), 540 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{26}H_{29}NO_5$ $[M]^+$ 435.2046; found 435.2033.

Ethyl 1-(4-Methoxybenzyl)-4-phenyl-1,4-dihydropyridine-3-carboxylate (13): Yellow oil (33 mg, 57%). ^1H NMR (500 MHz, $CDCl_3$): δ = 1.12 (t, J = 7.9 Hz, 3 H), 3.81 (s, 3 H), 3.95–4.08 (m, 2 H), 4.36 (s, 2 H), 4.52 (d, J = 5.1 Hz, 1 H), 4.89 (dd, J = 7.9, 5.1 Hz, 1 H), 5.88 (d, J = 7.9 Hz, 1 H), 6.90 (d, J = 8.8 Hz, 2 H), 7.13–7.16 (m, 1 H), 7.19 (d, J = 8.8 Hz, 2 H), 7.24–7.26 (m, 4 H), 7.35 (d, J = 1.7 Hz, 1 H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 14.3, 38.5, 55.3, 57.3, 59.4, 102.0, 108.9, 114.2, 126.1, 126.5, 127.7, 128.1, 128.5, 129.0, 140.2, 148.1, 159.3, 168.0 ppm. IR (neat): $\tilde{\nu}$ = 2930 (w), 2835 (w), 1683 (s), 1611 (w), 1582 (m), 1511 (m), 1490 (w), 1452 (w), 1411 (w), 1390 (w), 1370 (w), 1304 (m), 1246 (s), 1206 (w), 1156 (s), 1110 (w), 1072 (m), 1021 (m), 979 (w), 912 (w), 836 (m), 771 (w), 755 (w), 727 (w), 698 (m), 675 (w), 597 (w), 540

(w), 701 (m), 639 (w), 602 (w), 573 (w) cm^{-1}. HRMS (FAB): calcd. for $C_{22}H_{24}NO_3$ $[M + H]^+$ 350.1756; found 350.1742.

Supporting Information (see footnote on the first page of this article): ^1H and ^{13}C NMR spectra for 1,4-dihydropiridines **4aa**–**az**, **4ba**–**bf**, **4ca**–**ch**, **4da**–**dd**, **4ea**–**et**, **4fa**–**fh**, **5**, **5′**, **6**, **6′**, **9a**–**e**, its derivative **7**, related compounds **11**–**13**, HPLC traces for **4ay** and **4az**, details of synthetic routes to compounds **11**–**13**, and crystallographic X-ray data for **4ek**, **4er**, and **9c**.

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[11] The reactions of various benzylamine salts **1** with ethyl glyoxylate (**2a**) and **3a** were carried out: $BnNH_2$·HCl, 62%; $BnNH_2$·HBr, 0%; $BnNH_2$·HI, 59%; $(BnNH_2)_2$·H_2SO_4, 57%; $BnNH_2$·H_3PO_4, 20%; $BnNH_2$·HNO_3, 10%; $BnNH_2$·TfOH, 46%; $BnNH_2$·AcOH, <5%; $BnNH_2$·PTSA, 62%. Owing to their facile handling and versatility, practical amine hydrochloride salts were used for further syntheses.

[12] The reaction of **1b** (1.0 equiv.) with **3a** (2.5 equiv.) in DMSO at 90 °C was carried out and the corresponding 1,4-DHP (**5′**) and its decarboxylated product **6′** were obtained in yields of 42 and 15%, respectively.

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[17] In entry 11 of Table 5, the desired product **4ek** could not be obtained under the reaction conditions, however, we have succeeded in synthesizing **4ek** by using our former synthetic procedure, see ref.[8]

[18] CCDC-964466 (for **4ek**), -964464 (for **4er**) and -964465 (for **9c**) contain the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.
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