A New Synthesis of *N*-Alkyl 3-Acetyl-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridines Utilizing *sec*-Aminodienyl Esters with Acetylacetone

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The reactions of *sec*-aminodienyl esters 3 with acetylacetone (4) afforded *N*-alkyl 3-acetyl-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridines 5 and enamines 6, providing a new azaelectrocyclization reaction.

Key words aminodienyl ester; acetylacetone; 1,4-dihydropyridine; azaelectrocyclization reaction

We are interested in the reactivities of the *sec*-aminodienyl esters **3**. The enaminic, dienic, and electronic "push pull" character of these molecules can lead to interesting cycloaddition and azaelectrocyclization reactions, as well as nitrodienamines and aminoacrylates synthons.[1—4] Previously,[1)] we reported the cycloaddition reactions of methyl 5-(*N*,*N*-dimethylamino)-2,4-pentadienoate (*tert*-aminodienyl ester **1**) with α,β-unsaturated carbonyl compounds and quinones to give aromatic compounds.[1a)] We also determined that the reactions of methyl 5-(*N*-alkylamino)-2,4-pentadienoates (*sec*-aminodienyl esters **3**) with acetaldehyde provided 2,3-dihydro-6*H*-1,3-oxazines[1b)] and the reactions of **3** in the presence of propargylaldehyde diethylacetal afforded *N*-alkyl 3-[2-(methoxycarbonyl)ethenyl]-4-methoxycarbonylmethyl-1,4-dihydropyridines[1d)] (self-condensation products) as an unexpected reaction, and the reactions of **3** with crotonaldehyde yielded *N*-alkyl 3-[2-(methoxycarbonyl)ethenyl]-4-methyl-1,4-dihydropyridines as the expected reaction.[1f)] Although several reactions using related aminodienyl esters have been reported, their utility and basic reactivity have not been well documented.[5)]

Dihydropyridine derivatives are important for developing drugs and are relatively difficult to be synthesized. At this time, we synthesized designed 1,4-dihydropyridine derivatives utilizing *sec*-aminodienyl esters **3** with acetylacetone (**4**) compound containing a 1,3-diketone moiety, which produced the expected reaction. This reaction is a new synthetic method for obtaining 1,4-dihydropyridine derivatives, which is interesting in terms of organic chemistry research and also regarding the biological activity of drugs (hypotensive, anti-inflammatory and mutagenic effects).[6)] The *sec*-aminodienyl esters **3** were prepared by reactions[1b)] of the *tert*-aminodienyl ester **1** with primary amines **2**. The reactions of **3** with acetylacetone (**4**) afforded *N*-alkyl 3-acetyl-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridines **5** and enamines **6**, [(*Z*)-4-(alkylamino)-3-penten-2-one], providing a new azaelectrocyclization reaction.

The methyl 5-(*N*-alkylamino)-2,4-pentadienoate derivatives listed in Table 1, *sec*-aminodienyl esters **3a**—**f**, were selected for investigation (Chart 1). The *sec*-aminodienyl esters **3** were prepared by the reaction of the *tert*-aminodienyl ester **1** with the corresponding primary amines, namely, 3,4,5-trimethoxybenzylamine (**2a**), 2-(2-methoxyphenyl)ethylamine (**2b**), 4-methoxybenzylamine (**2c**), 3,4-dimethoxybenzylamine (**2d**), 2-(2,5-dimethoxyphenyl)ethylamine (**2e**), and 1-naphthalenemethylamine (**2f**), respectively, under reflux in tetrahydrofuran (THF) (Table 1).

Previous syntheses of 1,4-dihydropyridines have been reported,[6,7)] but synthetic methods using the related aminodienyl esters have hardly been studied. On the basis of our earlier report on the formation of the product *N*-alkyl 3-[2-(methoxycarbonyl)ethenyl]-4-methyl-1,4-dihydropyridines by the reaction of *sec*-aminodienyl esters with crotonaldehyde,[1f)] we attempted to prepare the condensation product 3-acetyl-1-(3,4,5-trimethoxybenzyl)-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridine (**5a**) by azaelectrocyclization reaction of the *sec*-aminodienyl ester **3a** with acetylacetone (**4**). As expected, the product **5a** and the severed enamine, (*Z*)-4-(3,4,5-trimethoxybenzylamino)-3-penten-2-one (**6a**) were obtained by refluxing in xylene *sec*-aminodienyl ester **3a** with acetylacetone (**4**) in 37 and 36% yields, respectively.

The structure of **5a** was proposed on the basis of the following spectroscopic analyses. The molecular formula of **5a** was found to be $C_{21}H_{27}NO_6$. The ^{1}H-NMR spectrum of **5a** showed the presence of aromatic protons at δ 6.36 (2H, s),

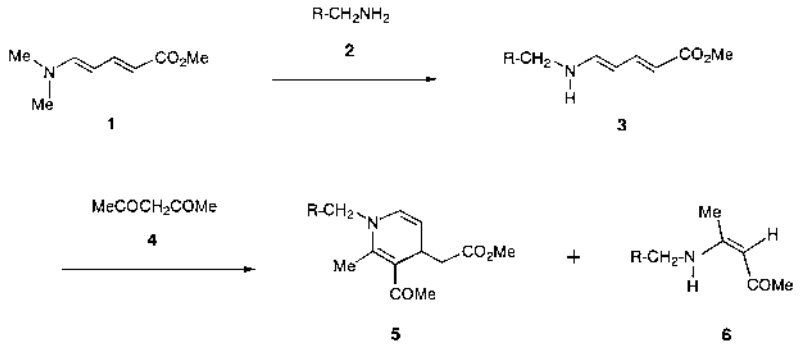

Chart 1

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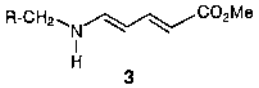
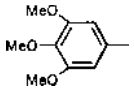
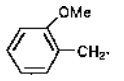
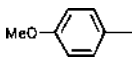
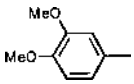
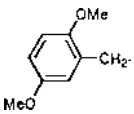
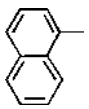
Table 1. The Reactions of *tert*-Aminodienyl Ester **1** with Primary Amines **2**[a)]



3

Starting amine	R	Reaction time (h)	Reaction product	Yield (%)	Appearance [solvent, mp (°C)]	^{1}H-NMR, δ (ppm)	IR (cm^{-1})
2a		90	**3a**	62	Light yellow oil	3.70 (3H, s, -Me), 3.84 (3H, s, -Me), 3.85 (3H, s, -Me), 3.86 (3H, s, -Me), 4.17 (2H, d, J=5.0 Hz, methylene H), 5.37 (1H, dd, J=13.1, 11.2 Hz, olefinic H), 5.50 (1H, d, J=14.9 Hz, olefinic H), 6.50 (2H, s, aromatic H), 6.80 (1H, dd, J=13.1, 7.5 Hz, olefinic H), 7.34 (1H, dd, J=14.9, 11.2 Hz, olefinic H), [$CDCl_3$]	3370, 1730, 1700, 1695, 1680, 1640, (neat)
2b		129	**3b**	30	Light yellow oil	2.88 (2H, t, J=6.7 Hz, methylene H), 3.29 (2H, q, J=6.7 Hz, methylene H), 3.69 (3H, s, -Me), 3.85 (3H, s, -Me), 5.31 (1H, dd, J=13.1, 8.6 Hz, olefinic H), 5.46 (1H, d, J=14.7 Hz, olefinic H), 6.69 (1H, dd, J=13.1, 7.9 Hz, olefinic H), 7.35—6.83 (5H, m, aromatic and olefinic H), [$CDCl_3$]	3350, 1730, 1700, 1695, 1685, 1630, (neat)
2c		129	**3c**	36	Light yellow plates (ether–hexane, 92—93)	3.69 (3H, s, -Me), 3.80 (3H, s, -Me), 4.16 (2H, d, J=5.5 Hz, methylene H), 5.35 (1H, dd, J=13.1, 11.6 Hz, olefinic H), 5.48 (1H, d, J=15.0 Hz, olefinic H), 6.78 (1H, dd, J=13.1, 7.9 Hz, olefinic H), 6.88 (2H, d, J=8.9 Hz, aromatic H), 7.20 (2H, d, J=8.5 Hz, aromatic H), 7.33 (1H, dd, J=15.0, 11.6 Hz, olefinic H), [$CDCl_3$]	3320, 1730, 1690, 1615, 1595, 1510, (KBr)
2d		120	**3d**	57	Light yellow prisms (ether–hexane, 111—113)	3.68 (3H, s, -Me), 3.87 (6H, s, -Me), 4.16 (2H, d, J=5.3 Hz, methylene H), 5.36 (1H, t, J=14.3 Hz, olefinic H), 5.53 (1H, d, J=14.7 Hz, olefinic H), 6.91—6.68 (4H, m, olefinic and aromatic H), 7.34 (1H, dd, J=14.7, 11.0 Hz, olefinic H), [$CDCl_3$]	3390, 1700, 1620, 1595, 1515, 1500, (KBr)
2e		120	**3e**	35	Light yellow oil	2.84 (2H, t, J=6.4 Hz, methylene H), 3.27 (2H, q, J=6.4 Hz, methylene H), 3.68 (3H, s, -Me), 3.75 (3H, s, -Me), 3.80 (3H, s, -Me), 5.30 (1H, dd, J=13.0, 11.4 Hz, olefinic H), 5.45 (1H, d, J=14.7 Hz, olefinic H), 6.88—6.57 (4H, m, olefinic and aromatic H), 7.32 (1H, dd, J=14.7, 11.4 Hz, olefinic H), [$CDCl_3$]	3380, 1740, 1700, 1695, 1685, 1640, (neat)
2f		98	**3f**	68	Light yellow oil	3.66 (3H, s, -Me), 4.55 (2H, d, J=4.9 Hz, methylene H), 5.39 (1H, dd, J=13.1, 11.6 Hz, olefinic H), 5.49 (1H, d, J=15.0 Hz, olefinic H), 6.76 (1H, dd, J=13.1, 7.3 Hz, olefinic H), 7.52—7.32 (5H, m, olefinic H and aromatic H), 7.87—7.77 (3H, m, aromatic H), [$CDCl_3$]	3355, 1730, 1700, 1695, 1685, 1640, (neat)

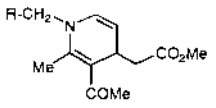
a) All reactions were run in refluxing THF.

methylene protons at δ 4.45 (1H, d, J=16.8 Hz) and 4.68 (1H, d, J=16.8 Hz), and three methoxy protons at δ 3.84 (3H, s) and 3.85 (6H, s) due to a 3,4,5-trimethoxybenzyl group, methoxy protons at δ 3.67 (3H, s), methylene protons at δ 2.31 (2H, d, J=8.2 Hz) due to a (methoxycarbonyl)-methyl group, acetyl protons at δ 2.29 (3H, s), methyl protons at δ 2.31 (3H, s), a methine proton at δ 3.84—3.81 (1H, m), and two olefinic protons at δ 5.12 (1H, t, J=7.3 Hz) and 6.04 (1H, d, J=7.3 Hz) due to a 1,4-dihydropyridine ring. The IR spectrum of **5a** indicated absorption bands at 1730, 1670 cm^{-1} (two carbonyl groups), and at 1640, 1595 cm^{-1} (two olefinic groups). The nuclear Overhauser effect correlation spectroscopy (NOESY) of **5a** revealed the presence of a cross-peak between the 2-methyl protons at δ 2.31 (3H) and the methylene protons of a trimethoxybenzyl group at δ 4.45 (1H) and 4.68 (1H), and a cross-peak between 2-methyl protons at δ 2.31 (3H) and aromatic protons at δ 6.36 (2H). Therefore, it may be deduced that **5a** is a 3-acetyl-2-methyl-1,4-dihydropyridine.

Concerning *sec*-dienylamine chemistry, we have studied the reactions of nitrodienamines with acetaldehyde to give 1,2-dihydropyridine derivatives,[4d,f)] and the reactions of aminodienyl esters with aminodienyl ester,[1d)] crotonaldehyde,[1f)] and acetylacetone to afford 1,4-dihydropyridine derivatives. These results have shown that these azaelectrocyclization reactions depend on the nature of the electron-withdrawing group (a nitro or a methoxycarbonyl group) at the terminal position of the *sec*-dienylamines resulting in changes in the reactive carbon site in the transition state and the nature of the acyl reagent. Their behavior suggests that we could make either 1,2- or 1,4-dihydropyridine derivatives as reaction products depending on the choice of *sec*-dienylamines.

1,4-Dihydropyridine derivatives are found in certain drugs. Compounds containing methoxy groups such as natural products have often been known to show good biological activity. Therefore, we synthesized 1,4-dihydropyridine derivatives having methoxy groups. In a similar manner, several other substituted 3-acetyl-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridines **5b**—**f** and enamines **6b**—**f** listed in Table 2, were prepared from the corresponding **3b**—**f** (Chart

Table 2. The Reactions of *sec*-Aminodienyl Esters **3** with Acetylacetone (**4**)[a)]



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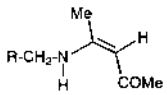
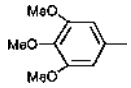
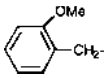
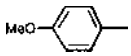
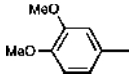
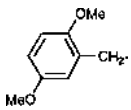
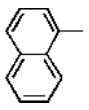


6

Starting amine	R	Reaction time (h)	Reaction product	Yield (%)	^{1}H-NMR, δ (ppm)	IR (cm^{-1})	Formula, HR-MS *m/z* Calcd (Found)
3a		4	**5a**	37	2.29 (3H, s, -Me), 2.31 (3H, s, -Me), 2.31 (2H, d, *J*=8.2 Hz, methylene H), 3.67 (3H, s, -Me), 3.84—3.81 (1H, m, methine H), 3.84 (3H, s, -Me), 3.85 (6H, s, -Me), 4.45 (1H, d, *J*=16.8 Hz, methylene H), 4.68 (1H, d, *J*=16.8 Hz, methylene H), 5.12 (1H, t, *J*=7.3 Hz, olefinic H), 6.04 (1H, d, *J*=7.3 Hz, olefinic H), 6.36 (2H, s, aromatic H), [$CDCl_3$]	1730, 1670, 1640, 1595, 1540, (neat)	$C_{21}H_{27}NO_6$ 389.1839 (389.1860)
			6a	36	1.93 (3H, s, -Me), 2.03 (3H, s, -Me), 3.83 (3H, s, -Me), 3.85 (6H, s, -Me), 4.39 (2H, d, *J*=6.4 Hz, methylene H), 5.05 (1H, s, olefinic H), 6.47 (2H, s, aromatic H), 11.08 (1H, br s, -NH), [$CDCl_3$]	3420, 1610, 1590, 1570, 1550, (KBr)	$C_{15}H_{21}NO$ 279.1471 (279.1471)
3b		4	**5b**	23	2.20 (1H, d, *J*=8.9 Hz, methylene H), 2.22 (1H, d, *J*=8.9 Hz, methylene H), 2.26 (3H, s, -Me), 2.37 (3H, s, -Me), 2.89—2.83 (2H, m, methylene H), 3.48—3.41 (2H, m, methylene H), 3.69 (3H, s, -Me), 3.77—3.67 (1H, m, methine H), 3.84 (3H, s, -Me), 5.08 (1H, dd, *J*=7.0, 6.4 Hz, olefinic H), 5.99 (1H, d, *J*=7.3 Hz, olefinic H), 6.92—6.85 (2H, m, aromatic H), 7.10 (1H, dd, *J*=7.3, 1.8 Hz, aromatic H), 7.25—7.20 (1H, m, aromatic H), [$CDCl_3$]	1730, 1670, 1640, 1615, 1580, (neat)	$C_{20}H_{25}NO_4$ 343.1784 (343.1814)
			6b	69	1.84 (3H, s, -Me), 1.99 (3H, s, -Me), 2.87 (2H, t, *J*=7.9 Hz, methylene H), 3.44 (2H, dd, *J*=14.7, 7.9 Hz, methylene H), 3.83 (3H, s, -Me), 4.92 (1H, s, olefinic H), 6.85 (1H, d, *J*=8.2 Hz, aromatic H), 6.90 (1H, td, *J*=7.6, 1.8 Hz, aromatic H), 7.14 (1H, dd, *J*=7.6, 1.8 Hz, aromatic H), 7.22 (1H, td, *J*=8.2, 1.5 Hz, aromatic H), 10.87 (1H, br s, -NH), [$CDCl_3$]	3430, 1615, 1580, 1515, 1495, (neat)	$C_{14}H_{19}NO_2$ 233.1416 (233.1417)
3c		4	**5c**	27	2.28 (2H, dd, *J*=8.9, 5.2 Hz, methylene H), 2.28 (3H, s, -Me), 2.30 (3H, s, -Me), 3.67 (3H, s, -Me), 3.80 (3H, s, -Me), 3.84—3.81 (1H, m, methine H), 4.50 (1H, d, *J*=16.8 Hz, methylene H), 4.63 (1H, d, *J*=16.8 Hz, methylene H), 5.10 (1H, d, *J*=7.3, 6.4 Hz, olefinic H), 6.02 (1H, d, *J*=7.3 Hz, olefinic H), 6.89 (2H, d, *J*=8.9 Hz, aromatic H), 7.07 (2H, d, *J*=8.9 Hz, aromatic H), [$CDCl_3$]	1730, 1670, 1640, 1615, 1590, (neat)	$C_{19}H_{23}NO_4$ 329.1628 (329.1640)
			6c	56	1.92 (3H, s, -Me), 2.02 (3H, s, -Me), 3.79 (3H, s, -Me), 4.39 (2H, d, *J*=6.1 Hz, methylene H), 5.02 (1H, s, olefinic H), 6.87 (2H, d, *J*=8.9 Hz, aromatic H), 7.17 (2H, d, *J*=8.5 Hz, aromatic H), 11.10 (1H, br s, -NH), [$CDCl_3$]	3440, 1610, 1580, 1510, 1460, (neat)	$C_{13}H_{17}NO_2$ 219.1259 (219.1285)
3d		5	**5d**	30	2.28 (3H, s, -Me), 2.28 (1H, d, *J*=5.5 Hz, methylene H), 2.29 (1H, d, *J*=5.5 Hz, methylene H), 2.31 (3H, s, -Me), 3.67 (3H, s, -Me), 3.85—3.80 (1H, m, methine H), 3.87 (6H, s, -Me), 4.48 (1H, d, *J*=16.5 Hz, methylene H), 4.66 (1H, d, *J*=16.5 Hz, methylene H), 5.11 (1H, t, *J*=7.3 Hz, olefinic H), 6.04 (1H, d, *J*=7.3 Hz, olefinic H), 6.66 (1H, d, *J*=1.8 Hz, aromatic H), 6.69 (1H, dd, *J*=8.2, 1.8 Hz, aromatic H), 6.84 (1H, d, *J*=8.2 Hz, aromatic H), [$CDCl_3$]	1730, 1670, 1640, 1610, 1595, (neat)	$C_{20}H_{25}NO_5$ 359.1733 (359.1735)
			6d	40	1.93 (3H, s, -Me), 2.03 (3H, s, -Me), 3.87 (3H, s, -Me), 3.87 (3H, s, -Me), 4.39 (2H, d, *J*=6.1 Hz, methylene H), 5.04 (1H, s, olefinic H), 6.76 (1H, d, *J*=1.8 Hz, aromatic H), 6.84—6.79 (2H, m, aromatic H), 11.10 (1H, br s, -NH), [$CDCl_3$]	3420, 1615, 1580, 1560, 1520, (neat)	$C_{14}H_{19}NO_3$ 249.1365 (249.1375)
3e		5	**5e**	25	2.21 (1H, d, *J*=8.5 Hz, methylene H), 2.22 (1H, d, *J*=8.5 Hz, methylene H), 2.26 (3H, s, -Me), 2.37 (3H, s, -Me), 2.84—2.80 (2H, m, methylene H), 3.50—3.42 (2H, m, methylene H), 3.66 (3H, s, -Me), 3.75—3.68 (1H, m, methine H), 3.75 (3H, s, -Me), 3.80 (3H, s, -Me), 5.08 (1H, dd, *J*=7.3, 6.4 Hz, olefinic H), 5.99 (1H, d, *J*=7.3 Hz, olefinic H), 6.79—6.68 (3H, m, aromatic H), [$CDCl_3$]	1730, 1670, 1640, 1595, 1545, (neat)	$C_{21}H_{27}NO_5$ 373.1887 (373.1877)
			6e	44	1.84 (3H, s, -Me), 1.99 (3H, s, -Me), 2.84 (2H, t, *J*=7.3 Hz, methylene H), 3.43 (2H, q, *J*=7.3 Hz, methylene H), 3.76 (3H, s, -Me), 3.78 (3H, s, -Me), 4.92 (1H, s, olefinic H), 6.81—6.72 (3H, m, aromatic H), 10.88 (1H, br s, -NH), [$CDCl_3$]	3390, 1615, 1580, 1565, 1505, (neat)	$C_{15}H_{21}NO_3$ 263.1522 (263.1537)
3f		4	**5f**	20	2.31 (3H, s, -Me), 2.32 (3H, s, -Me), 2.34—2.30 (2H, m, methylene H), 3.68 (3H, s, -Me), 3.93—3.89 (1H, m, methine H), 5.05 (1H, d, *J*=17.1 Hz, methylene H), 5.12 (1H, d, *J*=17.1 Hz, methylene H), 5.14 (1H, dd, *J*=7.3, 6.4 Hz, olefinic H), 6.03 (1H, d, *J*=7.3 Hz, olefinic H), 7.19 (1H, dd, *J*=7.3, 0.9 Hz, aromatic H), 7.46 (1H, t, *J*=7.3 Hz, aromatic H), 7.59—7.53 (2H, m, aromatic H), 7.92—7.80 (3H, m, aromatic H), [$CDCl_3$]	1730, 1670, 1635, 1615, 1600, (neat)	$C_{22}H_{23}NO_3$ 349.1678 (349.1686)
			6f	53	1.97 (3H, s, -Me), 2.05 (3H, s, -Me), 4.91 (2H, d, *J*=6.4 Hz, methylene H), 5.10 (1H, s, olefinic H), 7.45—7.39 (2H, m, aromatic H), 7.80—7.50 (2H, m, aromatic H), 7.89 (1H, dd, *J*=7.9, 0.6 Hz, aromatic H), 7.93 (1H, d, *J*=8.6 Hz, aromatic H), 11.26 (1H, br s, -NH), [$CDCl_3$]	3420, 1610, 1580, 1520, 1450, (KBr)	$C_{16}H_{17}NO$ 239.1273 (239.1290)

a) All reactions were run in refluxing xylene.

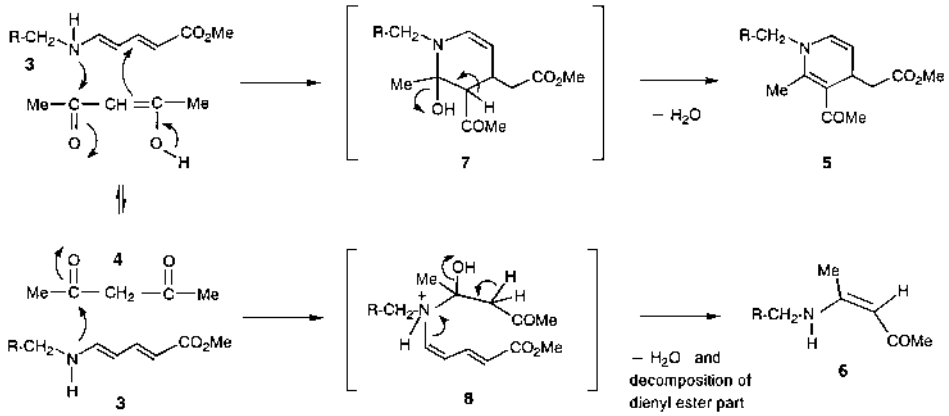


Chart 2

1, Table 2). On the other hand, treatment of 3,4,5-trimethoxybenzylamine (**2a**) (primary amine) with acetylacetone (**4**) in xylene gave (*Z*)-4-(3,4,5-trimethoxybenzylamino)-3-penten-2-one (**6a**) in 67% yield.

The 6π-azaelectrocyclization reactions of *sec*-aminodienyl esters **3** with acetylacetone (**4**) may be explained as follows. Initially, the condensation reaction of **3** with acetylacetone (**4**) may generate the intermediate **7**, followed by dehydration, which could lead to 3-acetyl-2-methyl-1,4-dihydropyridines **5**, as shown in Chart 2.

These results provide a new method of synthesizing *N*-alkyl 3-acetyl-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridines **5** and enamines **6**, [(*Z*)-4-(alkylamino)-3-penten-2-one], utilizing *sec*-aminodienyl esters **3** with acetylacetone (**4**).

Experimental

All melting points were determined on a Yanagimoto melting point apparatus and are uncorrected. IR spectra were recorded with a JASCO FT/IR-200 spectrometer, and ^{1}H- and ^{13}C-NMR spectra with a JEOL JNM-EX 90 or JEOL JNM-α500 spectrometer, with tetramethylsilane as an internal standard. MS were recorded with a JEOL JMS-D 300 spectrometer. Elemental analyses were recorded on a Yanaco CHN-corder MT-3. Merck Kieselgel G nach Stahl (silica gel) and NH-DM 1020 (basic 100 Å type silica gel, Fuji Silysia Chemical, Ltd.) were used for column chromatography and thin layer chromatography (TLC). All runs were carried out under an argon atmosphere.

General Procedure for Reactions of *tert*-Aminodienyl Ester 1 with Primary Amines 2 A solution of the *tert*-aminodienyl ester **1** (233 mg, 1.5 mmol) and an amine **2** (0.5 mmol) in THF (4 ml) was refluxed for an appropriate period until the disappearance of the amine (checked by TLC). The reaction mixture was concentrated under vacuum, then the residue was subjected to NH silica gel column chromatography with appropriate solvents. The isolated yield of **3** is based on **2**. The reaction conditions and properties of the prepared compounds **3** are shown in Table 1.

Methyl 5-(3,4,5-trimethoxybenzylamino)-2,4-pentadienoate (**3a**) was synthesized by the previously reported method.[1d)]

Methyl 5-[2-(2-Methoxyphenyl)ethylamino]-2,4-pentadienoate (**3b**): Amine **2b**: 76 mg. Solvent for chromatography: 30% ethyl acetate in hexane. Product **3b**: 39 mg. High-resolution electron impact (EI)-MS *m/z*: Calcd for $C_{15}H_{19}NO_3$ (M^+): 261.1365. Found: 261.1397.

Methyl 5-(4-Methoxybenzylamino)-2,4-pentadienoate (**3c**): Amine **2c**: 69 mg. Solvent for chromatography: 40% ethyl acetate in hexane. Product **3c**: 45 mg. High-resolution EI-MS *m/z*: Calcd for $C_{14}H_{17}NO_3$ (M^+): 247.1208. Found: 247.1208. *Anal.* Calcd for $C_{14}H_{17}NO_3$: C, 67.99; H, 6.93; N, 5.66. Found: C, 67.82; H, 6.96; N, 5.65.

Methyl 5-(3,4-Dimethoxybenzylamino)-2,4-pentadienoate (**3d**): Amine **2d**: 84 mg. Solvent for chromatography: 50% ethyl acetate in hexane. Product **3d**: 79 mg. High-resolution EI-MS *m/z*: Calcd for $C_{15}H_{19}NO_4$ (M^+): 277.1312. Found: 277.1304. *Anal.* Calcd for $C_{15}H_{19}NO_4$: C, 64.96; H, 6.91; N, 5.05. Found: C, 64.91; H, 6.93; N, 5.07.

Methyl 5-[2-(2,5-Dimethoxyphenyl)ethylamino]-2,4-pentadienoate (**3e**): Amine **2e**: 91 mg. Solvent for chromatography: 40% ethyl acetate in hexane. Product **3e**: 51 mg. High-resolution EI-MS *m/z*: Calcd for $C_{16}H_{21}NO_4$ (M^+): 291.1468. Found: 291.1443.

Methyl 5-(1-Naphthalenemethylamino)-2,4-pentadienoate (**3f**): Amine **2f**: 79 mg. Solvent for chromatography: 30% ethyl acetate in hexane. Product **3f**: 91 mg. High-resolution EI-MS *m/z*: Calcd for $C_{17}H_{17}NO_2$ (M^+): 267.1259. Found: 267.1294.

General Procedure for Reactions of *sec*-Aminodienyl Esters 3 with Acetylacetone (4) A solution of *sec*-aminodienyl ester **3** (0.3 mmol) and acetylacetone (10.0 mg, 0.1 mmol) in xylene (1.5 ml) was refluxed for an appropriate period. The reaction mixture was subjected to silica gel column chromatography with appropriate solvents. The reaction conditions and properties of the prepared compounds **5** and **6** are shown in Table 2.

3-Acetyl-1-(3,4,5-trimethoxybenzyl)-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridine (**5a**) and (*Z*)-4-(3,4,5-Trimethoxybenzylamino)-3-penten-2-one (**6a**): Substrate **3a**: 92 mg. Solvent for chromatography: 60% ethyl acetate in hexane. Product **5a**: 14 mg. Light yellow oil. ^{13}C-NMR (125 MHz, $CDCl_3$) δ: 16.6, 29.6, 31.4, 43.4, 51.5, 53.9, 56.1, 56.1, 60.9, 102.9, 102.9, 106.0, 108.8, 131.5, 133.4, 137.3, 148.8, 153.8, 153.8, 171.9, 198.9. Product **6a**: 10 mg. Colorless plates (ether–hexane). mp 78—80 °C. ^{13}C-NMR (125 MHz, $CDCl_3$) δ: 19.0, 29.0, 47.0, 56.2, 56.2, 60.9, 76.8, 77.1, 77.3, 96.0, 103.8, 103.8, 133.7, 137.3, 153.6, 153.6, 163.0, 195.5. Significant NOESY correlations: C-5 Me⇔H-3, C-1 Me⇔H-3, C-1′ CH_2⇔C-5 Me, NH⇔C-5 Me. *Anal.* Calcd for $C_{15}H_{21}NO_4$: C, 64.49; H, 7.58; N, 5.01. Found: C, 64.42; H, 7.62; N, 5.06.

3-Acetyl-4-methoxycarbonylmethyl-1-[2-(2-methoxyphenyl)ethyl]-2-methyl-1,4-dihydropyridine (**5b**) and (*Z*)-4-[2-(2-Methoxyphenyl)ethylamino]-3-penten-2-one (**6b**): Substrate **3b**: 78 mg. Solvent for chromatography: 40% ethyl acetate in hexane. Product **5b**: 8 mg. Light yellow oil. Product **6b**: 16 mg. Light yellow oil.

3-Acetyl-1-(4-methoxybenzyl)-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridine (**5c**) and (*Z*)-4-(4-Methoxybenzylamino)-3-penten-2-one (**6c**): Substrate **3c**: 74 mg. Solvent for chromatography: 50% ethyl acetate in hexane. Product **5c**: 9 mg. Light yellow oil. Product **6c**: 12 mg. Light yellow oil.

3-Acetyl-1-(3,4-dimethoxybenzyl)-4-methoxycarbonylmethyl-2-methyl-1,4-dihydropyridine (**5d**) and (*Z*)-4-(3,4-Dimethoxybenzylamino)-3-penten-2-one (**6d**): Substrate **3d**: 83 mg. Solvent for chromatography: 60% ethyl acetate in hexane. Product **5d**: 11 mg. Light yellow oil. Product **6d**: 10 mg. Colorless oil.

3-Acetyl-4-methoxycarbonylmethyl-1-[2-(2,5-dimethoxyphenyl)ethyl]-2-methyl-1,4-dihydropyridine (**5e**) and (*Z*)-4-[2-(2,5-Dimethoxyphenyl)ethylamino]-3-penten-2-one (**6e**): Substrate **3e**: 87 mg. Solvent for chromatography: 40% ethyl acetate in hexane. Product **5e**: 9 mg. Light yellow oil. Product **6e**: 12 mg. Light yellow oil.

3-Acetyl-4-methoxycarbonylmethyl-1-(1-naphthalenemethyl)-2-methyl-1,4-dihydropyridine (**5f**) and (*Z*)-4-(1-Naphthalenemethylamino)-3-penten-2-one (**6f**): Substrate **3f**: 80 mg. Solvent for chromatography: 30% ethyl acetate in hexane. Product **5f**: 7 mg. Light orange oil. Product **6f**: 13 mg. Light yellow needles (ether–hexane). mp 76—77 °C. *Anal.* Calcd for $C_{16}H_{17}NO$: C, 80.30; H, 7.16; N, 5.85. Found: C, 79.75; H, 7.23; N, 5.71.

Reaction of 3,4,5-Trimethoxybenzylamine (2a) with Acetylacetone (4) A solution of 3,4,5-trimethoxybenzylamine (**2a**) (99 mg, 0.5 mmol) and acetylacetone (50 mg, 0.5 mmol) in xylene (1.5 ml) was refluxed for 4 h. The reaction mixture was subjected to silica gel column chromatography. (*Z*)-4-(3,4,5-Trimethoxybenzylamino)-3-penten-2-one (**6a**): Solvent for chromatography: 50% ethyl acetate in hexane. Product **6a**: 93 mg (67%). Colorless plates (ether–hexane). mp 78—80 °C. This product was identical with **6a** previously obtained.

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