ed with 1N HCl to afford the diacid **1a**[7] in 85% yield(Scheme 2). The compound synthesized was identical in all respects (TLC, IR, NMR) with the compound reported in the literature.

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7. Satisfactory physical properties and spectroscopic data (^{1}H-NMR, IR) were obtained for the compounds: Siloxyalkene (3): TLC; R_f=0.74, hexane:CH_2Cl_2=5:5, SiO_2; IR(NaCl, neat) 2900, 1670 cm^{-1}; ^{1}H-NMR (80MHz, $CDCl_3$) 0.15(9H, s, $3CH_3$), 1.05(3H, d, CH_3), 1.32(4H, m, CH_2CH_2), 1.55(3H, s, CH_3), 1.95(3H, m, HCH_2); bp 40°C/15 mmHg. 2-Methyl-6-oxo-heptanoic acid(2b): TLC; R_f=0.47, CH_2Cl_2, SiO_2; IR (NaCl, neat) 2950, 1720 cm^{-1}; ^{1}H-NMR(80MHz, $CDCl_3$) 1.17(3H, d, CH_3), 1.56(4H, m, CH_2CH_2), 2.14(3H, s, CH_3), 2.43(3H, m, HCH_2), 3.68(3H, s, CH_3). 3,7-Dimethyl-2-octene-1,8-dioate(1b): TLC; R_f=0.82, CH_2Cl_2, SiO_2; IR(NaCl, neat) 2930, 1715, 1640 cm^{-1}; ^{1}H-NMR(80MHz, $CDCl_3$) 1.16(3H, d, CH_3), 1.55(4H, m, CH_2CH_2), 2.14(3H, s, CH_3), 2.43(3H, m, HCH_2), 3,68(6H, s, CH_3CH_3), 5.67(1H, s, H). 3,7-Dimethyl-2-octene-1,8-dioic acid(1a): TLC; R_f=0.14, CH_2CH_2, SiO_2; IR(NaCl, neat) 3600, 3000, 2950, 1700, 1650 cm^{-1}; ^{1}H-NMR(80MHz, $CDCl_3$) 1.20(3H, d, CH_3), 1.62(4H, m, CH_2CH_2), 2.16(3H, s, CH_3), 2.46(3H, m, HCH_2), 5.79(3H, brs, HC=, CO_2H, CO_2H).

t-Butyl 2-Pyridon-1-yl Carbonate and Benzyl 2-Pyridon-1-yl Carbonate. New Amino Protective Reagents foı t-Butoxycarbonylation and Benzyloxycarbonylation of Amines and Amino Acids

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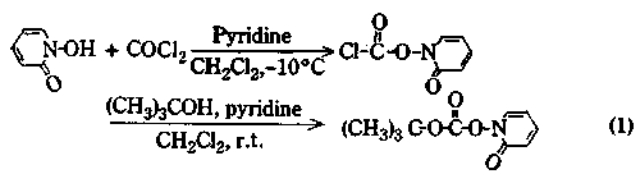
The t-butoxycarbonyl (Boc) group is one of the most important amino protective groups along with benzyloxycarbonyl (Cbz) group because of the resistance to racemization during peptide synthesis and facile cleavage of Boc group.[1]. The Boc group was originally introduced with t-butyl chloroformate but its use has been limited due to its instability.[2] In the case of benzyloxycarbonylation of amino acids, benzyl chloroformate has been widely used, but it is thermally unstable and decomposes to yield carbon dioxide and benzyl chloride when it is stored over a long period of time. Thus, considerable efforts have been devoted to the development of a variety of useful and reliable reagents for the protection of amino acids during last 30 years.[1,3] Recently, we have introduced several efficient amino protective reagents for t-butoxycarbonylation and benzyloxycarbonylation of amino acids.[4,5] We now wish to report that new amino protective reagents, t-butyl 2-pyridon-1-yl carbonate and benzyl 2-pyridon-1-yl carbonate, are very effective for t-butoxycarbonylation and benzyloxycarbonylation of amines and amino acids.



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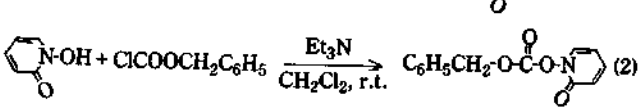

(2)

t-Bytyl 2-pyridon-1-yl carbonate was conveniently prepared in 70% yield by the reaction of 2-pyridon-1-yl chloroformate, generated from phosgene and 1-hydroxy-2(1H)-pyridone[6] in the presence of pyridine, with equimolar amounts of t-butyl alcohol in methylene chloride at room temperature (Eq. 1).[7] Benzyl 2-pyridon-1-yl carbonate was easily prepared in 90% yield by treatment of benzyl chloroformate with equimolar amounts of 1-hydroxy-2(1H)-pyridone and triethylamine in methylene chloride at room temperature (Eq. 2).[8] t-Butyl 2-pyridon-1-yl carbonate and benzyl 2-pyridon-1-yl carbonate were obtained as stable crystalline compounds, showing no sign of decomposition when kept at room temperature for one month.

As shown in Table 1, simple amines were cleanly t-butoxycarbonylated to give the corresponding t-butyl carbamates within 10 min at room temperature and sterically hindered amines such as 2,6-dimethylpiperidine and diisopropylamine worked well, although they required longer reaction times. Similarly, benzyloxycarbonylation of amines proceeded well with benzyl 2-pyridon-1-yl carbonate. When t-butoxycarbonylation of amino acids were carried out in aqueous N,N′-dimethylformamide, the N-Boc amino acids were obtained in relatively low yields because t-butyl 2-pyridon-1-yl carbonate was decomposed to some extent in aqueous N,N′-dimethylformamide. It was found that t-butoxycarbonylation of amino acids proceeded cleanly in p-dioxane, even

Table 1. Preparation of N-Boc and N-Cbz Carbamates from Amines[a]

amine	N-Boc carbamate time, h	N-Boc carbamate yield, %	N-Cbz carbamate time, h	N-Cbz carbamate yield, %
$C_6H_5CH_2NH_2$	0.1	90	0.1	96
$CH_3NHCH_2CH_2OH$	0.1	96		
$CH_3(CH_2)_2NH_2$	0.1	97		
$(CH_3)_2CHNHCH(CH_3)_2$	30	92	2	88
$C_6H_5NH_2$	5.5	94	0.5	98
	84	72	3	86

[a]The reaction was carried out with equimolar amounts of an amine and the reagent in methylene chloride at room temperature.

Table 2. Preparation of N-Boc and N-Cbz Amino Acids[a]

amino acid	method[b]	N-Boc amino acid time, h	N-Boc amino acid yield, %[c]	N-Cbz amino acid time, h	N-Cbz amino acid yield, %[c]
Pro	A	0.5	76	0.2	96
	B	10	97		
Ala	A	0.5	66	0.2	97
	B	10	82		
Try	A	0.5	60	0.2	95
	B	10	93		
Val	A	0.5	62	0.2	97
	B	10	96		
Leu	A	0.5	64	0.2	86
	B	10	80		
Met	A	0.5	70	0.2	90
	B	10	80		
Phe	A			0.2	96
	B	10	85		

[a]The reaction was carried out with equimolar amounts of an amino acid, the reagent, and triethylamine. [b]Method A: in aqueous DMF at room temperature. Method B: in p-dioxane at 80°C. [c]Isolated yields.

though the reaction required 10 h at 80°C for completion of the reaction. Under the present conditions, several amino acids were cleanly converted into the corresponding N-Boc amino acids as shown in Table 2. However, benzyloxycarbonylation of amino acids occurred cleanly and rapidly in aqueous N,N'-dimethylformamide and the reaction was generally complete 10 min at room temperature. The identities of N-Boc and N-Cbz amino acids were confirmed by comparison NMR, mp, and $[\alpha]_D$ values with reported data.

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7. mp 104°C; NMR($CDCl_3$) δ 1.68 (s, 1H), 6.20-6.48 (m, 1H), 6.75-6.90 (m, 1H), 7.36-7.62 (m, 2H); IR(KBr) 1825, 1675 cm^{-1}. Calcd for $C_{10}H_{13}NO_4$: C, 56.89; H, 6.21; N, 6.63. Found: C, 56.8; H, 6.3; N, 6.6.
8. mp 99°C; NMR($CDCl_3$) δ 5.34 (s, 2H), 5.90-6.20 (m, 1H), 6.48-7.71 (m, 1H), 7.20-7.45 (m, 7H); IR(KBr) 1800, 1685 cm^{-1}. Calcd for $C_{13}H_{11}NO_4$: C, 63.71; H, 4.52; N, 5.76. Found: C, 63.5; H, 4.7; N, 5.7.

A Simple Approach to the Valerane Skeleton

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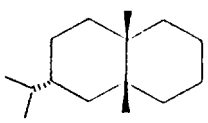
The carbon framework of the valerane sesquiterpenes provides stereochemically interesting *cis*-dimethyl substitution around the ring junction.[1] The parent compound is obtained by the reduction of 1-valeranone which isolated from *Valeriana officinalis*.[2] As a continuation of our studies using dianion methodology[3] we explored the stereospecific formation of the parent, valerane, (**1**).

Our approach is different from that recently reported by Garratt[4] in the timing of incorporation of the isopropyl group. Hydrogenolysis of the C-S bond of 12-thia[4.4.3]propell-3-



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ene(**2**) by using Raney-nickel whose synthesis was reported in the previous article[5], provided the required *cis*-9, 10-dimethyl decalin-2-ene-(**3**) in 73% yield. The introduction of the isopropyl group was achieved according to the sequences shown in Figure 1. Hydroboration of the alkene bond of **3**