

REACTION OF ALKYLIDENEPSEUDOXAZOLONES WITH AMINES

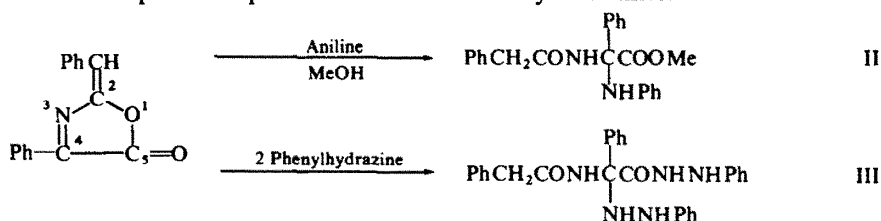
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Abstract—New 2-alkylidenepseudoxazolones reacted with primary amines to give 1:2-addition products of alkylidenepseudoxazolones and amines, while by the reaction with secondary amines, the mixtures of 1:1- and 1:2-adducts were isolated. A relationship of the structures of pseudoxazolones and amines to the products was discussed.

IN RECENT years, although 2-arylidene-pseudoxazolones have been investigated,^{1,2} the reactions of 2-alkylidenepseudoxazolones³ towards nucleophilic reagents have not been considered. The C-4 and C-5 positions in 2-arylidene-pseudoxazolones are regarded as the principal sites of attack by most nucleophilic reagents. Mustafa *et al.* reported⁴ that 2-benzylidene-4-phenyl-3-oxazolin-5-one (I) reacted with aniline in methanol to give a ring-fission product II and with excess phenylhydrazine to yield a product for which the structure III has been given.^{5,6} Our discovery of the preparation of 2-alkylidenepseudoxazolones from N-alkenoyl- α -amino acids prompted us to explore the problem of their reactivity to amines.⁷



RESULTS AND DISCUSSION

One mole of 2-alkylidene-3-oxazolin-5-ones (IV) reacts slowly with two moles of aniline at 60° for 12–24 hr without solvents to yield the addition products VI as shown in Table 1. Maximum yield of VI require threefold molar excess of amine. Intermediate saturated 5-oxazolone (V) was known to be more reactive than IV.⁸ The structure of VI was confirmed by chemical properties, hydrolyses, IR and NMR spectral data. Although VI resists hydrolysis in basic media, VIa is partially hydrolysed in concentrated aqueous HCl at 100–120° for 2 hr to give VIIa. The complete hydrolysis of VIa in concentrated aqueous HCl at 160° for 16 hr gives 1-anilinoisobutyric acid⁹ (VIII) and DL-alanine which was detected by paper-chromatography and isolated in the form of the benzoyl derivative.

Dimethylfulvene (IX) adds phenyllithium at the sterically hindered-*exo*-double bond to form a product X due to electron drift from the *exo*-double bond into the ring.^{10,11} The *exo*-double bond of IV would be attacked by nucleophilic reagents

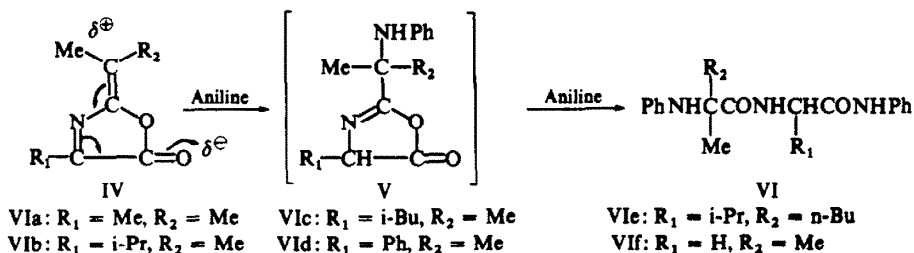
TABLE 1. 1:2-ADDUCTS OF 2-ALKYLDIENESEUDOAZOLONES AND AMINES

Compound	Amine	M.p.	Yield %	Formula	Required			Found		
					C	H	N	C	H	N
IVa	Aniline	142°	43	C ₁₅ H ₂₃ N ₃ O ₂	70-13,	7-12,	12-91	70-12,	6-77,	12-83
IVb	Aniline	174-176°	93	C ₂₁ H ₂₇ N ₃ O ₂	71-36,	7-70,	11-89	71-36,	7-40,	11-91
IVc	Aniline	171-173°	63	C ₂₂ H ₂₉ N ₃ O ₂	71-90,	7-95,	11-44	72-69,	7-57,	11-65
IVd	Aniline	200-202°	40	C ₂₄ H ₃₅ N ₃ O ₂	74-39,	6-50,	10-85	74-04,	6-20,	11-08
IVe	Aniline	204 205°	—	C ₂₄ H ₃₃ N ₃ O ₂	72-87,	8-41,	10-62	72-54,	7-98,	10-42
IVf	Aniline	176-177°	—	C ₁₈ H ₂₁ N ₃ O ₂	69-43,	6-80,	13-50	69-24,	6-96,	13-63
IVa	p-Phenetidine	182°	—	C ₂₃ H ₃₁ N ₃ O ₄	—	—	10-16	—	—	10-90
IVb	Benzylamine	89-92°	91	C ₂₃ H ₃₁ N ₃ O ₂	72-41,	8-19,	11-02	72-71,	7-94,	11-02
IVb	Phenethylamine	120-122°	20	C ₂₃ H ₃₃ N ₃ O ₂	73-31,	8-16,	10-26	73-24,	8-52,	10-23
IVb	Cyclohexylamine	127 129°	33	C ₂₁ H ₃₉ N ₃ O ₂	69-00,	10-75,	11-50	68-43,	10-40,	11-59

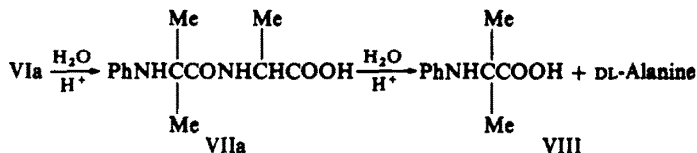
TABLE 2. REACTION WITH PIPERIDINE

Compound	Adduct	M.p.	Yield %	Formula	Required			Found		
					C	H	N	C	H	N
IVb	1:1-	129-131°	73	C ₁₄ H ₂₄ N ₂ O ₂	66-63,	9-59,	11-10	67-14,	9-57,	11-25
IVb	1:2-	95-96°	17	C ₁₉ H ₃₅ N ₃ O ₂	67-61,	10-45,	12-45	67-42,	10-14,	12-31
XV	1:1-	128-131°	73	C ₁₄ H ₂₄ N ₂ O ₂	66-63,	9-59,	11-10	67-07,	9-55,	10-88
2,4-Disopropyl- 2-oxazolin-5-one	1:1-	105-107°	75	C ₁₄ H ₂₆ N ₂ O ₂	66-10,	10-30,	11-01	66-06,	9-56,	10-88

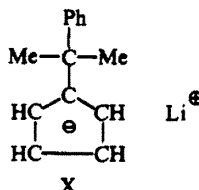
presumably by electron drift to the heterocyclic ring through the conjugation with the CO group.



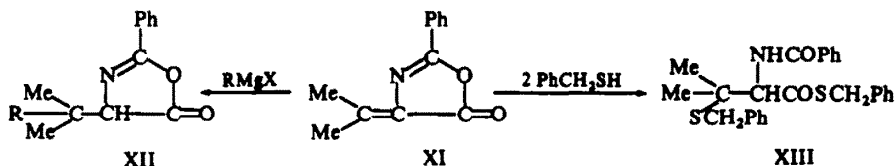
It is well known that the reaction of normal 5-oxazolones with primary and secondary amines occurs generally at the C-5 position to afford 1:1-addition products.¹² In contrast to the ring opening reaction, 2-phenyl-4-isopropylidene-2-oxazolin-5-one (XI) reacts with alkyl Grignard reagents by 1,2-addition to give saturated 5-oxazolone (XII).¹³ Especially, XI undergoes a ring opening reaction along with the



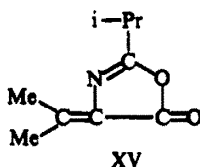
1:2-addition with benzyl mercaptane,¹⁴ thiophenol,¹⁶ hydrogen sulfide,¹⁴ and ammonia¹⁵ to give products such as XIII. 1:2-Adducts are produced by a similar reaction of IV with primary amines such as benzylamine, phenethylamine, and cyclohexylamine.



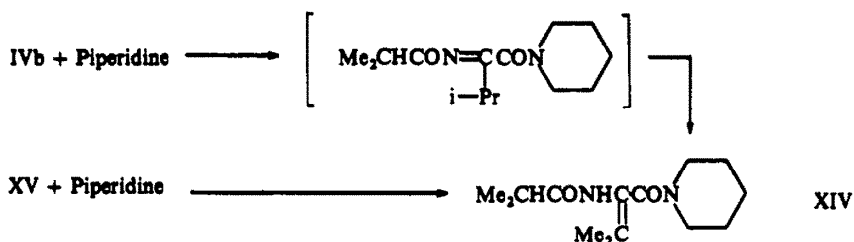
When piperidine reacts with IVb in aromatic solvents in place of primary amines, an exothermic reaction producing a 1:1-adduct (XIV) as the main product within a few hours occurs even in the presence of twice the equimolar amount of piperidine. The adduct (XIV) was identical in all respects with the compound prepared from 2-isopropyl-4-isopropylidene-2-oxazolin-5-one (XV) and piperidine. The addition reaction at the *exo*-double bond was preceded by the ring opening at C-5 position presumably because of steric hindrance of the amine. XIV was accompanied with a small amount of the 1,2-adduct which was separated from XIV by recrystallization. The structure of the 1,2-adduct is considered analogous to VI as listed in Table 2.



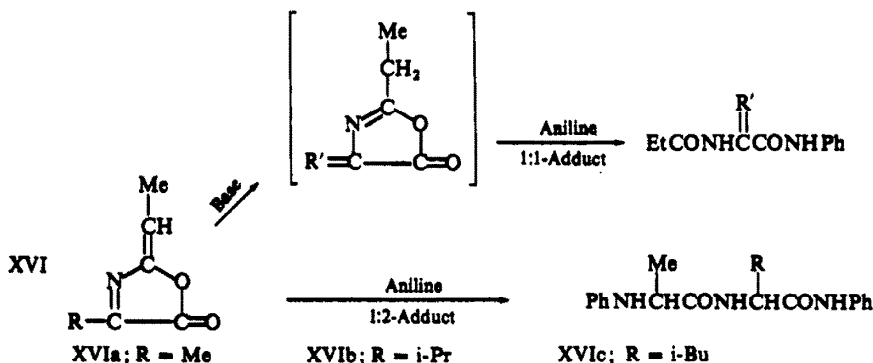
The 1,2-adduct was isolated from the reaction of morpholine and IVb as the principal product, while from *N*-methylbenzylamine and pyrrolidine with IVb, only 1:2-adducts were obtained as shown in Table 3.



The reaction was extended to 2-ethylidene-4-methyl-3-oxazolin-5-one (XVIa) prepared by Bergmann's method¹⁷ reacts with aniline, the 1:2-adduct together with the 1:1-adduct in the ratio of 2:5:1 is produced



(Table 4). The formation of 1:1-adducts may be due to the preferential attack on C-5 position of XVI followed by the rearrangement of the double bond or the rearrangement of XVI to 2-ethyl-2-oxazoline-5-ones by the catalytic effect of aniline followed by C-5 attack to 1,1-adducts.³



Finally, the normal 5-oxazolones (XVII) as mentioned in the literature¹² reacts with aniline in aromatic solvents at room temperature to give 1,1-adducts and the results are given in Table 5.

2-Ethyl-4-isopropylidene-2-oxazolin-5-one (XVIIa) and 2-isopropyl-4-benzylidene-2-oxazolin-5-one (XVIIb) were prepared by the cyclization⁷ of *N*-acryloyl-DL-valine and *N*-methacryloyl-DL-phenylalanine. XV was synthesized from *N*-isobutyrylglycine and acetone by Erlenmeyer's method.¹⁸ The reaction of IV with aliphatic amines including *n*-butylamine and diethylamine was tried, but the reaction products

TABLE 3. REACTION WITH SECONDARY AMINES

Compound	Amine	Adduct	M.p.	Yield %	Formula	Required			Found		
						C	H	N	C	H	H
IVb	Morpholine	1:2	119-122°	77	$C_{17}H_{11}N_3O_4$	58.90	9.15	12.31	59.32	9.10	12.25
IVb	N-Methyl- benzylamine	1:1	117-118°	22	$C_{17}H_{24}N_2O_2$	70.80	8.39	9.71	70.75	8.36	9.57
IVb	Pyrrolidine	1:1	154-156°	68	$C_{13}H_{22}N_2O_2$	65.51	9.31	11.76	65.98	9.27	11.57

neither crystallized nor form crystalline derivatives. The reaction, followed by the carbonyl absorption of IV in the IR spectra, does not proceed with N-methylaniline owing to its low reactivity. Thiophenol also gives the 1:2-adduct with IVb. The mode of reaction is probably similar to that with aniline.

TABLE 4. REACTION OF 2-ETHYLIDENESEUDOKAZOLONES WITH ANILINE

Compound	Adduct	M.p.	Formula	Required			Found		
				C	H	N	C	H	N
XVIa	1:2-(39%)	147-151°	C ₁₈ H ₂₁ N ₃ O ₂	69.43,	6.80,	13.50	69.32,	6.83,	13.47
XVIa	1:1-(16%)	114-117°	C ₁₂ H ₁₄ N ₂ O ₂	66.03,	6.47,	12.84	65.23,	6.47,	12.84
XVIb	1:2-	150-151°	C ₂₀ H ₂₃ N ₃ O ₂	70.77,	7.43,	12.38	70.28,	7.52,	11.86
XVIc	1:2-	145°	C ₂₁ H ₂₇ N ₃ O ₂	71.36,	7.70,	11.89	69.40,	7.32,	11.41
XVIc	1:1-	200°	C ₁₅ H ₂₀ N ₂ O ₂	69.20,	7.74,	10.76	69.32,	7.85,	10.86

TABLE 5. REACTION OF NORMAL 5-OXAZOLONES WITH ANILINE

Compound	Adduct	M.p.	Formula	Required			Found		
				C	H	N	C	H	N
XVIIa	1:1-	205-207°	C ₁₄ H ₁₈ N ₂ O ₂	68.27,	7.37,	11.37	68.23,	7.45,	11.61
XV	1:1-	242-243°	C ₁₅ H ₂₀ N ₂ O ₂	69.20,	7.74,	10.76	69.03,	7.53,	10.85
XVIIb	1:1-	198-199°	C ₁₉ H ₂₀ N ₂ O ₂	74.00,	6.54,	9.09	73.73,	6.65,	9.22

EXPERIMENTAL

N-Isobutyryl-DL-valine. *N*-Isobutyryl-DL-valine prepared by the reaction of DL-valine with isobutyryl chloride in water using two equivalents of 20% NaOH soln as acid acceptor, yielded the product (59%), m.p. 170-171° (lit.¹⁹ 165-167°). (Found: C, 58.06; H, 8.39; N, 7.50. C₉H₁₁NO₃ requires: C, 57.73; H, 9.15; N, 7.48%.)

α -Bromoisobutyrylglycine. Glycine (21 g) and NaOH (8.7 g) were dissolved in water (60 ml). To this soln, NaOH aq (NaOH 8.7 g/H₂O 60 ml) and α -bromoisobutyryl bromide (50 g) were added dropwise under cooling in an ice bath and the mixture was stirred at room temp for 1 hr. Then the mixture was acidified with conc HCl (18 ml). The product was filtered off and recrystallized from water (about 150 ml) (30.5 g, 63%), m.p. 116-118° (lit.²⁰ 118°). (Found: C, 33.50; H, 4.68; N, 6.65. C₆H₁₀NO₃Br requires: C, 32.10; H, 4.47; N, 6.25%.)

α -Bromopropionyl-DL-alanine. This compound¹⁷ was prepared in the same manner as α -bromoisobutyrylglycine using DL-alanine (9.3 g) and α -bromopropionyl bromide (25 g). The product was 24 g (93%), m.p. 149-151° (from H₂O); ν_{\max} 3300 (N-H), 1715, 1650 cm⁻¹ (C=O). (Found: C, 32.38; H, 4.72. C₆H₁₀NO₃Br requires: C, 32.10; H, 4.47%.)

2-Isopropylidene-4-methyl-3-oxazolin-5-one (IVa). The preparation of IVa from N-methacryloyl-DL-alanine was carried out by the method described earlier.^{7,21} IVa, 41%, b.p. 54-56°/1.5 mm; IVb, 64%, 74-76°/1 mm; IVc, 78%, 84-86°/1 mm; IVd, 14%, m.p. 138°; IVe, 58%, 86-88°/0.7 mm.

2-Ethylidene-4-isopropyl-3-oxazolin-5-one (XVIb) and 2-ethyl-4-isopropylidene-2-oxazolin-5-one (XVIIa). Both compounds were synthesized by the method described previously.⁷ XVIIa, 88.5-91.5°/11 mm; λ_{\max} 271 m μ (in cyclohexane); ν_{\max} 1780 (C=O), 1680 (C=N), 1620 cm⁻¹ (C=C).

2-Isopropylidene-3-oxazolin-5-one (IVf). This compound was prepared according to the procedure of Bergmann.¹⁷ A mixture of N- α -bromoisobutyrylglycine (20.5 g), NaOAc (7.5 g) and benzoic anhydride (31 g) was ground in a mortar. The solid mixture was heated on an oil bath at 12 mm and the distillate boiling at 80-89° was collected. The yield was 6.2 g (42%); ν_{\max} 1775 (C=O), 1675 cm⁻¹ (C=N), λ_{\max} 310 m μ . The product, upon exposure to the air, polymerized with evolution of heat within $\frac{1}{2}$ hr. To avoid

the formation of polymer, a trace of hydroquinone was added to the distillate and the reaction with aniline must be carried out as soon as possible after preparation.

2-Ethylidene-4-methyl-3-oxazolin-5-one (XVIa). A powdered mixture of *N*- α -bromopropionyl-DL-alanine (10.5 g), anhyd NaOAc (3.7 g), and benzoic anhydride (16.9 g) was heated in 50 ml flask on an oil bath kept at 100–120° *in vacuo*. The fraction boiling at 57–60°/5 mm (lit.¹⁷ 76–77°/12 mm) was collected (5 g; 75%); ν_{\max} 1775 (C=O), 1680 cm^{-1} (C=N).

2,4-Diisopropyl-2-oxazolin-5-one. About 100 ml of Ac_2O was heated to 100° on an oil bath and into the preheated Ac_2O , *N*-isobutyryl-DL-valine (9 g) was added as quickly as possible and the mixture was held at 100° for additional 5 min.²² AcOH and excess Ac_2O were removed under reduced press and the residue was fractionated *in vacuo*. The yield of the product boiling at 84–85°/10 mm was 5 g (62%); ν_{\max} 1810 (C=O), 1670 cm^{-1} (C=N). (Found: C, 63.99; H, 9.08; N, 8.47. $\text{C}_9\text{H}_{13}\text{NO}_2$ requires: C, 63.88; H, 8.94; N, 8.28%.)

2-Isopropyl-4-isopropylidene-2-oxazolin-5-one (XV). This compound was prepared by the method reported by Ramage and Simonsen;¹⁸ 76–78°/2.5 mm (8 g, 11%).

Reaction with aniline

(a) A mixture of IVa (10.7 g) and aniline (7.55 g) in toluene (10 ml) was kept at 60° for 24 hr in a sealed tube. The resulting crystals were recrystallized from 150 ml toluene, yielding VIa (10.8 g), m.p. 142°; ν_{\max} 3380, 3300 (N—H), 1690, 1650, 1605 cm^{-1} (C=O); NMR singlet, $\delta = 1.60$ ppm (6H, *gem*-dimethyl); doublet, $\delta = 1.44$ ppm (3H, >CH—CH_3 , $J = 6.6$ c/s) in pyridine.

Using a similar procedure, the following compounds reacted with aniline.

VIb from acetone, ν_{\max} 3390, 3320 (N—H), 1685, 1650, 1610 cm^{-1} (C=O);

VIc from toluene, ν_{\max} 3360, 3300 (N—H), 1680, 1650, 1605 cm^{-1} (C=O);

VI d from benzene, ν_{\max} 3380, 3300 (N—H), 1660, 1605 cm^{-1} (C=O);

VI e from benzene, ν_{\max} 3380, 3320 (N—H), 1690, 1650, 1600 cm^{-1} (C=O);

VI f from benzene and petroleum ether, ν_{\max} 3300 (N—H), 1680, 1655, 1605 cm^{-1} (C=O).

(b) Aniline (8 g) was added to XVIa (4.64 g) dissolved in toluene (10 ml). The mixture was allowed to stand overnight and then the resulting white mass was collected by filtration. This was mainly composed of 1:2-adduct mixed with small quantity of 1:1-adduct. Since the 1:2-adduct was less soluble in EtOAc, it was purified by recrystallization from EtOAc in 39% yield (4.33 g). The 1:1-adduct was recovered from the combined residual soln and recrystallized twice from $\text{H}_2\text{O—EtOH}$ in 16% yield (1.3 g). In the reaction of XVIc with aniline, only a small quantity of adduct was isolated melting 200° from benzene, while with XVIb the 1:1-adduct was not isolated at all. The 1:2-adduct from XVIa has ν_{\max} 3270 (N—H), 1680, 1640, 1600 cm^{-1} (C=O). The 1:2-adduct from XVIb has ν_{\max} 3280 (N—H), 1650, 1595 cm^{-1} (C=O). The 1:2-adduct from XVIc has ν_{\max} 3200 (N—H), 1650, 1595 cm^{-1} (C=O).

Reaction with piperidine

(a) To IVb (2.30 g) in benzene (5 ml) piperidine (2.51 g) was added in a sealed tube. The mixture was kept at 60° for 4 hr. The resulting solid material was dissolved in benzene (10 ml), then the soln was cooled and the crystals were separated, and recrystallized from 40 ml of a mixture of benzene and *n*-hexane to yield 2.53 g (73%) of 1,1-adduct. The filtrate was evaporated and the residue dissolved in *n*-hexane (10 ml). The insoluble matter was separated by filtration from a hot soln and the filtrate was allowed to stand in a refrigerator. The yield of 1:2-adduct was 0.80 g (17%). The 1:1-adduct has ν_{\max} 3190 (N—H), 1680, 1600 cm^{-1} (C=O). The 1:2-adduct has ν_{\max} 3300 (N—H), 1680, 1620 cm^{-1} (C=O).

(b) XV (1.08 g) reacted with piperidine (1.35 g) in benzene (10 ml) to give the product (1.18 g, 73% based on XV); m.p. 128–131°. By removal of solvent from the filtrate, about 0.14 g of the 1:1-adduct was recovered, but no 1:2-adduct was obtained.

(c) To a soln of 2,4-diisopropyl-2-oxazolin-5-one (2.08 g) in benzene (50 ml) piperidine (1.28 g) was added. The mixture was allowed to stand at room temp overnight. About 2.35 g (75%) adduct was obtained by filtration and this was recrystallized from the mixture of benzene (5 ml) and *n*-hexane (20 ml); m.p. 105–107°, ν_{\max} 3330 (N—H), 1675, 1620 cm^{-1} (C=O).

Reaction of IVb with morpholine

A mixture of morpholine (3.58 g) and IVb (3.24 g) was kept at 60° for 12 hr. The resulting crystals were recrystallized from a mixture of benzene (10 ml) and pet. ether (20 ml). The yield was 5.03 g (77%), ν_{\max} 3360, 3200 (N—H), 1760, 1640, 1610 cm^{-1} (C=O).

By the same method, the following compounds were subjected to the reaction with secondary amines: Compound IVb with *N*-methylbenzylamine— ν_{\max} 3300 (N—H), 1670 (w), 1640, 1610 cm^{-1} (C=O); IVb with pyrrolidine— ν_{\max} 3200, 3150 (N—H), 1670, 1610 cm^{-1} (C=O).

Reaction of IVb with thiophenol

A mixture of IVb (2.02 g) and thiophenol (2.87 g) was allowed to stand at room temp for about 2 weeks. The resulting crystals were recrystallized from a mixture of *n*-hexane (20 ml) and benzene (20 ml), 17%; m.p. 120–122°, ν_{\max} 3380 (N—H), 1690 cm^{-1} (C=O). (Found: C, 65.34; H, 6.52; N, 4.14; S, 16.79. $\text{C}_{21}\text{H}_{23}\text{NO}_2\text{S}_2$ requires: C, 65.07; H, 6.51; N, 3.61; S, 16.55%.)

Preparation of 1-anilinoisobutyric acid. As an authentic sample of VIII, 1-anilinoisobutyric acid was prepared from ethyl α -bromoisobutyrate and aniline via ethyl 1-anilinoisobutyrate by the method described by Bischoff.²³ The m.p. was 180–183°, ν_{\max} 3300 (broad, N—H), 1600 cm^{-1} (C=O). The author mentioned that two compounds were produced by the reaction.²³ The NMR data supports that the compound of higher m.p. is 1-anilinoisobutyric acid;⁹ $\delta = 1.74$ ppm (singlet, *gem*-dimethyl), $\delta = 250$ ppm (NH) in pyridine.

Partial hydrolysis of VIa. A sample of VIa (2 g) was refluxed with conc HCl (20 ml) for 2 hr on an oil bath kept at 100–120°. The water and HCl were removed by evaporation under reduced press and then dissolved in H_2O (30 ml). After neutralization with 10% NaOH aq to pH 4, the resulting crystals were recrystallized from EtOH– H_2O . The yield was 970 mg (63%); ν_{\max} 3380, 3330 (N—H), 1730, 1720, 1620 cm^{-1} (C=O); m.p. 187–188°; NMR singlet, $\delta = 1.67$ ppm (6H, *gem*-dimethyl), doublet, $\delta = 1.56$ ppm (3H, >CH—CH_3 , $J = 7.2$ c/s). (Found: C, 62.36; H, 7.37; N, 11.15. $\text{C}_{13}\text{H}_{13}\text{N}_2\text{O}_3$ requires: C, 62.38;

H, 7.25; N, 11.19%.) By an analogous procedure, the hydrolysis of VIb was carried out at 160° for 6 hr in 42% yield. Drastic conditions were required for hydrolysis owing to the branched alkyl group; ν_{\max} 3350 (N—H), 1710, 1630 (C=O), m.p. 164–168°. (Found: C, 65.75; H, 8.05; N, 10.14. $\text{C}_{13}\text{H}_{22}\text{N}_2\text{O}_3$ requires: C, 64.72; H, 7.97; N, 10.07%.)

Complete hydrolysis of VIa. A sample of VIa (5 g) was refluxed with conc HCl (50 ml) for 16 hr on an oil bath kept at 160°. After evaporation of the aqueous HCl, H_2O (30 ml) was added and neutralized with 10% NaOH aq to pH 4. The resulting solid was filtered off and washed with H_2O and dried. The compound (1.62 g, 59%) was 1-anilinoisobutyric acid and after recrystallization from EtOH– H_2O , subjected to elemental analyses (m.p. 180°). The filtrate was adjusted to pH 9 with dil NaOH aq and treated twice with 50 ml of ether in order to extract the resulting aniline. To the soln, the theoretical amount of benzoyl chloride and NaOH were added and the mixture stirred for 1 hr. After acidification of the mixture with 10% HCl, the resulting solid was separated and recrystallized from H_2O ; m.p. 159–161° (lit.²⁴ 165–166°). The yield of *N*-benzoyl-DL-alanine was 245 mg (21%). 1-Anilinoisobutyric acid. (Found: C, 67.45; H, 7.22; N, 8.03. $\text{C}_{10}\text{H}_{13}\text{NO}_2$ requires: C, 67.02; H, 7.31; N, 7.82%). *N*-Benzoyl-DL-alanine. (Found: N, 7.19. $\text{C}_{10}\text{H}_{11}\text{NO}_3$ requires: N, 7.25%.)

By a similar procedure, the hydrolysis of VIc was undertaken. From VIc (5 g), 2.14 g (87% yield) of 1-anilinoisobutyric acid was obtained. After extraction of aniline with ether, the soln was adjusted to pH 7. DL-Leucine was obtained in 25% yield (437 mg) in crystalline form because of its poor solubility in H_2O . 1-Anilinoisobutyric acid (m.p. 180–190°). (Found: C, 66.43; H, 7.24; N, 7.74. $\text{C}_{10}\text{H}_{13}\text{NO}_2$ requires: C, 67.02; H, 7.31; N, 7.82%). 1-Anilinoisobutyric acid (679 mg, 67%) was obtained from the hydrolysis of VIb (2 g) at 160° for 36 hr. Benzoylation of the filtrate afforded 1.85 g of *N*-benzoyl-DL-valine in 59% yield. *N*-Benzoyl-DL-valine, m.p. 130° (lit.²⁵ 132.5°). (Found: N, 6.53. $\text{C}_{12}\text{H}_{15}\text{NO}_3$ requires: N, 6.33%.)

*Reaction of IVb with *n*-butylamine.* The mixture of IVb (0.02 mole) and *n*-butylamine (0.04 mole) was allowed to stand at room temp for a week, but no crystalline material was obtained. The resulting oil showed IR absorptions at 3350 and 1650 cm^{-1} .

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