A Facile Preparation of *N*-(Isopropoxyalkyl) Amides by Generation and Trapping of *N*-Acyliminium Ions from Ionization–Rearrangement Reactions of *N*-Triflyloxy Amides

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A series of hydroxamic acids were converted to *N*-triflyloxy amides which were heated in 2-propanol to give *N*-(1-isopropoxyalkyl) amides in high yields. The method is simple, direct, and extremely tolerant of structural diversity both in the *N*-acyl group, as well as in the 1-isopropoxyalkyl group. N-Alkylation of secondary *N*-(1-isopropoxyalkyl) amides can be used for converting them to tertiary *N*-(1-isopropoxyalkyl) amides. *N*-Acyliminium ions of wide structural diversity can be generated easily from *N*-(1-isopropoxyalkyl) amides available by this methodology.

Introduction

N-Acyliminium ions are tremendously versatile carbon electrophiles for carbon–carbon bond-forming reactions. They have been utilized as intermediates to produce a large variety of structurally diverse compounds. Consequently it is not surprising that many methods for the generation of *N*-acyliminium ions have been investigated, and they have been reviewed elsewhere.[1]

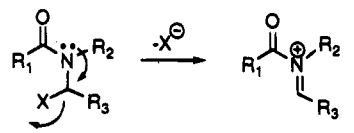
The most common strategy for the generation of *N*-acyliminium ions is to use assisted ionization of a heteroatom substituent on a carbon atom α to the amide nitrogen (Scheme 1). Individual methods utilizing this strategy differ by the heteroatoms which are used as the leaving groups or by the synthetic approach which is used to assemble the precursor, but it is clear from the literature that all are problematic in one respect or another.[2] Often the starting material is difficult to synthesize or unstable, or the conditions required to generate the iminium ion are so stringent as to limit the utility of the process.

Of the various precursors of *N*-acyliminium ions shown in Scheme 1, the most widely used are *N*-(1-alkoxyalkyl) amides (X = OR). These materials are often stable compounds that readily undergo conversion to *N*-acyliminium ions under a variety of acidic conditions. Several traditional preparations of *N*-(1-alkoxyalkyl) amides **1** are shown in Scheme 2. These include the acylation of imines (path a), the reduction of imides (path b), or the electrochemical oxidation of amides (path c), among others. While the latter two methods have proven to be the most useful,[1] all of these methods have significant limitations.

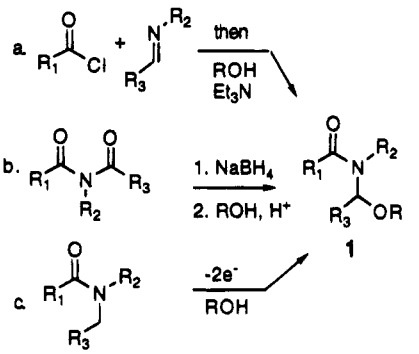
The acylation of imines (path a) gives a very unstable α-chloro amide intermediate, and is better known as a route to β-lactams than as a route to *N*-acyliminium ions.[3] With a few exceptions[4ab] the reduction of imides (path b) has been utilized almost exclusively with symmetric cyclic imides because only a single reduction product is formed and the carbinolamide intermediate remains cyclized.[4,5] The electrochemical oxidation of amides (path c) has been the most important route to *N*-(1-alkoxyalkyl) amides **1**; however, it is only useful for amides which have functional groups in R_1, R_2, or R_3 less oxidizable than the amide group itself. Thus most examples of **1** prepared by the electrochemical oxidation of amides contain only saturated groups in R_1, R_2, and R_3. Very few *N*-(1-alkoxyalkyl) amides **1** which contain aryl, olefinic, ester, or ketone groups have been prepared by electrochemical oxidation of amides.[1a,d]

Recently it was reported that *N*-(1-alkoxyalkyl) amides, **1**, can be prepared by condensing amides, aldehydes, and benzotriazole to give *N*-(1-(benzotriazol-1-yl)alkyl) amides followed by replacement of the benzotriazolyl group by alkoxide (Scheme 3).[6] This approach is reported to be general and could prove to be a very important new method

Scheme 1



Scheme 2



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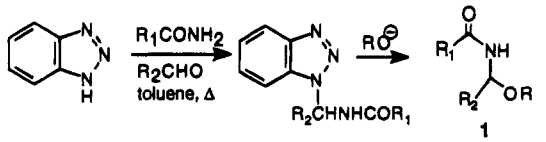
Scheme 3



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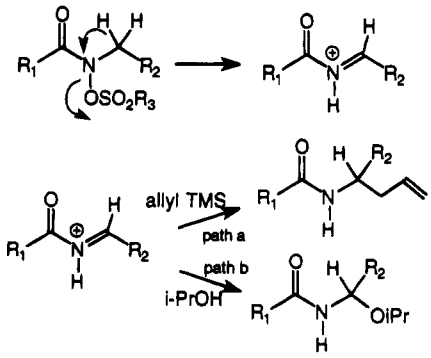
for the preparation of *N*-acyliminium ion precursors. At present only aryl groups and a limited number of alkyl groups have been incorporated as R_1 and R_2 so the structural limits of this method remain to be defined. Nevertheless, this method appears to be generally superior to the traditional methods as well as other recently reported routes to **1**.[7]

An important structural feature of *N*-(1-alkoxyalkyl) amides, as well as the other *N*-acyliminium ion precursors shown in Scheme 1, is that the α-carbon atom has the oxidation level of a carbonyl group. This oxidation state permits conversion to the iminium ion to take place by formal oxidation of the nitrogen atom. An alternate strategy for the production of iminium ions is to use N-oxidized precursors rather than C-oxidized precursors. In this strategy, conversion to the iminium ion requires a formal oxidation of the α-carbon atom, the nitrogen remains unchanged. This approach has some precedence in the work of Fowler who used FVP to convert *N*-acetoxy amides to *N*-acylimines.[8a-c] The method is not amenable, however, to the production of *N*-acyliminium ions since it requires high temperature and gas phase conditions. *N*-Acylimines have also been produced by base-promoted eliminations in O-benzylated hydroxamic acids,[8d,e] but the corresponding *N*-acyliminium ions were not produced in the basic reaction mixture.

In considering potential N-oxidized precursors to be used for the formation of *N*-acyliminium ions, we reckoned that if *N*-sulfonyloxy amides were to undergo the same type of ionization–rearrangement reactions that are common in *N*-sulfonyloxy amines,[9] they would yield *N*-acyliminium ions. This hypothesis was recently confirmed by the observation that *N*-triflyloxy amides undergo smooth ionization in refluxing 2-propanol to produce *N*-acyliminium ions which can be trapped by allyltrimethylsilane present in the reaction mixture (Scheme 4, path a).[10] This process is, to our knowledge, the first general method for accessing *N*-acyliminium ions directly from N-oxidized precursors.

The importance of *N*-triflyloxy amides as a gateway into *N*-acyliminium ion chemistry increased dramatically

Scheme 4



when it was found that their solvolysis in refluxing 2-propanol without added allyltrimethylsilane gave *N*-(1-isopropoxyalkyl) amides as stable products in high yields (Scheme 4, path b).[10] Presumably the initially formed *N*-acyliminium ion is trapped by the solvent to deliver the observed product. In this process, the oxidation levels of the nitrogen and the α-carbon atoms are interchanged. Thus in addition to serving as a direct source of *N*-acyliminium ions in 2-propanol solvent, *N*-triflyloxy amides also provide an effective new route to *N*-(1-alkoxyalkyl) amides **1**. Alkoxyalkyl amides **1** can be converted to *N*-acyliminium ions under a variety of conditions,[1] thus isolation of **1** and *then* conversion to *N*-acyliminium ions can provide a variety of different reaction environments for iminium ion trapping reactions.

This report presents the experimental details of the conversion of *N*-triflyloxy amides to *N*-acyliminium ions and the trapping of these intermediates with allyltrimethylsilane and 2-propanol. Experiments which define structural limitations in both R_1 and R_2 are described. In addition methods for further elaborating *N*-(1-isopropoxyalkyl) amides are reported. Taken together, these results reveal that the ionization of *N*-triflyloxy amides may be the most convenient and general method for the production of *N*-(1-isopropoxyalkyl) amides and their derived *N*-acyliminium ions that has yet been described. Most impressive is the extreme structural diversity that can be achieved with this strategy.

Results

Hydroxamic acids were prepared by the reaction of acid chlorides with N-substituted hydroxylamines by one of three procedures (eq 1). The procedure of Miller (A) involves the addition of the acid chloride in THF to a methanolic solution of the hydroxylamine (1 equiv) and KOH (1 equiv).[11] This procedure worked very well for both aliphatic and aromatic R_1-groups. If R_1 is benzylic, the procedure of Murray (B), in which the acid chloride is added to a dichloromethane solution of the hydroxylamine (1 equiv) and triethylamine (1 equiv), gave better results.[12] If R_1 is a base-sensitive functional group such as chloromethyl or carbethoxymethyl, then the acid chloride was added to a dichloromethane solution of the hydroxylamine (2 equiv) which serves both as the base and nucleophile (C). Using these procedures, four groups of hydroxamic acids **7–10** were prepared by reacting four different hydroxylamines **3–6** with various acid chlorides **2a–o** (eq 1).

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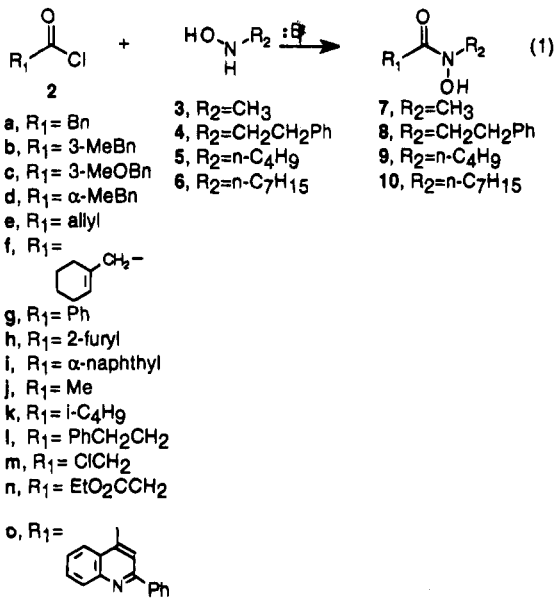
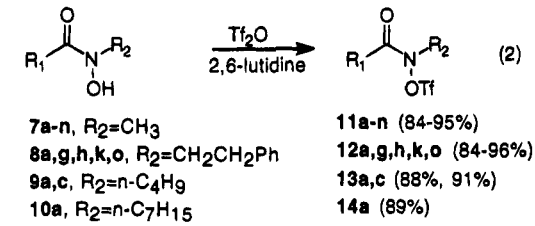
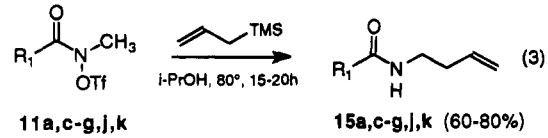


Hydroxamic acids **7a–n**, **8a,g,h,k,o**, **9a,c**, and **10a** were converted to the corresponding *N*-triflyloxy amides by treatment with triflic anhydride and 2,6-lutidine.[9] After aqueous workup triflates **11a–n**, **12a,g,h,k,o**, **13a,c**, and **14a** were normally obtained as crude products in high yields (84–95%) and good purities (>95%) (eq 2). In only

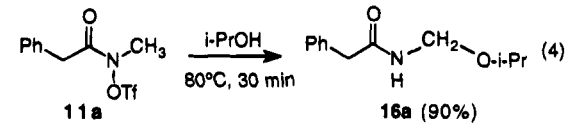


two cases, **11h** (74%) and **11j** (67%), were the isolated yields lower than 84%, but the purity of the crude products was still excellent. *N*-Triflyloxy amides **11a** and **12a** are solids which were recrystallized to analytical purity; however, all of the other *N*-triflyloxy amides were obtained as oils. Upon attempted purification or storage, they begin to decompose. Since they can be isolated routinely in purities >95%, they were normally prepared, characterized spectroscopically, and used immediately without further purification with excellent results.

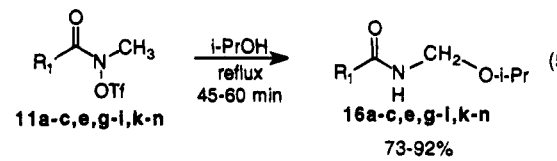
Mixtures of *N*-triflyloxy amides **11a,c–g,j,k** and allyltrimethylsilane (>5 equiv) refluxed in 2-propanol for 15–20 h led to the formation of *N*-(4-butenyl) amides **15a, c–g, j, k** in good yields (60–80%) of purified products (eq 3). The conversion of **11** to **15** is a standard iminium ion trapping process which is consistent with the hypothesis that *N*-triflyloxy amides can undergo ionization–rearrangement reactions and so deliver *N*-acyliminium ions (Scheme 4).



The ^{1}H NMR spectrum of the crude product showed traces of a second component (<5%) which contained the 2-propoxy group. Furthermore, TLC examination of the reaction mixture from **11a** over the course of the solvolysis revealed that the starting material disappeared fairly rapidly (<1 h) to give a new component which slowly disappeared as the *N*-(4-butenyl) amide **15a** was formed. In order to identify the intermediate, *N*-triflyloxy amide **11a** was refluxed in 2-propanol and was found to disappear in 30 min. Upon workup isopropoxy derivative **16a** was isolated in 90% yield (eq 4).



This result indicates that iminium ion formation and trapping by 2-propanol occurs rapidly. In the presence of the triflic acid byproduct, the *N*-(isopropoxymethyl) amide is in equilibrium with the iminium ion which is ultimately trapped by allyltrimethylsilane when it is present in the reaction mixture. Thus in Scheme 4, path b is reversible while path a is not. Because 1-alkoxyalkyl amides are such versatile sources of iminium ions under a variety of acid-catalyzed conditions,[1] their synthesis by the ionization–rearrangement of *N*-triflyloxy amides was further investigated. A representative group of *N*-triflyloxy amides **11a–c,e,g–i,k–n** were heated to reflux in 2-propanol for 45–60 min. After aqueous workup, *N*-(isopropoxymethyl) amides **16a–c,e,g–i,k–n** were obtained in high yields (73–92%) of analytically pure product (eq 5). Carboethoxy analog **16n** gave a slightly lower, but still acceptable, yield of 62% of pure product.



The range of functionality in the R_1-group found to be compatible with the method is impressive. Alkyl, aryl, olefin, ester, chloroalkyl, and even the 2-furyl group were included in the series of compounds studied, and all gave very good results. This structural tolerance is significantly greater than those reported for other methods of *N*-(1-alkoxymethyl) amide preparation.[1]

Besides the *N*-methyl group, several other nitrogen substituents can be used equally well. *N*-Triflyloxy amides **12a,g,h,k,o**, **13a,c**, and **14a** were all converted to the respective *N*-(1-isopropoxyalkyl) amides **17a,g,h,k,o**, **18a,c**, and **19a** in high yields (65–97%) of purified products (eq 6). In these cases, however, solvolysis took place under much milder conditions than for *N*-methyl derivatives **11**. All except one were complete in 4–10 h at room temperature (**12o** required 20 h), conditions under which the *N*-methyl analogs **11** failed to react at a significant rate. This finding demonstrates that there is a marked electronic effect of substituents at the migration origin as expected for an ionization–rearrangement process.[13]

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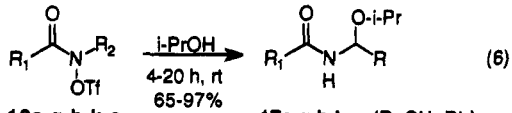
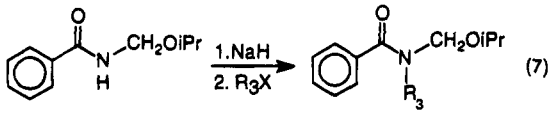


12a,g,h,k,o
13a,c
14a

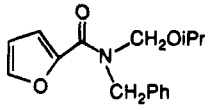
17a,g,h,k,o (R=CH_2Ph)
18a,c (R=n-C_3H_7)
19a (R=n-C_6H_{13})

Since *N*-triflyloxy amides are the starting materials for ionization–hydride rearrangement to iminium ions, the products are necessarily *secondary N*-(1-isopropoxyalkyl) amides. It is also true that *tertiary N*-(1-alkoxyalkyl)-*N*-alkyl amides are also widely used to generate iminium ions. Because of regiochemical considerations, the most common examples are produced by the electrochemical oxidation of symmetrically substituted *N,N*-dialkyl amides.[1] Thus the electrochemical procedure is not only limited to nonoxidizable functional groups, but it is also structurally limited. If secondary *N*-(1-isopropoxyalkyl) amides **16–19** could be alkylated on nitrogen, then a route to tertiary *N*-(1-isopropoxyalkyl)-*N*-alkyl amides could be produced in which the nitrogen substituents need not be structurally related. This possibility was realized by treating isopropoxymethyl amide **16g** with sodium hydride followed by an alkyl halide.[14] In this way, tertiary *N*-(isopropoxymethyl) amides **20–22** were obtained in good yields (eq 7). By the same procedure 2-furyl derivative **16h** was alkylated with benzyl bromide to give the tertiary amide **23**. The ability to convert secondary *N*-(1-isopropoxyalkyl)amides to tertiary amides by alkylation significantly increase the scope of the ionization–rearrangement reaction of *N*-triflyloxy amides.



16g

20 (R=CH_3)
21 (R=allyl)
22 (R=Bn)



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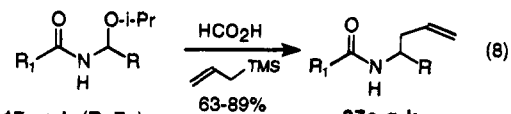
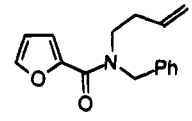
Having developed versatile preparations of *N*-(1-isopropoxyalkyl) amides, we believe it is important to demonstrate that they are competent sources of iminium ions. As was communicated earlier, *N*-(1-isopropoxymethyl) amides **16a,g,k,n** gave **24**, **25**, **15k**, and **26**, respectively, in typical yields when subjected to several standard iminium ion trapping reactions (Chart 1).[10] In addition *N*-(1-isopropoxyalkyl) amides **17a,g,k** and **18a,c** were treated with allyltrimethylsilane in formic acid at 35 °C and gave amides **27a,g,k** and **28a,c** in high yields (63–89%) (eq 8).



17a,g,k (R=Bn)
18a,c (R=n-Pr)

27a,g,k
28a,c

Under the same conditions amide **21** gave **29** and **23** gave **30**, illustrative of the complex and sensitive structures which can be assembled by this methodology.



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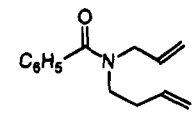

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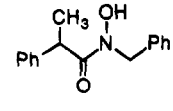
Discussion

These results highlight the versatility of *N*-sulfonyloxy amides as synthetic intermediates. Their novel and very useful base-promoted chemistry has been utilized for synthetic access to a wide variety of amide and lactam derivatives.[15] This study shows that in the absence of base, *N*-triflyloxy amides undergo ionization–rearrangement in 2-propanol to produce *N*-acyliminium ions. This mechanistic assignment is consistent with the observed leaving group effect (only triflates, but not nosylates or mesylates, decompose at useful rates),[10] solvent effect (polar solvents accelerate the process markedly),[10] and electronic effects at the migration origin (*N*-alkyl ≫ *N*-methyl). These observations parallel the behavior of *N*-sulfonyloxy amines which yield iminium ions upon solvolysis[13c,g] and point to a concerted ionization–rearrangement as the operative mechanism. The derived *N*-acyliminium ions are trapped effectively by the 2-propanol solvent.

The use of *N*-triflyloxy amides as precursors to *N*-(1-isopropoxyalkyl) amides **16–19** is particularly noteworthy because the mild conditions required for the conversion permit a wide variety of R_1 groups to be efficiently incorporated into the acyl portion of the *N*-acyliminium ion. The uniformly good results suggest that there are no significant structural limitations on the *N*-acyl group. This structural tolerance is quite remarkable compared to other methods.

Several nitrogen substituents (methyl, 2-phenylethyl, *n*-butyl, and *n*-heptyl) have also been employed with good results. The sole difference is that the *n*-alkyl groups of **12–14** cause ionization–rearrangement to be much faster than in *N*-methyl compounds **11**. The yields and purities of the *N*-(1-isopropoxyalkyl) amides are indistinguishable for different nitrogen substituents. Nitrogen substituents other than *n*-alkyl groups, however, are not successful. *N*-Triflyloxy derivatives of hydroxamic acids **31–33**, which contain a secondary center or benzylic center next to the nitrogen, could not be isolated when the hydroxamic acid was treated with triflic anhydride and 2,6-lutidine in the standard fashion. The greater stabilization of the migration origin in these systems (benzylic or tertiary) enhances the rate of ionization–rearrangement and causes the *N*-triflyloxy amide to decompose rapidly after it is formed, thus precluding its isolation. The use of less-reactive sulfonyloxy leaving groups in these cases is under investigation.



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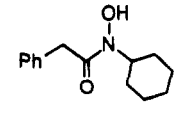

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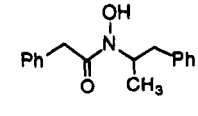

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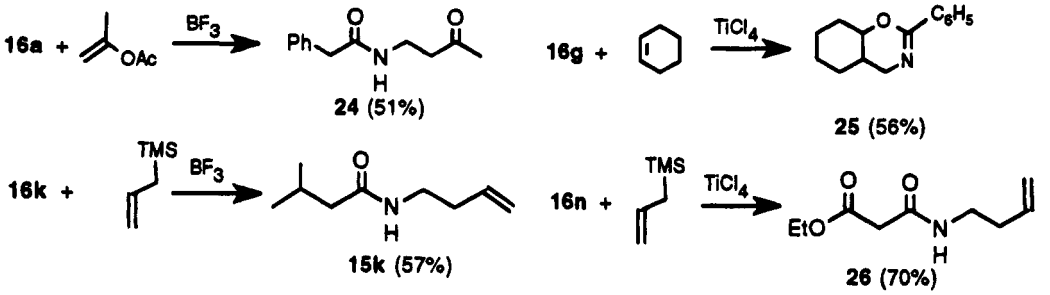
Chart 1



The alkylation of secondary *N*-(1-isopropoxyalkyl) amides to give tertiary *N*-(1-isopropoxyalkyl) amides is an important extension of the methodology since iminium ions derived from tertiary amides are among the most commonly used types. The reaction works best with reactive alkylating agents such as methyl iodide, allyl bromide, and benzyl bromide. The use of primary alkyl iodides and triflates is being evaluated presently. Even within this constraint, however, the versatility of the approach is remarkable.

As expected, treatment of *N*-(1-isopropoxyalkyl) amides with Lewis acids produces *N*-acyliminium ions which can be captured by a variety of nucleophilic trapping agents. The yields of products are typical, thus the structural tolerance found in the precursor synthesis is maintained in the conversion to *N*-acyliminium ions.

In summary a new method for the preparation of *N*-(1-isopropoxyalkyl) amides from hydroxamic acids is reported which is simple and direct. The range of compounds produced thus far shows the method to be extraordinarily tolerant of structural diversity and able to accommodate far more sensitive functional groups than any other method yet reported. As a consequence a large variety of *N*-acyliminium ions can be generated easily from these readily available starting materials.

Experimental Section

Melting points are uncorrected. Chemical shifts are reported for chloroform-d solution in ppm relative to Me_4Si. Elemental analyses were performed by M-H-W Laboratories, Phoenix, AZ. Thin-layer chromatography was performed on silica gel 60 F254 plates from EM reagents and visualized by UV irradiation or iodine. Flash column chromatography was performed using silica gel 60 (230–400 mesh). Phenylacetyl chloride, 3-methylphenylacetic acid, 3-methoxyphenylacetyl chloride, 2-phenylpropionic acid, 1-napthoyl chloride, isovaleroyl chloride, dihydrocinnamoyl chloride, chloroacetyl chloride, ethylmalonyl chloride, allyltrimethylsilane, and triflouromethanesulfonic anhydride were purchased from Aldrich, cyclohexene-1-acetic acid was purchased from Alfa, and 2-phenyl-4-quinolinecarboxylic acid was purchased from Janssen Chimica and used as received. *N*-Methylhydroxylamine hydrochloride was purchased from Aldrich, *N*-(phenylethyl)hydroxylamine was prepared by the reduction of *trans*-β-nitrostyrene,[16] *N*-(*n*-butyl)- and *N*-(*n*-heptyl)hydroxylamine were prepared by the reduction of the corresponding oximes[17] and were used as crude materials.

Synthesis of *N*-Hydroxy-*N*-alkanecarboxamides. General Procedure A, B, or C. Procedure A:[11] Solutions of an *N*-alkylhydroxylamine hydrochloride (42 mmol) dissolved in methanol (25 mL), and KOH (77 mmol) dissolved in methanol (25 mL), were each cooled to 0 °C. The two solutions were mixed at 0 °C, stirred for 5 min, and the acid chloride (35 mmol) in THF (25 mL) was added dropwise. The resulting mixture was stirred at 0 °C for 30 min and then at room temperature for 2 h. The solvent was removed under vacuum, the residue was treated with saturated NaCl (20 mL), and the solution was extracted with ethyl acetate (3 × 50 mL) which was dried over $MgSO_4$. After rotary evaporation, the *N*-hydroxy-*N*-alkylcarboxamide was purified by either crystallization (hexane–dichloromethane, 6:4) or flash chromatography (hexane–ethyl acetate, 1:9).

Procedure B:[12] A cold (0 °C) solution of the acid chloride (10 mmol, prepared from the corresponding acid and oxalyl chloride) in CH_2Cl_2 (75 mL) was added over a period of 45–60 min to an ice-cold mixture of an *N*-alkylhydroxylamine hydrochloride (12 mmol) and Et_3N (22 mmol) in CH_2Cl_2 (100 mL). The mixture was warmed to room temperature and allowed to stir for 1 h. The mixture was diluted with with water (100 mL), and the organic layer was washed with 1 N HCl (2× 25 mL) and brine (2 × 100 mL), dried ($MgSO_4$), and evaporated. The crude product was purified by either crystallization (hexane–dichloromethane, 6:4) or flash chromatography (hexane–ethyl acetate, 1:9). Hydroxamic acids **7a**,**c**,**e**,[15a] **7d**,[15c] and **8a**[15a] were prepared by procedure B as reported earlier.

Procedure C: *N*-Methylhydroxylamine hydrochloride (77 mmol) was dissolved in methanol (25 mL), KOH (70 mmol) was dissolved in methanol (25 mL), and both solutions were cooled in ice. The two solutions were mixed at 0 °C and stirred for 5 min, and then the acid chloride (35 mmol) in THF (25 mL) was added dropwise. The resulting solution was stirred at 0 °C for 30 min and then at room temperature for 2 h. The solvent was then removed under low pressure, and the residue was treated with saturated NaCl (20 mL) and extracted with ethyl acetate (3 × 50 mL). The organic extract was dried over $MgSO_4$. After rotary evaporation, the product was purified by flash chromatography (hexane–ethyl acetate, 1:9).

***N*-Hydroxy-*N*-methyl-(3-methylphenyl)acetamide (7b)** was prepared in 84% yield (procedure B) as a colorless oil after flash chromatography: ^{1}H NMR δ 2.30 (bs, 3H), 3.12 and 3.22 (two s, 3H), 3.64 (s, 2H), 6.99–7.17 (m, 4H), 8.70 (bs, 1H); ^{13}C NMR δ 21.4, 36.1, 36.8, 38.6, 39.0, 125.6, 126.5, 127.5, 128.2, 128.4, 128.9, 129.3, 130.2, 133.4, 135.0, 138.1, 138.7, 165., 177.67; IR (neat) 3178, 2919, 1618, 1491 cm^{-1}. Anal. Calcd for $C_{10}H_{13}NO_2$: C, 67.01; H, 7.31. Found: C, 66.94; H, 7.36.

***N*-Hydroxy-*N*-methyl-(1-cyclohexenyl)acetamide (7f)** was prepared in 90% yield (procedure B) as a colorless oil after flash chromatography: ^{1}H NMR δ 1.53–1.67 (m, 4H), 1.97–2.04 (m, 4H), 3.01 (s, 2H), 3.34 (s, 3H), 5.52 (s, 1H), 8.59 (bs, 1H); ^{13}C NMR δ 21.9, 22.0, 22.6, 22.7, 25.2, 28.3, 28.6, 36.0, 36.7, 41.0, 41.2, 124.7, 125.3, 130.6, 131.9, 165.8, 172.8; IR (neat) 3172, 2931, 1615, 1439 cm^{-1}; MS *m/e* (rel intensity) 170 (M^+ + 1; 2.5), 169 (M^+; 20.7), 123 (38.5), 95 (100). Anal. Calcd for $C_9H_{15}NO_2$: C, 63.87; H, 8.93. Found: C, 63.92; H, 9.00.

***N*-Hydroxy-*N*-methylbenzamide (7g)** was prepared in 78% yield (procedure A) as a colorless oil after flash chromatography: ^{1}H NMR δ 3.36 (s, 3H), 7.38–7.52 (m, 5H); IR (neat) 3160, 2927, 1608, 1574 cm^{-1}; MS *m/z* (rel intensity) 152 (M^+ + 1; 1.2), 151 (M^+; 11.5), 134 (1.1), 105 (100), 77. Anal. Calcd for $C_8H_9NO_2$: C, 63.56; H, 6.00. Found: C, 63.45; H, 5.91.

***N*-Hydroxy-*N*-methyl-2-furancarboxamide (7h)** was prepared in 83% yield (procedure A) after flash chromatography: mp 103–105 °C; ^{1}H NMR δ 3.51 (s, 3H), 6.48 (dd, J = 1.7 and 1.8 Hz, 1H), 7.19 (d, J = 3.4 Hz, 1H), 7.5 (dd, J = 0.7 and 0.9 Hz, 1H), 9.00 (bs, 1H); ^{13}C NMR (acetone-d_6) δ 37.1, 112.2,

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118.2, 145.8, 146.9, 159.6; IR 3144, 2902, 1615, 1576, 1163 cm^{-1}. Anal. Calcd for $C_6H_7NO_3$: C, 51.06; H, 4.99. Found: C, 51.18; H, 5.14.

***N*-Hydroxy-*N*-methyl-1-napthamide (7i)** was prepared in 83% yield (procedure A) after flash chromatography: mp 126–127 °C; ^1H NMR δ 3.16 (s, 3H), 7.42–7.47 (m, 4H), 7.84–7.90 (m, 3H), 10.07 (bs, 1H); ^{13}C NMR δ 36.7, 123.0, 123.3, 123.5, 124.9, 125.8, 126.8, 128.0, 128.6, 131.8, 164.18; IR ($CHCl_3$) 3157, 3014, 1618, 1510 cm^{-1}.

***N*-Hydroxy-*N*-methylacetamide (7j)** was prepared according to ref 18.

***N*-Hydroxy-*N*-methyl-3-methylbutanamide (7k)** was prepared in 88% yield (procedure A) as a colorless oil after flash chromatography: ^1H NMR δ 0.97 (d, J = 5.9 Hz, 6H), 2.17–2.38 (m, 3H), 3.25–3.37 (m, 3H), 9.0 (bs, 1H); ^{13}C NMR δ 22.4, 22.6, 25.3, 26.1, 36.0, 36.7, 40.4, 41.0, 167.4, 174.2; IR (neat) 3182, 2959, 1609, 1466 cm^{-1}.

***N*-Hydroxy-*N*-methyl-3-phenylpropanamide (7l)** was prepared in 88% yield (procedure B) after flash chromatography: mp 77–79 °C; ^1H NMR δ 2.57–2.94 (m, 4H), 3.15 and 3.19 (two s, 3H) 7.15–7.27 (m, 5H), 8.99 (bs, 1H); ^{13}C NMR δ 30.7, 31.3, 33.3, 34.0, 36.1, 126.0, 126.5, 128.2, 128.4, 128.52, 128.5, 128.6, 140.0, 141.0, 166.7, 173.8; IR ($CHCl_3$) 3160, 2929, 1603, 1497 cm^{-1}. Anal. Calcd for $C_{10}H_{13}NO_2$: C, 67.01; H, 7.31. Found: C, 67.23; H, 7.49.

***N*-Hydroxy-*N*-methyl-2-chloroethanamide (7m)** was prepared in 89% yield (procedure C) after flash chromatography: mp 60–62 °C; ^1H NMR δ 3.29 and 3.45 (s, 3H), 4.11 and 4.41 (s, 2H),8.59 (bs, 1H); ^{13}C NMR δ 36.7, 38.1, 39.2, 41.7, 167.6; IR ($CHCl_3$) 3154, 2931, 1642, 1438, 1202 cm^{-1}. Anal. Calcd for $C_3H_6ClNO_2$: C, 29.16; H, 4.89. Found: C, 29.21; H, 4.80.

***N*-Hydroxy-*N*-methyl-2-carbethoxyethanamide (7n)** was prepared in 83% yield (procedure C) as a colorless oil after flash chromatography: ^1H NMR δ 1.28 (t, J = 7.1 Hz, 3H), 3.27 (s, 3H), 3.56 (s, 2H), 4.19 (q, J = 6.9 Hz, 2H), 9.14 (bs, 1H); ^{13}C NMR δ 14.0, 36.0, 40.4, 61.6, 167.3, 168.4; IR (neat) 3180, 2985, 1745, 1641, 1395 cm^{-1}.

***N*-Hydroxy-*N*-(2-phenylethyl)benzamide (8g)** was prepared in 87% yield (procedure B) after flash chromatography: mp 118–120 °C; ^1H NMR δ 3.00 (dd, J = 6.8 and 6,4 Hz, 2H), 3.84 (dd, J = 6.5 and 6.4 Hz, 2H), 7.0–7.39 (m, 10H), 8.72 (bs, 1H); ^{13}C NMR δ 33.2, 52.3, 126.6, 127.4, 128.2, 128.5, 129.1, 130.4, 137.7, 167.5; IR ($CHCl_3$) 3242, 3018, 1622, 1600, 1498 cm^{-1}. Anal. Calcd for $C_{15}H_{15}NO_2$: C, 74.66; H, 6.26. Found: C, 74.51; H, 6.40.

***N*-Hydroxy-*N*-(2-phenylethyl)-2-furancarboxamide (8h)** was prepared in 86% yield (procedure A) after crystallization: mp 141–143 °C; ^1H NMR δ 3.04 (dd, J = 7.1 and 7.3 Hz, 2H), 4.2 (t, J = 7.3 Hz, 2H), 6.95 (d, J = 3.4 Hz, 1H), 7.17–7.3 (m, 5H), 8.30 (bs, 1H); ^{13}C NMR δ 33.8, 51.4, 11.6, 117.2, 126.6, 128.5, 128.8, 137.8, 144.3, 144.4, 156.0; IR ($CHCl_3$) 3019, 2838, 1603, 1160 cm^{-1}. Anal. Calcd for $C_{13}H_{13}NO_3$: C, 67.52; H, 5.66. Found: C, 67.36; H, 5.65.

***N*-Hydroxy-*N*-(2-phenylethyl)-3-methylbutanamide (8k)** was prepared in 86% yield (procedure A) after flash chromatography: mp 42–43 °C; ^1H NMR δ 0.80 (d, J = 6.4 Hz, 6H), 1.76 (d, J = 6.7 Hz, 2H), 1.96 (m, 1H), 2.99 (dist t, J = 6.3 and 6.6 Hz, 2H), 3.84 (dist t, J = 6.5 and 6.4 Hz, 2H), 7.17–7.30 (m, 5H), 8.72 (bs, 1H); ^{13}C NMR δ 22.3, 23.6, 25.2, 25.7, 32.9, 33.5, 39.5, 41.2, 49.5, 50.8, 126.3, 126.8, 128.4, 128.6, 128.7, 128.9, 137.8, 138.7, 167.1, 173.8; IR ($CHCl_3$) 3186, 2959, 1600, 1466 cm^{-1}. Anal. Calcd for $C_{13}H_{19}NO_2$: C, 70.55; H, 8.65. Found: C, 70.71; H, 8.57.

***N*-Hydroxy-*N*-(2-phenylethyl)-2-phenyl-4-quinolinamide (8o)** was prepared using Nakonieczna's[19] procedure in 83% yield after crystallization from hexane:dichloromethane (6:4): mp 117–119 °C; ^1H NMR δ 2.94 (s, 2H), 3.59 (s, 2H), 6.90–7.05 (m, 8H), 7.33 (dd, J = 7.3 and 7.6 Hz, 1H), 7.48 (d, J = 6.2 Hz, 2H), 7.65 (dd, J = 8.4 and 5.4 Hz, 2H), 7.92 (dd, J = 7.6 and 1.5 Hz, 2H), 8.12 (d, J = 8.4 Hz, 1H); ^{13}C NMR δ 32.8, 52.3, 117.0, 122.9, 124.1, 126.9, 127.6, 127.7, 128.6, 128.7, 129.1, 129.7, 130.0, 130.3, 137.2, 138.3, 139.8, 148.1, 156.7, 163.7; IR ($CHCl_3$) 3028, 2956, 1630, 1596 cm^{-1}. Anal. Calcd for $C_{24}H_{20}NO_2$: C, 78.23; H, 5.47. Found: C, 78.36; H, 5.51.

***N*-Hydroxy-*N*-(*n*-butyl)phenylacetamide (9a)** was prepared in 89% yield (procedure B) as a colorless oil after flash chromatography: ^1H NMR δ 0.88 (dd, J = 7.2 and 7.3 Hz, 3H), 1.27 (m, 2H), 1.57 (m, 2H), 3.50 (dd, J = 6.6 and 6.9 Hz, 2H), 3.72 (s, 2H), 7.23–7.33 (m, 5H), 8.0 (bs, 1H); ^{13}C NMR δ 13.6, 13.7, 19.6, 19.7, 28.5, 29.4, 38.4, 39.2, 47.9, 49.2, 126.5, 127.2, 128.3, 128.5, 128.8, 129.3, 133.8, 135.2, 164.9, 172.0; IR (neat) 3190, 2999, 1616, 1496 cm^{-1}.

***N*-Hydroxy-*N*-(*n*-butyl)-3-methoxyphenylacetamide (9c)** was prepared in 86% yield (procedure B) as a colorless oil after flash chromatography:^1H NMR δ 0.92 (bs, 3H), 1.31 (m,2H), 1.60 (m, 2H), 3.62–3.75 (m, 4H), 3.81 (s, 3H), 6.80–6.84 (m, 3H), 7.24 (m, 1H), 8.50 (bs, 1H); ^{13}C NMR δ 13.6, 13.7, 19.7, 19.8, 28.6, 29.4, 38.4, 39.2, 47.9, 49.2, 55.0, 55.1, 112.1, 112.6, 114.3, 114.9, 120.8, 125.7, 129.2, 129.8, 135.3, 136.8, 159.5, 159.9, 164.8, 171.9; IR (neat) 3175, 2958, 1601, 1491, 1151 cm^{-1}.

***N*-Hydroxy-*N*-(*n*-heptyl)phenylacetamide (10a)** was prepared in 84% yield (procedure B) as a colorless oil after flash chromatography: ^1H NMR δ 0.87 (dd, J = 6.7 and 5.7 Hz, 3H), 1.23 (bs, 8H), 1.60 (m, 2H), 3.59 (dd, J = 6.7 and 7.3 Hz, 2H), 3.69 and 3.76 (two s, 2H), 7.24–7.29 (m, 5H); ^{13}C NMR δ 14.1, 22.6, 26.4, 26.6, 27.4, 28.8, 29.0, 31.6, 31.8, 38.5, 39.3, 48.3, 49.6, 126.5, 127.3, 128.3, 128.6, 128.8, 129.4, 133.9, 135.4, 165.0, 172.1; IR (neat) 3187, 2929, 2868, 1613 cm^{-1}.

Synthesis Of *N*-Triflyloxy Amides. General Procedure: Trifluoromethanesulfonic anhydride (1.2 mmol, neat) was added in one portion to a −78 °C solution of the hydroxamic acid (1.0 mmol) in CH_2Cl_2 (5.0 mL). The mixture was stirred for 5 min and 2,6-lutidine (1.2 mmol, neat) was then added in one portion. The cooling bath was removed immediately. When the reaction mixture reached room temperature (ca. 10 min), it was washed with water, 1 N HCl, and brine and dried over $MgSO_4$. After rotary evaporation at *room temperature*, the crude product which has a purity >90% (by ^1H NMR) was used immediately. Any attempt to purify the crude product by column chromatography resulted in the partial decomposition of the the triflate, although in certain cases it could be purified by crystallization (**11a** and **12a**) or Kugelrohr distillation (**11e,j,k,m**, and **n**).

***N*-(Triflyloxy)-*N*-methylphenylacetamide (11a)** was prepared from **7a** in 90% crude yield as a light yellow solid: ^1H NMR δ 3.45 (s, 3H), 3.84 (s, 2H), 7.22–7.35 (m, 5H); ^{13}C NMR δ 39.8, 39.9, 113.6, 116.8, 120.0, 123.2, 127.6, 128.8, 129.4, 132.1, 174.2; IR ($CHCl_3$) 3034, 1723, 1498, 1136 cm^{-1}. Recrystallization from hexane:dichloromethane (8:2) gave a product of analytical purity: mp 55–56 °C. Anal. Calcd for $C_{10}H_{10}FNO_4S$: C, 40.40; H, 3.39; N, 4.71. Found: C, 40.37; H, 3.28; N, 4.68.

***N*-(Triflyloxy)-*N*-methyl-3-methylphenylacetamide (11b)** was prepared from **7b** in 92% crude yield as a colorless oil: ^1H NMR δ 2.33 (s, 3H), 3.43 (s, 3H), 3.78 (s, 2H), 7.02 (dd, J = 7.6 and 6.4 Hz, 2H), 7.10 (d, J = 7.2 Hz, 1H), 7.22 (dd, J = 8.0 and 7.6 Hz, 1H); ^{13}C NMR δ 21.3, 39.9, 113.6, 116.8, 120.0, 123.2, 126.3, 128.4, 128.7, 130.0, 131.9, 138.5,174.2; IR (neat) 3026, 2923, 1725, 1434, 1137 cm^{-1}.

***N*-(Triflyloxy)-*N*-methyl-3-methoxyphenylacetamide (11c)** was prepared from **7c** in 81% crude yield as a light yellow oil: ^1H NMR δ 3.45 (s, 3H), 3.80 (s, 3H), 3.82 (s, 2H), 6.78–6.82 (m, 3H), 7.25 (m, 1H); IR ($CHCl_3$) 2941, 2838, 1718, 1602, 1135 cm^{-1}.

***N*-(Triflyloxy)-*N*-methyl-2-phenylpropanamide (11d)** was prepared from **7d** in 87% crude yield as a light yellow oil: ^1H NMR δ 1.51 (d, J = 6.9 Hz, 3H), 3.36 (s, 3H), 3.94 (q, J = 6.9 Hz, 1H), 7.23–7.36 (m, 5H); IR (neat) 2985, 2938, 1723, 1434, 1136 cm^{-1}.

***N*-(Triflyloxy)-*N*-methyl-3-butenamide (11e)** was prepared from **7e** in 84% crude yield as a light brown oil which can be purified by distillation (bath temperature 62–65 °C/0.5 mm); ^1H NMR δ 3.30 (d, J = 6.7 Hz, 2H), 3.47 (s, 3H), 5.20–5.29 (m, 2H), 5.86–5.94 (m, 1H); ^{13}C NMR δ 37.7, 39.6, 114.6, 116.9, 119.9, 120.1, 123.5, 128.6, 174.5; IR ($CHCl_3$) 2957, 1717, 1436, 1135 cm^{-1}.

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N-(Triflyloxy)-N-methyl-(1-cyclohexenyl)acetamide (11f) was prepared from **7f** in 89% crude yield as a yellow viscous oil: ^{1}H NMR δ 1.56–1.97 (m, 4H), 2.03–2.05 (m, 4H), 3.14 (s, 2H), 3.46 (s, 3H), 5.57 (s, 1H); IR (neat) 2934, 1726, 1435, 1137 cm^{-1}.

N-(Triflyloxy)-N-methylbenzamide (11g) was prepared from **7g** in 90% crude yield as a yellow oil: ^{1}H NMR δ 3.51 (s, 3H), 7.27–7.72 (m, 5H); IR ($CHCl_3$) 2954, 2911, 1718, 1601, 1137 cm^{-1}.

N-(Triflyloxy)-N-methylfurancarboxamide (11h) was prepared from **7h** in 74% crude yield as a yellow oil: ^{1}H NMR δ 3.68 (s, 3H), 6.60 (dd, J = 1.8 Hz, 1H), 7.37 (d, J = 3.60 Hz, 1H), 7.64 (m, 1H); IR (neat) 3145, 2957, 1707, 1573, 1138 cm^{-1}.

N-(Triflyloxy)-N-methyl-1-napthamide (11i) was prepared from **7i** in 93% crude yield as a light yellow oil: ^{1}H NMR δ 3.34 (s, 3H), 7.45–7.61 (m, 4H), 7.86 (d, J = 7.6 Hz, 1H), 7.95 (d, J = 8.4 Hz, 1H), 8.01 (d, J = 8.0 Hz, 1H); IR ($CHCl_3$) 3062, 2954, 1713, 1510, 1433, 1137 cm^{-1}.

N-(Triflyloxy)-N-methylacetamide (11j) was prepared from **7j** in 67% crude yield as a colorless oil which can be purified by distillation (bath temperature 40 °C/0.5 mm); ^{1}H NMR δ 2.27 (s, 3H), 3.45 (s, 3H); IR ($CHCl_3$) 2951, 1723, 1435, 1135 cm^{-1}.

N-(Triflyloxy)-N-methyl-3-methylbutanamide (11k) was prepared from **7k** in 86% crude yield as a light yellow oil which can be purified by distillation (bath temperature 45–50 °C/0.5 mm); ^{1}H NMR δ 0.98 (d, J = 8.0 Hz, 6H), 2.20 (m, 1H), 2.35 (d, J = 8.0 Hz, 2H), 3.45 (s, 3H); IR (neat) 2965, 2876, 1734, 1434, 1137 cm^{-1}.

N-(Triflyloxy)-N-methyl-3-phenylpropanamide (11l) was prepared from **7l** in 88% crude yield as a light yellow oil: ^{1}H NMR δ 2.81 (t, J = 8.0 Hz, 2H), 2.99 (t, J = 8.0 Hz, 2H), 3.14 (s, 3H), 7.19–7.30 (m, 5H); IR (neat) 3030, 2939, 1726, 1433, 1136 cm^{-1}.

N-(Triflyloxy)-N-methyl-2-chloroethanamide (11m) was prepared from **7m** in 86% crude yield as a light yellow oil which can be purified by distillation (bath temperature 65 °C/0.5 mm); ^{1}H NMR δ 3.54 (s, 3H), 4.31 (s, 2H); ^{13}C NMR δ 40.2, 40.9, 113.6, 116.8, 120.0, 123.2, 169.5; IR (neat) 3010, 2957, 1732, 1437, 1134 cm^{-1}.

N-(Triflyloxy)-N-methyl-2-carbethoxyethanamide (11n) was prepared from **7n** in 80% crude yield as a light yellow oil which can be purified by distillation (bath temperature75–80 °C/0.5 mm); ^{1}H NMR δ 1.29 (t, J = 8.0 Hz, 3H), 3.50 (s, 3H), 3.61 (s, 2H), 4.23 (q, J = 8.0 Hz, 2H); IR ($CHCl_3$) 2986, 1745, 1721, 1437, 1135 cm^{-1}.

N-(Triflyloxy)-N-(2-phenylethyl)phenylacetamide (12a) was prepared from **8a** in 82% crude yield as a colorless solid. Recrystallization from hexane:dichloromethane (8:2) gave product of analytical purity: mp 76–77 °C; ^{1}H NMR δ 2.89 (t, J = 7.3 Hz, 2H), 3.55 (s, 2H), 4.07 (dd, J = 7.2 and 7.3 Hz, 2H), 7.09–7.32 (m, 10H); ^{13}C NMR δ 32.5, 39.8, 54.1, 113.6, 116.8, 120.0, 123.0, 127.2, 127.4, 127.5, 128.7, 128.9, 129.0, 129.3, 132.1, 136.6, 173.0; IR ($CHCl_3$) 3067, 2931, 1715, 1434, 1133 cm^{-1}. Anal. Calcd for $C_{17}H_{16}F_3NO_4S$: C, 52.71; H, 4.16. Found: C, 52.80; H, 4.09.

N-(Triflyloxy)-N-(2-phenylethyl)benzamide (12g) was prepared from **8g** in 96% crude yield as a deep yellow oil: ^{1}H NMR δ 2.98 (d, J = 6.9 Hz, 2H), 4.07 (dd, J = 6.8 and 6.9 Hz, 2H), 6.98–7.52 (m, 10H); IR (neat) 3165, 3091, 1716, 1601, 1135 cm^{-1}.

N-(Triflyloxy)-N-(2-phenylethyl)-2-furancarboxamide (12h) was prepared from **8h** in 84% crude yield as a light yellow oil: ^{1}H NMR δ 2.99 (t, J = 7.3 Hz, 2H), 4.30 (t, J = 7.3 Hz, 2H), 6.46 (m, 1H), 7.06–7.22 (m, 6H), 7.51 (s, 1H); IR ($CHCl_3$) 3146, 2957, 1710, 1147 cm^{-1}.

N-(Triflyloxy)-N-(2-phenylethyl)-3-methylbutanamide (12k) was prepared from **8k** in 91% crude yield as a light yellow oil: ^{1}H NMR δ 0.88 (d, J = 6.6 Hz, 6H), 2.06 (m, 3H), 2.97 (dist t, J = 7.2 and 7.3 Hz, 2H), 4.07 (dist t, J = 7.4 and 7.0 Hz, 2H), 7.17–7.33 (m, 5H); IR ($CHCl_3$) 3037, 2880, 1720, 1432, 1135 cm^{-1}.

N-(Triflyloxy)-N-(2-phenylethyl)-2-phenyl-4-quinolinamide (12o) was prepared from **8o** in 96% crude yield as a light yellow solid: ^{1}H NMR δ 2.96 (t, J = 5.4 Hz, 2H), 3.91 (t, J = 5.7 Hz, 2H), 6.94 (d, J = 3.2 Hz, 2H), 7.08–7.13 (m, 4H), 7.49–7.59 (m, 4H), 7.75–7.82 (m, 2H), 8.00 (d, J = 7.6 Hz, 2H), 8.19 (d, J = 8.4 Hz, 1H); IR ($CHCl_3$) 3061, 2966, 1703, 1595, 1133 cm^{-1}.

N-(Triflyloxy)-N-(n-butyl)phenylacetamide (13a) was prepared from **9a** in 88% crude yield as a light yellow oil: ^{1}H NMR δ 0.87 (dd, J = 7.2 and 7.0 Hz, 3H), 1.24 (sextet, J = 7.3 Hz, 2H), 1.59 (quintet, 2H), 3.82 (m, 4H), 7.22–7.36 (m, 5H); IR 3031, 2939, 1719, 1136 cm^{-1}.

N-(Triflyloxy)-N-(n-butyl)-3-methoxyphenylacetamide (13c) was prepared from **9c** in 91% crude yield as a light yellow oil: ^{1}H NMR δ 0.87–0.92 (m, 3H), 1.27 (m, 2H), 1.56 (m, 2H), 3.81 (s, 7H), 6.84 (m, 3H), 7.27 (m, 1H); IR (neat) 2963, 2876, 1719, 1602, 1136 cm^{-1}.

N-(Triflyloxy)-N-(n-heptyl)phenylacetamide (14a) was prepared from **10a** in 89% crude yield as a light yellow oil: ^{1}H NMR δ 0.83–0.89 (m, 3H), 0.90–1.34 (bs, 8H), 1.51–1.59 (m, 2H), 3.78–3.85 (m, 4H), 7.23–7.39 (m, 5H); IR ($CHCl_3$) 2932, 2859, 1718, 1496, 1136 cm^{-1}.

Synthesis Of N-(3-Butenyl) Secondary Amides from N-Triflyloxy Amides. General Procedure: The N-triflyloxy amide (1 mmol) was dissolved in 2-propanol (3.0 mL) to which allyltrimethylsilane (10 mmol) was added. The mixture was heated for 15–20 h at 80–85 °C (bath temperature). After the reaction mixture was concentrated by rotary evaporation, the residual oil was dissolved in ethyl acetate (15 mL) and washed with aqueous $NaHCO_3$ (10 mL). The aqueous layer was extracted twice with ethyl acetate (2 × 10 mL). The combined organic extracts were dried over $MgSO_4$. After rotary evaporation, the crude product was usually purified by column chromatography (hexanes:ethyl acetate, 1:1) or bulb-to-bulb distillation (0.5 mm).

N-(3-Butenyl)phenylacetamide (15a) was prepared from **11a** (1.2 g, 4.04 mmol) as a crude oil (0.75 g, 98%) which upon flash chromatography gave a colorless solid (0.485 g, 2.56 mmol, 63%): mp 47–48 °C; ^{1}H NMR δ 2.16 (q, J = 6.7 Hz, 2H), 3.27 (dd, J = 6.4, 6.2 Hz, 2H), 3.56 (s, 2H), 4.90–4.97 (m, 2H), 5.39 (bs, 1H), 5.59–5.67 (m, 1H), 7.23–7.36 (m, 5H); ^{13}C NMR δ 33.6, 38.4, 43.7, 117.0, 127.1, 128.8, 129.3, 135.0, 135.0, 170.9; IR ($CHCl_3$) 3314, 3015, 1654, 1526 cm^{-1}. Anal. Calcd for $C_{12}H_{15}NO$: C, 76.15; H, 7.98. Found: C, 76.30; H, 8.04.

N-(3-Butenyl)-3-methoxyphenylacetamide (15c) was prepared from **11c** (1.74 g, 5.32 mmol) as a crude oil (1.1 g, 95%) which on flash chromatography gave a light yellow solid (0.7 g, 3.19 mmol, 60%): mp 33–34 °C; ^{1}H NMR δ 2.17 (q, J = 6.7 Hz, 2H), 3.27 (dd, J = 6.4 and 6.2 Hz, 2H), 3.53 (s, 2H), 3.80 (s, 3H), 4.92–4.99 (m, 2H), 5.45 (bs, 1H), 5.61–5.68 (m, 1H), 6.78–6.84 (m, 3H), 7.24–7.28 (m, 1H); ^{13}C NMR δ 33.6, 38.4, 43.8, 55.1, 112.7, 115.0, 117.0, 121.6, 129.9, 135.0, 136.5, 159.9, 170.8; IR ($CHCl_3$) 3335, 2939, 1659, 1601, 1523 cm^{-1}; MS m/z (rel intensity) 220 (M^+ + 1; 6.8), 219 (M^+; 38.4), 178 (23.3), 149 (28.8), 122 (69.9), 121 (100), 91 (37.0). Anal. Calcd for $C_{13}H_{17}NO_2$: C, 71.20; H, 7.81. Found: C, 71.23; H, 7.88.

N-(3-Butenyl)-2-phenylpropanamide (15d) was prepared from **11d** (1.45 g, 4.66 mmol) as a crude oil (0.905 g, 96%) which on flash chromatography gave a colorless oil (0.615 g, 3.02 mmol, 65.0%): ^{1}H NMR δ 1.51 (d, J = 7.2 Hz, 3H), 2.26 (m, 2H), 3.23 (dd, J = 6.7 and 6.2 Hz, 2), 3.55 (dd, J = 7.1 and 7.3 Hz, 1H), 4.86–4.98 (m, 2H), 5.57–5.74 (m, 2H), 7.28–7.32 (m, 5H); ^{13}C NMR δ 18.4, 33.6, 38.4, 47.0, 117.0, 127.1, 127.6, 128.8, 135.0, 141.4, 174.1; IR ($CHCl_3$) 3315, 3096, 2996, 1661, 1556 cm^{-1}.

N-(3-Butenyl)-3-butenamide (15e) was prepared from **11e** (1.73 g, 7.00 mmol) as a crude oil (0.97 g, 99%) which on flash chromatography gave a colorless oil (0.662 g, 4.76 mmol, 68%): ^{1}H NMR δ 2.21–2.32 (m, 2H), 3.01 (d, J = 7.0 Hz, 2H), 3.32 (dd, J = 6.0 and 6.6 Hz, 2H), 5.06–5.26 (m, 4H), 5.66–5.99 (m, 3H); ^{13}C NMR δ 33.6, 38.6, 41.5, 117.0, 119.3, 131.5, 135.2, 170.8; IR ($CHCl_3$) 3292, 3079, 2931, 1652, 1566 cm^{-1}.

N-(3-Butenyl)-1-cyclohexenylacetamide (15f) was prepared from **11f** (1.57 g, 5.21 mmol) as a crude oil (0.96 g, 96%) which on flash chromatography gave a colorless oil (0.565 g, 2.92 mmol, 56%): ^{1}H NMR δ 1.53–1.65 (m, 4H), 1.95–2.04 (m, 4H), 2.25 (dd, J = 6.4 and 6.7 Hz, 2H), 2.85 (s, 2H), 3.31 (dd, J = 6.2 and 6.4 Hz, 2H), 5.06–5.10 (m, 2H), 5.60 (s, 1H), 5.71–5.80 (m, 2H); ^{13}C NMR δ 22.0, 22.7, 25.3, 28.4, 33.8, 38.2, 46.2, 117.0, 126.7, 126.6, 132.9, 135.4, 171.0; IR (neat) 3288, 3078, 2926, 1645, 1553 cm^{-1}; MS m/z (rel intensity) 194 (M^+ + 1; 6.0),

193 (M^+; 50.7), 152 (37.3), 123 (35.8), 122 (14.2), 96 (36.6), 95 (80.6), 94 (21.6).

***N*-(3-Butenyl)benzamide (15g)**[20] was prepared from **11g** (1.78 g, 6.28 mmol) as a crude oil (1.1 g, 100%) which on flash chromatography gave a colorless oil (0.885 g, 5.05 mmol, 81%): ^{13}C NMR δ 33.7, 38.9, 117.1, 126.9, 128.4, 131.2, 134.7, 135.3, 167.6; IR ($CHCl_3$) 3335, 2937, 1665, 1611, 1556 cm^{-1}; MS *m/z* (rel intensity) 176 ($M^+ + 1$; 1.4), 175 (M^+; 10.5), 135 (2.7), 134 (26.7), 106 (8.0), 105 (100), 78 (2.9), 77 (38.3), 54 (2.0), 52 (1.5), 51 (17.0).

***N*-(3-Butenyl)acetamide (15j)**[21] was prepared from **11j** (1.85 g, 8.37 mmol) as a crude oil (0.81 g, 86%) which on distillation (bath temperature 70–72 °C/0.5 mm) gave a colorless oil (0.566 g, 5.00 mmol, 60%). Amide **15j** was described above.

***N*-3-Butenyl-3-methylbutanamide (15k)** was prepared from **11k** (1.83 g, 6.9 mmol) as a crude oil (0.836 g, 81%) which on distillation (bath temperature 92–95 °C/0.5 mm) gave a colorless oil (0.66 g, 4.2 mmol, 61%): ^{1}H NMR δ 0.94 (d, J = 6.4 Hz, 6H), 2.01 (d, J = 6.9 Hz, 2H), 2.07–2.12 (m, 1H), 2.26 (dd, J = 6.6 and 6.7 Hz, 2H), 3.33 (dd, J = 6.0 and 6.5 Hz, 2H), 5.07–5.12 (m, 2H), 5.11 (bs, 1H), 5.56–5.79 (m, 1H); ^{13}C NMR δ 22.4, 26.1, 33.9, 38.4, 46.1, 116.9, 135.4, 172.6; IR ($CHCl_3$) 3297, 3079, 2958, 1645, 1553 cm^{-1}.

Synthesis of *N*-(Isopropoxymethyl) Secondary Amides from *N*-Triflyloxy Amides. General Procedure: The *N*-triflyloxy amide (1.0 mmol) was dissolved in 2-propanol (5.0 mL). The mixture was then heated for 45–60 min at 80–85 °C (bath temperature). The reaction mixture was concentrated by rotary evaporation, and the residual oil was taken up in ethyl acetate (10 mL) and washed with brine (10 mL). The aqueous layer was extracted once with ethyl acetate (10 mL). The combined organic extracts were dried over $MgSO_4$. After rotary evaporation, the product was purified by column chromatography (hexane–ethyl acetate, 6:4) or by passing through a short pad of silica gel (the crude product obtained in all cases has a purity of >90% and the purity is directly dependent on the purity of the starting triflate).

***N*-(Isopropoxymethyl)phenylacetamide (16a)** was prepared from **11a** (7.5 g, 25.25 mmol) as a crude oil (5.19 g, 99%) which on crystallization from hexane:dichloromethane (7:3) gave a solid (4.70 g, 22.75 mmol, 90%): mp 62–63 °C; ^{1}H NMR δ 1.12 (d, J = 6.1 Hz, 6H), 3.61 (s, 2H), 3.68–3.75 (m, 1H), 4.69 (d, J = 6.6 Hz, 2H), 6.26 (bs, 1H), 7.25–7.38 (m, 5H); ^{13}C NMR δ 22.3, 43.8, 68.0, 69.4, 127.3, 128.9, 129.3, 134.6, 171.5; IR ($CHCl_3$) 3314, 1666, 1540 cm^{-1}. Anal. Calcd for $C_{12}H_{17}NO_2$: C, 69.53; H, 8.26. Found: C, 69.32; H, 8.50.

***N*-(Isopropoxymethyl)-3-methylphenylacetamide (16b)** was prepared from **11b** (1.75 g) as a crude oil (1.14 g, 92%) which on flash chromatography gave a colorless solid (1.07 g, 4.87 mmol, 87%): mp 37–38 °C; ^{1}H NMR δ 1.12 (d, J = 6.4 Hz, 6H), 2.34 (s, 3H), 3.56 (s, 2H), 3.71 (septet, J = 6.0 Hz, 1H), 4.68 (d, J = 6.4 Hz, 2H), 6.10 (bs, 1H), 7.03–7.11 (m, 3H), 7.24 (dd, J = 7.2 and 7.6 Hz, 1H); ^{13}C NMR δ 21.3, 22.3, 43.7, 67.3, 69.3, 126.4, 128.0, 128.8, 130.1, 134.5, 138.6, 171.7; IR (neat) 3298, 2972, 1663, 1541 cm^{-1}. Anal. Calcd for $C_{13}H_{19}NO_2$: C, 70.55; H, 8.65. Found: C, 70.49; H, 8.60.

***N*-(Isopropoxymethyl)-3-methoxyphenylacetamide (16c)** was prepared from **11c** (1.1 g, 3.36 mmol) as a crude oil (0.79 g, 99%) which on flash chromatography gave a colorless oil (0.69 g, 2.91 mmol, 87%): ^{1}H NMR δ 1.12 (d, J = 6.0 Hz, 6H), 3.57 (s, 2H), 3.70–3.73 (m, 1H), 3.80 (s, 3H), 4.69 (d, J = 6.8 Hz, 2H), 6.03 (bs, 1H), 6.79–6.84 (m, 3H), 7.24–7.29 (m, 1H); ^{13}C NMR δ 22.3, 43.9, 55.2, 68.0, 69.50, 112.9, 115.1, 121.7, 130.0, 136.0, 160.1, 171.3; IR ($CHCl_3$) 3421, 2975, 1674, 1601 cm^{-1}.

***N*-(Isopropoxymethyl)-3-butenamide (16e)** was prepared from **11e** (1.89 g, 7.65 mmol) as a crude oil (1.2 g, 100%) which on flash chromatography gave a colorless oil (0.89 g, 5.66 mmol, 74%): ^{1}H NMR δ 1.16 (d, J = 6.1 Hz, 6H), 3.03 (d, J = 6.9 Hz, 2H), 3.74–3.80 (m, 1H), 4.74 (d, J = 6.5 Hz, 2H), 5.21–5.28 (m, 2H), 5.90–5.97 (m, 1H), 6.31 (bs, 1H); ^{13}C NMR δ 22.3, 41.6, 67.9, 69.4, 119.6, 131.1, 171.3; IR ($CHCl_3$) 3329, 2976, 1674, 1147 cm^{-1}.

***N*-(Isopropoxymethyl)benzamide (16g)**[6a] was prepared from **11g** (1.1 g, 3.88 mmol) as a crude oil (0.74 g, 98.9%) which on flash chromatography gave a colorless oil (0.638 g, 3.30 mmol, 85%).

***N*-(Isopropoxymethyl)-1-furancarboxamide (16h)** was prepared from **11h** (0.43 g, 1.57 mmol) as a crude solid (0.28 g, 97%) which on flash chromatography gave a light yellow solid (0.266 g, 1.45 mmol, 92%): mp 45–46 °C; ^{1}H NMR δ 1.20 (d, J = 6.1 Hz, 6H), 3.86 (m, 1H), 4.93 (d, J = 6.8 Hz, 2H), 6.52 (dd, J = 1.7 Hz, 1H), 7.03 (bs, 1H), 7.17 (dd, J = 3.5 and 0.7 Hz, 1H), 7.47 (dd, J = 1.7 and 0.8 Hz, 1H); ^{13}C NMR δ 22.2, 67.3, 69.3, 112.2, 115.0, 144.2, 147.4, 158.5; IR ($CHCl_3$) 3328, 2974, 1663, 1593 cm^{-1}. Anal. Calcd for $C_9H_{13}NO_2$: C, 59.00; H, 7.15. Found: C, 59.20; H, 7.28.

***N*-(Isopropoxymethyl)-1-napthamide (16i)** was prepared from **11i** (750 mg, 2.25 mmol) as a crude oil (545 mg, 100%) which on flash chromatography gave a colorless solid (440 mg, 1.80 mmol, 80%): mp 101–102 °C; ^{1}H NMR δ 1.23 (d, J = 6.0 Hz, 6H), 3.96 (septet, J = 6.0 Hz, 1H), 4.99 (d, J = 6.8 Hz, 2H), 6.62 (bs, 1H), 7.60 (d, J = 7.2 Hz, 1H), 7.48–7.55 (m, 2H), 7.42, (dd, J = 7.6 and 7.2 Hz, 1H), 7.90 (d, J = 8.4 Hz, 1H), 7.83 (dd, J = 7.2 and 1.6 Hz, 1H), 8.30 (d, J = 8.0 Hz, 1H); ^{13}C NMR δ 22.4, 68.2, 69.7, 124.5, 124.9, 125.2, 126.4, 127.1, 128.3, 130.0, 130.8, 133.6, 133.8, 169.7; IR ($CHCl_3$) 3337, 3019, 1669 cm^{-1}. Anal. Calcd for $C_{15}H_{17}NO_2$: C, 74.04; H, 7.04. Found: C, 73.86; H, 7.19.

***N*-(Isopropoxymethyl)-3-methylbutanamide (16k)** was prepared from **11k** (1.61 g, 6.12 mmol) as a crude oil (1.05 g, 99%) which on flash chromatography gave a colorless oil (0.828 g, 4.78 mmol, 78%): ^{1}H NMR δ 0.96 (d, J = 6.4 Hz, 6H), 1.16 (d, J = 6.0 Hz, 6H), 2.07 (d, J = 6.4 Hz, 2H), 2.2–2.3 (m, 1H), 3.77–3.80 (m, 1H), 4.74 (d, J = 6.7 Hz, 2H), 6.09 (bs, 1H); ^{13}C NMR δ 22.3, 22.4, 25.9, 46.0, 67.7, 69.2, 173.2; IR (neat) 3316, 2961, 2872, 1660 cm^{-1}.

***N*-(Isopropoxymethyl)-3-phenylpropanamide (16l)** was prepared from **11l** (1.92 g, 6.46 mmol) as a crude oil (1.29 g, 97%) which on flash chromatography gave a low-melting solid (1.05 g, 5.06 mmol, 78%): ^{1}H NMR δ 1.12 (d, J = 6.0 Hz, 6H), 2.51 (dd, J = 7.5, 7.8 Hz, 2H), 2.97 (dd, J = 7.5, 7.8 Hz, 2H), 3.85–3.91 (m, 1H), 4.7 (d, J = 6.5 Hz, 2H), 6.02 (bs, 1H), 7.17–7.29 (m, 5H); ^{13}C NMR δ 22.2, 31.3, 38.3, 67.7, 69.1, 126.2, 128.3, 128.5, 140.7, 172.6; IR (neat) 3312, 2971, 1661 cm^{-1}.

***N*-(Isopropoxymethyl)-2-chloroethanamide (16m)** was prepared from **11m** (2.0 g, 7.82 mmol) as a crude oil (1.1 g, 93.6%) which upon eluting through a short pad of silica gel (25 g) with (hexane–ethyl acetate, 7:3) gave a low-melting solid (0.95 g, 5.74 mmol, 73%): ^{1}H NMR δ 1.18 (d, J = 6.2 Hz, 6H), 3.74–3.80 (m, 1H), 4.08 (s, 2H), 4.80 (d, J = 6.5 Hz, 2H), 7.17 (bs, 1H); ^{13}C NMR δ 22.3, 42.5, 68.2, 69.9, 166.7; IR (neat) 3315, 2973, 1676 cm^{-1}.

***N*-(Isopropoxymethyl)-1-carbethoxyethanamide (16n)** was prepared from **11n** (2.15 g, 7.31 mmol) as a crude oil (1.4 g, 94%) which on flash chromatography gave a colorless oil (0.92 g, 4.53 mmol, 62%): ^{1}H NMR δ 1.17 (d, J = 6.2 Hz, 6H), 1.29 (t, J = 6.9 Hz, 3H), 2.07 (s, 2H), 3.75–3.81 (m, 1H), 4.20 (q, J = 6.9 Hz, 2H), 4.78 (d, J = 6.5 Hz, 2H), 7.68 (bs, 1H); ^{13}C NMR δ 22.3, 41.5, 61.6, 67.8, 69.5, 165.7, 169.0; IR (neat) 3321, 2975, 1743, 1670, 1151 cm^{-1}. A small impurity always was always present in **16n**.

***N*-(1-Isopropoxy-2-phenylethyl)phenylacetamide (17a)** was prepared from **12a** (760 mg, 1.96 mmol) as a crude oil (520 mg, 89%) which on flash chromatography gave a colorless solid (480 mg, 1.61 mmol, 82%): mp 81–82 °C; ^{1}H NMR δ 1.03 (d, J = 5.7 Hz, 6H), 2.77 (dd, J = 5.4 and 5.3 Hz, 2H), 3.50 (s, 2H), 3.7 (m, 1H), 5.47–5.52 (m, 2H), 7.06–7.38 (m, 10H); ^{13}C NMR δ 21.5, 23.2, 42.0, 43.8, 69.5, 77.9, 126.5, 127.3, 128.1, 129.0, 129.3, 129.6, 134.4, 136.0, 170.6; IR ($CHCl_3$) 3319, 3035, 2974, 1660 cm^{-1}. Anal. Calcd for $C_{19}H_{23}NO_2$: C, 76.35; H, 7.79. Found: C, 76.76; H, 7.72.

***N*-(1-Isopropoxy-2-phenylethyl)benzamide (17g)** was prepared from **12g** (740 mg, 1.98 mmol) as a crude oil (500 mg, 89%) which on flash chromatography gave a colorless solid (360 mg, 1.27 mmol, 64%): mp 110–111 °C; ^{1}H NMR δ 1.08 (d, J

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= 6.1 Hz, 3H), 1.13 (d, J = 6.3 Hz, 3H), 3.01 (d, J = 5.6 Hz, 2H), 3.84 (septet, J = 6.1 Hz, 1H), 5.73 (m, 1H), 6.34 (m, 1H), 7.26–7.48 (m, 8H), 7.68 (dd, J = 6.6 and 1.5 Hz, 2H); ^{13}C NMR δ 21.5, 23.3, 42.3, 69.7, 78.4, 126.6, 126.9, 128.2, 128.5, 129.8, 131.7, 134.0, 137.0, 166.8; IR ($CHCl_3$) 3302, 3015, 2974, 1652 cm^{-1}. Anal. Calcd for $C_{18}H_{21}NO_2$: C, 76.29; H, 7.47. Found: C, 76.43; H, 7.70.

***N*-(1-Isopropoxy-2-phenylethyl)-1-furancarboxamide (17h)** was prepared from **12h** (1.22 g, 3.37 mmol) as a crude oil (920 mg, 100%) which on flash chromatography gave a colorless solid (810 mg, 2.96 mmol, 88%): mp 70–71 °C; ^{1}H NMR δ 1.05 (d, J = 5.6 Hz, 3H), 1.11 (d, J = 5.6 Hz, 3H), 2.98 (d, J = 5.6 Hz, 2H), 3.80 (m, 1H), 5.64–5.69 (m, 1H), 6.47 (d, J = 1.2 Hz, 1H), 6.66 (d, J = 8.4 Hz, 1H), 7.10 (d, J = 3.2 Hz, 1H), 7.21–7.27 (m, 5H), 7.41 (m, 1H); ^{13}C NMR δ 21.4, 23.3, 42.4, 69.6, 77.6, 112.2, 114.9, 126.6, 128.2, 129.8, 136.3, 144.2, 147.5, 157.9; IR ($CHCl_3$) 3016, 2975, 1663, 1174 cm^{-1}. Anal. Calcd for $C_{16}H_{19}NO_3$: C, 70.30; H, 7.00. Found: C, 70.26; H, 7.20.

***N*-(1-Isopropoxy-2-phenylethyl)-3-methylbutanamide (17k)** was prepared from **12k** (1.41 g, 3.99 mmol) as a crude oil (940 mg, 90%) which on flash chromatography gave a light yellow solid (900 mg, 3.42 mmol, 86%): mp 72–73 °C; ^{1}H NMR δ 0.87 (dd, J = 6.1 and 6.8 Hz, 6H), 1.04 (d, J = 6.0 Hz, 3H), 1.11 (d, J = 6.2 Hz, 3H), 1.96–2.00 (m, 3H), 2.88 (dd, J = 5.3 and 5.7 Hz, 2H), 3.76 (dd, J = 6.1 and 6.2 Hz, 1H), 5.56 (m, 2H), 7.21–7.31 (m, 5H); ^{13}C NMR δ 21.5, 22.2, 22.3, 23.3, 25.9, 42.3, 46.1, 69.3, 77.1, 125.4, 126.56, 128.2, 128.5, 129.7, 136.4, 172.2; IR ($CHCl_3$) 3288, 2960, 1650, 1127 cm^{-1}. Anal. Calcd for $C_{16}H_{25}NO_2$: C, 72.96; H, 9.56. Found: C, 72.90; H, 9.47.

***N*-(1-Isopropoxy-2-phenylethyl)-2-phenyl-4-quinolinamide (17o)** was prepared from **12o** (1.95, 3.9 mmol) as a crude oil (1.59 g, 99%) which on flash chromatography gave a colorless solid (1.54 g, 3.75 mmol, 96%): mp 171–172 °C; ^{1}H NMR δ 1.13 (d, J = 6.9 Hz, 3H), 1.16 (d, J = 6.4 Hz, 3H), 2.91 (ddd, J = 6.0, 6.0 and 14.0 Hz, 1H), 3.10 (ddd, J = 6.0, 6.0 and 14.0 Hz, 1H), 3.93 (m, 1H), 5.75–5.79 (m, 1H), 6.38 (d, J = 9.2 Hz, 1H), 7.22–7.47 (m, 10H), 7.60 (dd, J = 8.0 and 7.6 Hz, 1H), 7.72 (d, J = 8.4 Hz, 1H), 7.94 (d, J = 6.8 Hz, 2H), 8.05 (d, J = 8.4 Hz, 1H); ^{13}C NMR δ 21.7, 23.4, 42.3, 70.1, 78.4, 116.1, 123.6, 124.7, 126.8, 127.2, 127.6, 128.5, 128.8, 129.7, 129.7, 129.9, 130.0, 136.1, 138.6, 142.4, 148.5, 156.5, 167.2; IR ($CHCl_3$) 3309, 3010, 2976, 1671 cm^{-1}. Anal. Calcd for $C_{27}H_{26}N_2O_2$: C, 78.99; H, 6.38. Found: C, 79.16; H, 6.46.

***N*-(1-Isopropoxybutyl)phenylacetamide (18a)** was prepared from **13a** (790 mg, 2.32 mmol) as a crude oil (570 mg, 98%) which on flash chromatography gave a colorless solid (514 mg, 2.06 mmol, 89%): mp 55–56 °C; ^{1}H NMR δ 0.90 (dd, J = 7.2 and 8.0 Hz, 3H), 1.06 (d, J = 6.4 Hz, 3H), 1.15 (d, J = 5.6 Hz, 3H), 1.29–1.52 (m, 4H), 3.59 (s, 2H), 3.76 (m, 1H), 5.27–5.29 (m, 1H), 5.77 (bs, 1H), 7.26–7.39 (m, 5H); ^{13}C NMR δ 13.7, 18.2, 21.6, 23.3, 38.1, 43.9, 69.1, 77.6, 127.3, 129.0, 129.3, 134.7, 170.8; IR ($CHCl_3$) 3315, 3010, 2971, 1663 cm^{-1}. Anal. Calcd for $C_{15}H_{23}NO_2$: C, 72.25; H, 9.29. Found: C, 72.14; H, 9.50.

***N*-(1-Isopropoxybutyl)-3-methoxyphenylacetamide (18c)** was prepared from **13c** (690 mg, 1.86 mmol) as a crude oil (518 mg, 100%) which on flash chromatography gave a colorless solid (425 mg, 1.52 mmol, 82%): mp 55–56 °C; ^{1}H NMR δ 0.87 (dd, J = 6.8 and 7.6 Hz, 3H), 1.04 (d, J = 6.0 Hz, 3H), 1.13 (d, J = 6.0 Hz, 3H), 1.26–1.50 (m, 4H), 3.54 (s, 2H), 3.73 (m, 1H), 3.79 (s, 3H), 5.22–5.27 (m, 1H), 5.60 (d, J = 8.4 Hz, 1H), 6.78–6.84 (m, 3H), 7.26 (dd, J = 7.6 and 8.0 Hz, 1H); ^{13}C NMR δ 13.1, 17.6, 21.1, 22.8, 37.5, 43.5, 54.6, 68.5, 77.1, 112.3, 114.4, 121.0, 129.8, 135.5, 159.5, 170.1; IR ($CHCl_3$) 3311, 3008, 1660, 1154 cm^{-1}. Anal. Calcd for $C_{16}H_{25}NO_3$: C, 68.78; H, 9.01. Found: C, 68.75; H, 8.96.

***N*-(1-Isopropoxyheptyl)phenylacetamide (19a)** was prepared from **14a** (880 mg, 2.09 mmol) as a crude oil (580 mg, 95%) which on flash chromatography gave a colorless low-melting solid (440 mg, 1.52 mmol, 72%): ^{1}H NMR δ 0.86 (dd, J = 6.7 and 6.0 Hz, 3H), 1.03 (d, J = 6.3 Hz, 3H), 1.12 (d, J = 6.0 Hz, 3H), 1.23 (bs, 8H), 1.40–1.56 (m, 2H), 3.57 (s, 2H), 3.73 (m, 1H), 5.18–5.29 (m, 1H), 5.73 (d, J = 9.4 Hz, 1H), 7.22–7.35 (m, 5H); ^{13}C NMR δ 13.4, 21.1, 21.9, 22.8, 24.2, 28.3, 31.1, 35.4, 43.4, 68.5, 77.3, 126.8, 128.4, 128.7, 134.1, 170.1; IR (neat) 3283, 2929, 2858, 1649 cm^{-1}.

Synthesis of *N*-(1-Alkoxyalkyl)-*N*-Alkyl Amides. General Procedure. To a suspension of sodium hydride (1.2 mmol of 60% dispersion in mineral oil, rinsed with hexane) in DMF (5.0 mL) was added the *N*-alkoxyalkyl amide (1.0 mmol) in DMF (25.0 mL) at rt over 10 min. After 30 min, an excess of the alkylating agent (1.2–2.5 mmol, neat) was added over a period of 5 min. The reaction was complete after 2 h of stirring at rt as judged by TLC. Ethyl acetate (75.0 mL) was added, the mixture was washed with water (3 × 50 mL) and brine (3 × 50 mL) and dried over $MgSO_4$, and the solvent was removed by rotary evaporation to give crude product. Flash column chromatography (hexanes:ethyl acetate, 4:1) gave pure products.

***N*-Isopropoxymethyl-*N*-methylbenzamide (20)** was prepared from **16g** (3.2 g, 16.58 mmol) and methyl iodide as a crude oil which on flash chromatography gave a colorless oil (2.42 g, 11.69 mmol, 71%): ^{1}H NMR δ 1.04–1.22 (m, 6H), 2.97 and 3.12 (two s, 3H), 3.51 and 3.86 (m, 1H), 4.63 and 5.03 (m, 2H), 7.38–7.48 (m, 5H); ^{13}C NMR δ 21.9, 22.4, 32.6, 35.6, 68.3, 68.6, 74.4, 78.9, 126.9, 127.2, 127.3, 128.2, 128.4, 129.9, 131.6, 134.0, 135.6, 167.7, 172.2; IR (neat) 2972, 2930, 1652 cm^{-1}. Anal. Calcd for $C_{12}H_{17}NO_2$: C, 69.53; H, 8.26. Found: C, 69.38; H, 8.16.

***N*-(Isopropoxymethyl)-*N*-2-propenylbenzamide (21)** was prepared from **16g** (500 mg, 2.59 mmol) and allyl bromide as a crude oil which on flash chromatography gave a colorless oil (580 mg, 2.47 mmol, 96%): ^{1}H NMR δ 1.07–1.22 (m, 6H), 3.50 (m, 1H), 3.94 and 4.21 (m, 2H), 4.58 (bs, 2H), 5.04–5.26 (m, 2H), 5.75 and 5.91 (m, 1H), 7.26–7.54 (m, 5H); ^{13}C NMR δ 22.0, 22.3, 46.8, 49.2, 68.8, 71.3, 76.3, 117.4, 126.5, 127.4, 128.2, 130.0, 133.1, 171.7; IR (neat) 2974, 2927, 1640 cm^{-1}.

***N*-(Isopropoxymethyl)-*N*-benzylbenzamide (22)** was prepared from **16g** (2.09 g, 10.36 mmol) and benzyl bromide as a crude oil which on flash chromatography gave a colorless oil (2.28 g, 8.05 mmol, 78%): ^{1}H NMR δ 1.03–1.22 (m, 6H), 3.46 (m, 1H), 4.53 and 4.58 (m, 2H), 4.82 and 4.99 (m, 2H), 7.25–7.56 (m, 10H); ^{13}C NMR δ 21.9, 22.4, 47.1, 50.2, 68.8, 71.2, 76.1, 127.4, 128.2, 128.4, 128.5, 130.0, 135.5, 137.3, 172.0; IR (neat) 2971, 1647 cm^{-1}.

***N*-Isopropoxy-*N*-benzyl-2-furancarboxamide (23)** was prepared from **16h** (2.0 g, 10.92 mmol) and benzyl bromide as a crude oil which on flash chromatography gave a colorless oil (2.81 g, 10.29 mmol, 94%): ^{1}H NMR δ 1.16 (d, J = 6.0 Hz, 6H), 3.67 (m, 1H), 4.82 and 4.92 (m, 4H), 6.47 (m, 1H), 7.14 (m, 1H), 7.26–7.32 (m, 5H), 7.51 (m, 1H); ^{13}C NMR δ 22.1, 48.4, 69.3, 75.4, 11.3, 116.5, 127.4, 128.3, 128.5, 137.0, 144.4, 147.1, 160.1; IR (neat) 2971, 2927, 1645 cm^{-1}.

Synthesis of *N*-(3-Butenyl) Secondary Amides from *N*-(Isopropoxymethyl) Secondary Amides General Procedure D: Using Shono's[1c] procedure, a trapping reagent (allyltrimethylsilane, cyclohexene, or isopropenyl acetate) was added to a solution of an *N*-isopropoxymethylamide (1.0 mmol) in CH_2Cl_2 (5.0 mL) at −78 °C followed by addition of $TiCl_4$ or BF_3·Et_2O. The mixture was allowed to warm to room temperature and stirred overnight. It was then added to a 2:1 mixture of brine and CH_2Cl_2 and stirred at room temperature for 10 min. The organic layer was separated and the aqueous layer was extracted once with CH_2Cl_2. The combined organic extracts were dried over $MgSO_4$. After rotary evaporation the product was purified by flash chromatography (hexanes:ethyl acetate, 1:1) or Kugelrohr (0.5 mm) distillation.

General Procedure E: To a solution of an *N*-isopropoxyalkylamide (1 mmol) in anhydrous formic acid (2.5 mL) was added allyltrimethysilane (2 mmol) at rt. After being heated at 50 °C for 8–10 h, the reaction mixture was concentrated in vacuo, dissolved in ethyl acetate (10 mL), washed with 10% sodium bicarbonate (2 × 10 mL), water (10 mL), and brine (10 mL), and dried ($MgSO_4$). Rotary evaporation gave crude products which were puified by flash chromatography (hexanes: ethyl acetate, 1:1).

***N*-(3-Oxo-1-butyl)phenylacetamide (24)** was prepared from **16a** (500 mg, 2.41 mmol), isopropenyl acetate (2.0 equiv), and BF_3-etherate (1.8 equiv) as white crystals (252 mg, 1.22 mmol, 51%) after flash chromatography: mp 75–76 °C; ^{1}H NMR

δ 2.09 (s, 3H), 2.63 (dist t, J = 6.0, 5.2 Hz, 2H), 3.41 (dd, J = 6.0 and 5.6 Hz, 2H), 3.50 (s, 2H), 6.07 (bs, 1H), 7.21–7.35 (m, 5H); ^{13}C NMR δ 30.0, 34.2, 42.7, 43.6, 127.2, 128.8, 129.2, 134.8, 171.0, 208.1; IR ($CHCl_3$) 3314, 1713, 1650 cm^{-1}.

1-Phenyl-5,6-dihydro-4*H*-1,3-oxazine (25)[22] was prepared from **16g** (640 mg, 3.31 mmol), cyclohexene (1.5 equiv), and $TiCl_4$ (1.5 equiv) as a crude oil (550 mg, 77%) which on Kugelrohr distillation (bath temperature 140–145 °C/0.5 mm) gave a colorless oil (400 mg, 1.86 mmol, 56%): ^{1}H NMR δ 1.33–2.08 (m, 9H), 3.38–3.69 (m, 2H), 4.40–4.41 (bs, 1H), 7.25–7.41 (m, 3H), 7.93–7.95 m, 2H); ^{13}C NMR δ 20.3, 24.4, 25.3, 30.4, 32.0, 48.7, 73.0, 126.9, 127.9, 130.3, 155.5; IR (neat) 2931, 2856, 1655 cm^{-1}.

***N*-(3-Butenyl)-3-methylbutanamide (15k)** (described above) was prepared from **16k** (535 mg, 3.09 mmol), allyltrimethylsilane (3.0 equiv), and BF_3 etherate (3.0 equiv) as a crude oil (470 mg, 98%) which on distillation (bath temperature 90–95 °C/0.5 mm) gave a colorless oil (275 mg, 1.77 mmol, 57%).

***N*-(3-Butenyl)-2-carbethoxyethanamide (26)** was prepared from **16n** (400 mg, 1.96 mmol), allyltrimethylsilane (10.0 equiv), and $TiCl_4$ (1.5 equiv) as a crude oil (360 mg, 99%) which on Kugelrohr distillation (bath temperature 122–126 °C/0.5 mm) gave a colorless oil (255 mg, 1.37 mmol, 70%): ^{1}H NMR δ 1.29 (t, J = 7.2 Hz, 3H), 2.29 (m, 2H), 3.30 (s, 2H), 3.37 (m, 2H), 4,19 (dd, J = 6.9 and 7.0 Hz, 2H), 5.12 (m, 2H), 5.65–5.85 (m, 1H), 7.21 (bs, 1H); ^{13}C NMR δ 14.0, 33.5, 38.7, 41.4, 61.4, 117.1, 135.1, 165.1, 169.3; IR (neat) 3301, 3080, 2981, 2938, 1742, 1654 cm^{-1}.

***N*-(4-(5-Phenyl-1-pentenyl))-2-phenylethanamide (27a)** was prepared from **17a** (1.18 g, 3.97 mmol) as a colorless solid (860 mg, 3.08 mmol, 78%, procedure E) after crystallization (hexane:dichloromethane, 8:2): mp 94–95 °C; ^{1}H NMR δ 2.00–2.26 (m, 2H), 2.69 (d, J = 6.4 Hz, 2H), 3.50 (s, 2H), 4.23 (ddd, J = 6.4, 7.2 and 6.9 Hz, 1H), 4.89–5.12 (m, 2H), 5.14–5.20 (m, 1H), 5.62–5.76 (m, 1H), 7.00–7.43 (m, 10H); ^{13}C NMR δ 37.9, 39.7, 43.8, 49.5, 117.9, 126.3, 127.2, 128.3, 128.8, 129.3, 129.4, 134.1, 134.8, 137.6, 170.2. Anal. Calcd for $C_{19}H_{21}NO$: C, 81.68; H, 7.57. Found: C, 81.78; H, 7.44.

***N*-(4-(5-Phenyl-1-pentenyl))benzamide (27g)** was prepared from **17g** (900 mg, 3.18 mmol) as a crude solid (800 mg, 95%) which on flash chromatography gave a colorless solid (530 mg, 2.00 mmol, 63%, procedure E): mp 99–100 °C; ^{1}H NMR δ 2.25 (ddd, J = 7.0, 7.0 and 13.7 Hz, 1H), 2.37 (ddd, J = 7.6, 5.5 and 13.2 Hz, 1H), 2.88–2.96 (m, 2H), 4.45 (dd, J = 6.4 and 6.7 Hz, 1H), 5.12 (d, J = 13.1 Hz, 2H), 5.81–5.87 (m, 1H), 5.97 (d, J = 6.1 Hz, 1H), 7.21–7.46 (m, 9H), 7.66 (d, J = 7.3 Hz, 1H); ^{13}C NMR δ 37.8, 39.9, 50.0, 118.0, 126.3, 126.4, 126.8, 128.4, 129.4, 131.2, 134.4, 137.8, 167.0; IR ($CHCl_3$) 3301, 3017, 1642 cm^{-1}. Anal. Calcd for $C_{18}H_{19}NO$: C, 81.47; H, 7.21. Found: C, 81.61; H, 7.24.

***N*-(4-(5-Phenyl-1-pentenyl))-3-methylbutanamide (27k)** was prepared from **17k** (1.1 g, 4.18 mmol) after flash chromatography as a colorless solid (750 mg, 3.06 mmol, 73%, procedure E): mp 53–54 °C; ^{1}H NMR δ 0.87 (dd, J = 5.0 and 6.0 Hz, 6H), 1.99–2.36 (m, 5H), 2.79 (d, J = 6.9 Hz, 2H), 4.30 (ddd, J = 7.1, 6.9 and 6.7 Hz, 1H), 5.00–5.12 (m, 2H), 5.26 (m, 1H), 5.69–5.90 (m, 1H), 7.17 (m, 5H); ^{13}C NMR δ 22.3, 26.0, 38.1, 40.1, 46.2, 49.3, 117.8, 126.3, 128.3, 129.3, 131.4, 137.9, 171.9; IR ($CHCl_3$) 3298, 3077, 1652 cm^{-1}. Anal. Calcd for $C_{16}H_{23}NO$: C, 78.32; H, 9.44. Found: C, 78.46; H, 9.48.

***N*-(4-(1-Heptenyl))-2-phenylethanamide (28a)** was prepared from **18a** (1.0 g, 4.01 mmol) as a crude solid (900 mg, 97%) which on flash chromatography gave a colorless solid (830 mg, 3.59 mmol, 90%, procedure E): mp 73–74 °C; ^{1}H NMR δ 0.86 (dd, J = 7.2 and 6.8 Hz, 3H), 1.24–1.39 (m, 4H), 2.07 (dt, J = 6.8 and 7.2 Hz, 1H), 2.17 (dt, J = 6.0 and 6.8 Hz, 1H), 3.54 (s, 2H), 3.97 (dd, J = 6.0 and 5.6 Hz, 1H), 4.88–4.98 (m, 2H), 5.19 (d, J = 6.0 Hz, 1H), 5.58 (m, 1H), 7.23 (d, J = 6.8 Hz, 2H), 7.29 (d, J = 7.2 Hz, 1H), 7.34 (dd, J = 7.2 and 7.1 Hz, 2H); ^{13}C NMR δ 12.8, 17.9, 35.2, 33.9, 42.8, 47.2, 116.5, 126.0, 127.7, 128.2, 133.0, 134.0, 169.3; IR ($CHCl_3$) 3313, 3017, 2959, 1655 cm^{-1}. Anal. Calcd for $C_{15}H_{21}NO$: C, 77.87; H, 9.15. Found: C, 78.00; H, 9.11.

***N*-(4-(1-Heptenyl))-2-(3-methoxyphenyl)ethanamide (28c)** was prepared from **18c** (660 mg, 2.36 mmol) as a crude solid (590 mg, 96%) which on flash chromatography gave a colorless solid (480 mg, 1.83 mmol, 78%, procedure E): mp 55–56 °C; ^{1}H NMR δ 0.86 (t, J = 6.5 Hz, 3H), 1.21–1.37 (m, 4H), 2.05–2.18 (m, 2H), 3.52 (s, 2H), 3.80 (s, 3H), 3.98 (m, 1H), 4.89–4.99 (m, 2H), 5.21 (bs, 1H), 5.60–5.70 (m, 1H), 6.77–6.83 (m, 3H), 7.25 (dd, J = 7.6 Hz, 1H); ^{13}C NMR δ 13.3, 18.5, 35.8, 38.4, 43.4, 47.7, 54.6, 112.2, 114.3, 117.1, 121.1, 129.3, 133.6, 136.0, 159.4, 169.0; IR ($CHCl_3$) 3312, 2968, 1654, 1152 cm^{-1}. Anal. Calcd for $C_{16}H_{23}NO_2$: C, 73.52; H, 8.87. Found: C, 73.57; H, 8.81.

***N*-(4-(1-Butenyl))-*N*-benzyl-2-furancarboxamide (29)** was prepared from **23** (600 mg, 2.19 mmol), allyltrimethylsilane (1.8 equiv), and $TiCl_4$ (1.8 equiv) as a crude oil (530 mg, 95%) which on flash chromatography gave a colorless oil (510 mg, 2.01 mmol, 91%, procedure D): ^{1}H NMR δ 2.39 (dd, J = 7.2 Hz, 2H), 3.54 (m, 2H), 4.81 (m, 2H), 5.01–5.09 (m, 2H), 5.76 (m, 1H), 6.45 (m, 1H), 6.98 (m, 1H), 7.24–7.35 (m, 5H), 7.45 (m, 1H); ^{13}C NMR δ 31.6, 33.3, 46.1, 46.6, 49.5, 51.8, 111.3, 116.1, 116.9, 126.9, 127.4, 128.0, 128.6, 137.1, 143.8, 160.2; IR (neat) 3064, 2977, 1623, 1176 cm^{-1}.

***N*-(4-(1-Butenyl))-*N*-(3-(1-propenyl))benzamide (30)** was prepared from **21** (700 mg, 3.0 mmol), allyltrimethylsilane (1.8 equiv), and $TiCl_4$ (1.8 equiv) as a crude oil (595 mg, 92%) which on flash chromatography gave a colorless oil (550 mg, 2.55 mmol, 85%, procedure D): ^{1}H NMR δ 2.25 and 2.43 (m, 2H), 3.28 and 3.56 (m, 2H), 3.84 and 4.17 (m, 2H), 5.00–5.23 (m, 4H), 5.53–5.80 (m, 2H), 7.38 (s, 5H); ^{13}C NMR δ 31.8, 32.8, 44.0, 47.1, 47.8, 51.8, 116.7, 117.3, 126.4, 128.3, 129.3, 133.4, 134.1, 135.4, 136.6, 171.7; IR (neat) 3082, 2931, 1626 cm^{-1}.

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Supplementary Material Available: Copies of ^{13}C NMR spectra of compounds **7i,k,n, 9a,c, 10a, 15d–g,k, 16c,e,k–m, 19a, 21–24, 26, 29**, and **30** (24 pages). This material is contained in libraries on microfiche, immediately follows this article in the microfilm version of the journal, and can be ordered from the ACS; see any current masthead page for ordering information.

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