Synthesis of (*E*)-α,β-Unsaturated Amides with High Selectivity by Using Samarium Diiodide

José M. Concellón,* Juan A. Pérez-Andrés, and Humberto Rodríguez-Solla[a]

Abstract: Stereoselective β-elimination of 2-chloro-3-hydroxyamides **1** is achieved by using samarium diiodide to yield α,β-unsaturated amides **2**, in which the C=C bond is di- tri-, or tetrasubstituted. The starting compounds **1** are easily prepared by reaction of the corresponding lithium enolates of α-chloroamides with aldehydes or ketones at $-78\,^{\circ}C$. The influence of the reaction conditions and the structure of the starting compounds on the stereoselectivity of the β-elimination reaction is also discussed.

Keywords: alkenes · amides · diastereoselection · elimination · samarium

Introduction

α,β-Unsaturated amides belong to an important class of natural products which show both biological[1] and insecticide activities.[2] Moreover α,β-unsaturated amides are useful building blocks in organic synthesis[3] and are attractive starting materials for many natural products.[4]

However, compared with the synthesis of other α,β-unsaturated acid derivatives such as esters, the preparation of α,β-unsaturated amides has been scarcely reported, and the development of effective general methods for the synthesis of α,β-unsaturated amides is of significant value. Previously described preparations of α,β-unsaturated amides are generally achieved by C=C bond formation by a Wittig–Horner[5] or by Peterson[6] reactions, from acetylenic compounds[4, 7] or by using 2,2-difluorovinyllithium.[8] Nevertheless, in most of these syntheses the total control of stereoselectivity of the carbon–carbon double bond formation remains unsolved or typically involves multistep transformations.[4, 5] Other methodologies are limited by their poor yield,[7] and in other syntheses, α,β-unsaturated amides, in which the C=C bond is tri- or tetrasubstituted, cannot be prepared.[6–8]

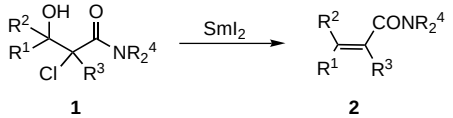
Recently, we described the first general methodology to promote stereoselective β-elimination reactions using SmI_2. We reported a synthesis of (*Z*)-vinyl halides with high stereoselectivity by reaction of *O*-acetylated 1,1-dihaloalkan-2-ols with samarium diiodide[9] and the preparation of α,β-unsaturated esters with total stereoselectivity by treatment of the easily available 2-halo-3-hydroxyesters with samarium diiodide.[10] In the latter we also described the preparation of three disubstituted α,β-unsaturated amides with total stereoselectivity, starting from 2-halo-3-hydroxyamides and samarium diiodide.

Taking into account the interest in the α,β-unsaturated amides, our objective has been to generalize the synthesis of di-, tri-, and tetrasubstituted α,β-unsaturated amides. This preparation is very stereoselective. We also describe the influence of the reaction conditions and the structure of **1** on the stereoselectivity of the β-elimination reaction.

Results and Discussion

Synthesis of disubstituted α,β-unsaturated amides: Our first attempts involved the preparation of α,β-unsaturated amides in which the C=C bond is disubstituted.

Treatment of 2-chloro-3-hydroxyamides **1a–c** with a solution of SmI_2 (2.5 equiv) in THF for 30 min at room temperature afforded the corresponding disubstituted α,β-unsaturated amides **2**, after hydrolysis, with total stereoselectivity and in high yield. This β-elimination reaction was general for disubstituted α,β-unsaturated amides **2** (Scheme 1): linear or branched aliphatic, and aromatic α,β-unsaturated amides can be achieved (Table 1). The described conditions and stereo-



1 **2**

Scheme 1. Synthesis of (*E*)-α,β-unsaturated amides.

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Table 1. Synthesis of disubstituted α,β-unsaturated amides **2** ($R^2 = R^3 = H$).

Entry	**2**[a]	R^1	R^4	T [°C]	*de*[b]	Yield [%][c]
1	**2a**	Ph	Et	25	>98	90
2	**2b**	C_7H_{15}	Et	25	>98	89
3	**2c**	MeCH(Ph)	Et	25	>98	82

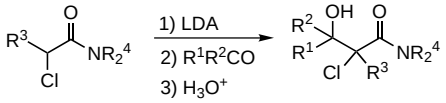
[a] All reactions were carried out by using 2.5 equivalents of SmI_2 with a reaction time of 30 min. [b] Diastereoisomeric excess (*de*) determined by GC-MS and 300 MHz ^1H and ^{13}C NMR analysis of the crude products **2**. [c] Yield of isolated product after column chromatography (based on compound **1**).

selectivity of the reaction were the same as in the synthesis of α,β-unsaturated esters.[10]

The diastereoisomeric excess of the crude reaction products was determined by GC-MS and ^1H NMR spectroscopy.

The *E* stereochemistry of the C–C double bond of α,β-unsaturated amides **2** was assigned on the basis of the value of the ^1H NMR coupling constant of the olefinic protons of compounds **2a**–**2c**.[11] In the case of compound **2a** comparison with the ^1H values described in the bibliography has also been carried out.[12] This stereochemistry is in agreement with the previously reported synthesis of α,β-unsaturated esters with SmI_2.[10]

The starting 2-chloro-3-hydroxyamides **1** used to prepare di-, tri-, and tetra-substituted α,β-unsaturated amides were easily prepared by reaction of the corresponding lithium enolates of α-chloroamides **4**[13] (generated by treatment of α-chloroamides **3** with lithium diisopropylamide (LDA) at $-85\,^\circ C$) with aldehydes or ketones at $-78\,^\circ C$ (Scheme 2).



3 **1**

Scheme 2. Preparation of starting compounds **1**.

Preparation of trisubstituted α,β-unsaturated amides: Significant differences were detected when the same reaction conditions (2.5 equiv of SmI_2 at room temperature) were used to obtain trisubstituted α,β-unsaturated amides **2d**–**k**; a decrease in the reactivity of the starting compounds **1d**–**k** and lower stereoselectivity of the β-elimination reaction were observed (determined on the crude reaction products by GC-MS). Therefore, the elimination was uncompleted and, consequently, different amounts of starting compound **1** were recovered (Table 2, entries 2 and 7). Increasing the reaction temperature (Table 2, entry 1) or the amount of SmI_2 (4 equiv, Table 2, entries 3 and 11), led to complete reaction, but with the same stereoselectivity. The decrease of reactivity of **1d**–**k** with respect to **1a**–**c** could be owing to the increase of the steric hindrance when $R^3 \neq H$.

Table 2. Synthesis of trisubstituted α,β-unsaturated amides **2** ($R^2 = H$).

Entry	**2**	R^1	R^3	R^4	T [°C][a]	*de*[b]	Yield [%][c]
1	**2d**	Ph	Me	Et	66[d]	87	98[e]
2	**2d**	Ph	Me	Et	25[d]	89	51[e]
3	**2d**	Ph	Me	Et	25[f]	93	97[e]
4	**2d**	Ph	Me	Et	–25	>98	88
5	**2e**	Ph	Me	*i*Pr	–25	91	63
6	**2f**	C_7H_{15}	Me	Et	–25[g]	>98	81
7	**2g**	*p*MeO-C_6H_4	Me	*i*Pr	25[d]	83	86[e]
8	**2g**	*p*MeO-C_6H_4	Me	*i*Pr	–25	93	75
9	**2h**	*p*Cl-C_6H_4	Me	*i*Pr	–25	90	65
10	**2i**	Cyclohexyl	Me	Et	–25	>98	95
11	**2j**	$Me_2C{=}CH(CH_2)_2CH(Me)CH_2$	Me	Et	25[f]	65	78[e]
12	**2j**	$Me_2C{=}CH(CH_2)_2CH(Me)CH_2$	Me	Et	0[g]	80	70[e]
13	**2j**	$Me_2C{=}CH(CH_2)_2CH(Me)CH_2$	Me	Et	–25[g]	>95	76
14	**2k**	Bu	Et	Et	–25[g]	>98	79

[a] Unless otherwise noted, reactions were carried out with four equivalents of SmI_2 with a reaction time of 12 h. [b] Diastereoisomeric excess (*de*) determined by GC-MS and 300 MHz ^1H and ^{13}C NMR analysis of the crude products **2**. [c] Yield of isolated product after column chromatography (based on compound **1**). [d] 2.5 equivalents of SmI_2 were used with a reaction time of 30 min. [e] Yield of the crude products isolated (based on compound **1**). [f] Four equivalents of SmI_2 were used with a reaction time of 1 h. [g] Four equivalents of SmI_2 were used with a reaction time of 90 min.

To enhance the stereoselectivity, the β-elimination reaction was carried out at lower temperature. Therefore, total or very high stereoselectivity (*de* > 90%) was obtained at $-25\,^\circ C$, a longer time reaction (12 h) and larger amount of SmI_2 (4 equiv) being necessary at this temperature.

The presence of SmI_2 during the hydrolysis of the reaction afforded the partial reduction of the C–C double bond. To avoid this problem the excess SmI_2 was transformed into Sm^{III} by bubbling a stream of air through the reaction mixture before the hydrolysis.

This methodology for obtaining trisubstituted α,β-unsaturated amides, with high diastereoselection, is general: R^1, R^3, and R^4 can be varied widely. Thus, aliphatic (linear, branched or cyclic), unsaturated or aromatic aldehydes could be used to introduce different R^1 groups; R^3 and R^4 could also be changed using different aliphatic α-chloroamides to prepare the starting compounds **1** (Scheme 2) and subsequently to obtain **2**. The stereoselectivity was only slightly affected to changes of R^1, R^3 or R^4. It is noteworthy that only a slight decrease of the stereoselectivity was observed with amides with bulky substituents on nitrogen (Table 2, entries 5, 8, and 9). The reaction also showed tolerance to other functional groups (Table 2, entries 8, 9, and 13).

The *E* stereochemistry in the C–C double bond of trisubstituted α,β-unsaturated amides **2** was assigned by NOESY experiments (compounds **2d** and **2f**).

Abstract in Spanish: *La reacción de β-eliminación de 2-cloro-3-hidroxiamidas **1**, promovida por diyoduro de samario, produce amidas α,β-insaturadas con elevada estereoselección. Los compuestos de partida **1** empleados se preparan fácilmente por reacción, a −78 °C, de enolatos de litio derivados de α-cloroamidas con aldehídos o cetonas. También se estudia la influencia de las condiciones de reacción y de la estructura de los compuestos de partida en la estereoselección con que transcurre la reacción de β-eliminación.*

Synthesis of tetrasubstituted α,β-unsaturated amides: In contrast with the previously described[10] synthesis of esters,[14] tetrasubstituted α,β-unsaturated amides **2l–s** were obtained. The reaction conditions were the same as those described for the preparation of trisubstituted α,β-unsaturated amides **2d–2k**. Our first trials were carried out to test the possibility of carrying out the synthesis of α,β-unsaturated amides when the C=C bond is tetrasubstituted.

Treatment of amides **1**, obtained by reaction of symmetrical ketones (pentan-3-one and cyclohexanone) and 2-chloro-*N,N*-diethylpropanamide, with samarium diiodide (4 equiv) at $-25\,^{\circ}C$ afforded the corresponding α,β-unsaturated amides in high yield (Table 3, entries 1 and 2).

Table 3. Synthesis of tetrasubstituted α,β-unsaturated amides **2** ($R^3 = Me$ and $R^4 = Et$).

Entry	2	R^1	R^2	t [h]	T [°C][a]	*de*[b]	Yield [%][c]
1	**2l**	Et	Et	1	25	–	70
2	**2m**	$(CH_2)_5$		1	25	–	80
3	**2n**	Et	Me	2.5	–25	42	70
4	**2n**	Et	Me	12	–50[d]	50	41[e]
5	**2n**	Et	Me	72	–78[d]	60	36[e]
6	**2o**	*n*Pr	Me	2.5	–25	40	73
7	**2o**	*n*Pr	Me	72	–78[d]	46	46[e]
8	**2p**	C_5H_{11}	Me	2.5	–25	44	70
9	**2q**	Ph	Me	2.5	–25	78	71
10	**2r**	Ph	Et	2.5	–25	91	75
11	**2s**	$PhCH_2$	Me	2.5	–25	94	96

[a] Unless otherwise noted, reactions were carried out with four equivalents of SmI_2. [b] Diastereoisomeric excess (*de*) determined by GC-MS and 300 MHz ^1H and ^{13}C NMR analysis of the crude products **2**. [c] Yield of isolated product after column chromatography (based on compound **1**). [d] Five equivalents of SmI_2 were used. [e] Approximately 50% of starting product was recovered.

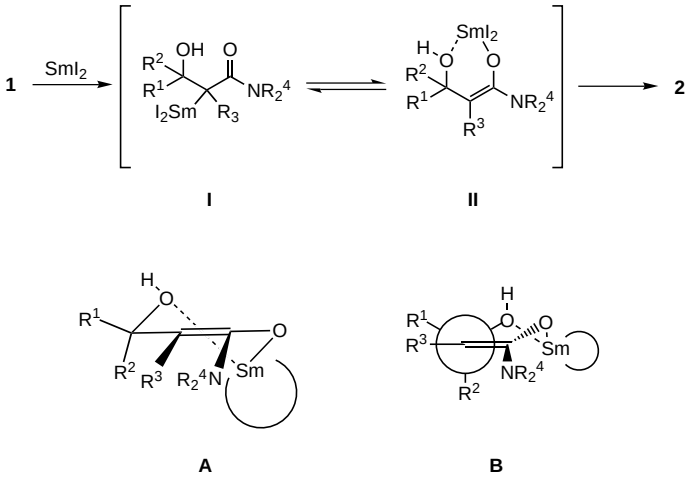
The stereoselection in the synthesis of tetrasubstituted α,β-unsaturated amides (determined on the crude reaction products by GC-MS) was studied by using the amides **1**, obtained from unsymmetrical ketones and 2-chloro-*N,N*-diethylpropanamide, as starting compounds.

At $-25\,^{\circ}C$ the stereoselection of the elimination reaction was lower when R^1 and R^2 were alkyl groups and the stereoselectivity was not affected by the difference of size between R^1 and R^2. The usual stereoselectivity/temperature trend was observed: on decreasing the temperature (-50 or $-78\,^{\circ}C$), a higher *de* value was observed,[15] but significant amounts of starting compound **1** (50%) were recovered (Table 3, entries 4, 5, and 7), even using long reactions times (3 days). When R^1 was phenyl or benzyl, high stereoselection ($de > 78\%$) was obtained. The described preparation is general and aliphatic or aromatic α,β-unsaturated amides in which the C–C double bond is tetrasubstituted can be prepared in high yield and with moderate to high stereoselectivity (Table 3).

The *E* stereochemistry of the C–C double bond of tetrasubstituted α,β-unsaturated amides **2** was assigned by NOESY experiments (compound **2r**).

It is noteworthy that although 1:1 mixtures of diastereoisomers of starting compounds **1** were used in all the reactions described, the corresponding di-, tri- or tetrasubstituted α,β-unsaturated amides **2** were obtained with high stereoselectivity.

Mechanism: The observed stereochemistry of products **2** may be explained by assuming the formation of the enolate intermediate (Scheme 3), in which the oxophilic Sm^{III} center



Scheme 3. Proposed mechanism of the β-elimination reaction.

is chelated with the oxygen atom of the alcohol group producing a six-membered ring.[16] We surmise that the chairlike transition state model **A** might be involved with the bulkier group R^1 (comparatively to R^2) in the equatorial orientation (to avoid 1,3-diaxial interactions). As depicted in **B** (C2–C3 Newman projection of **A**), R^1 and R^3 show a *cis* relationship and, consequently, elimination from **A** affords (*E*)-α,β-unsaturated amides.

Synthesis of **2**, with total stereoselection, from a mixture of diastereoisomer of **1** could be explained by assuming that after reaction of **1** with SmI_2, the C–R^3 center suffers epimerization affording only a diastereoisomer with the appropriate conformation for coordination of the samarium center with the alcohol oxygen.

Conclusion

Herein we have presented an easy, simple and general methodology for the preparation of di-, tri-, or tetrasubstituted α,β-unsaturated amides starting from 2-chloro-3-hydroxyamides and promoted by samarium diiodide. The elimination reaction proceeds with total or high *E* diastereoselectivity. The starting compounds are easily available. A mechanism to explain the high stereoselectivity has been proposed based on the chelation of the Sm^{III} center with both oxygen atoms.

Experimental Section

General: Reactions which required an inert atmosphere were conducted under dry nitrogen, and the glassware was oven dried (120 °C). THF was

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distilled from sodium/benzophenone ketyl immediately prior to use. All reagents were purchased from Aldrich or Merck and were used without further purification. Samarium diiodide was prepared by reaction of CH_2I_2 with samarium powder.[17] 2-Chloroamides **3** were prepared by treatment of different 2-chloroacid chlorides with amines and, in turn, 2-chloroacid chlorides were obtained according to literature methods from the corresponding carboxylic acids.[18] Silica gel for flash chromatography was purchased from Merck (230–400 mesh), and compounds were visualized on analytical thin layer chromatograms (TLC) by UV light (254 nm). ^{1}H NMR spectra were recorded at 200 or 300 MHz. ^{13}C NMR spectra and DEPT experiments were determined at 50 or 75 MHz. Chemical shifts are given in ppm relative to tetramethylsilane (TMS), which is used as an internal standard, and coupling constants *J* are reported in Hz. The diastereoisomeric excesses were obtained from ^{1}H NMR analysis and GC-MS of crude products. GC-MS (HP-5973) and HRMS (finnigan mat-MAT 95) were measured at 70 eV. Only the most important IR absorptions (cm^{-1}) and the molecular ions and/or base peaks in MS are given.

Synthesis of 2-chloro-3-hydroxyamides (1): To a stirred solution of the corresponding 2-chloroamide **3** (9 mmol) at −85 °C in dry THF (4 mL) was added dropwise lithium diisopropylamide [prepared from MeLi (6.4 mL of 1.5 M solution in diethyl ether, 10 mmol) and diisopropylamine (1.4 mL, 10 mmol) in THF (50 mL)at 0 °C]. After the mixture had been stirred for 10 min, a solution of the corresponding carbonyl compound (4.5 mmol) in dry THF (4.5 mL) was added dropwise at −78 °C. The reaction mixture was stirred for 1 h, then the reaction was quenched with an aqueous saturated solution of NH_4Cl (5 mL). Usual workup provided crude 2-chloro-3-hydroxyamides **3**, which were purified by column flash chromatography over silica gel (10:1 hexane/ethyl acetate) to provide pure compounds **1**.

2-Chloro-*N,N*-diethyl-3-hydroxy-3-phenylpropanamide (1a): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.49-7.27$ (m, 10H), 5.26–5.10 (m, 2H), 4.91 (br s, 1H), 4.70 (br s, 1H), 4.46 (d, $J = 4.1$ Hz, 1H), 4.42 (d, $J = 6.2$ Hz, 1H), 3.48–3.11 (m, 8H), 1.17–1.05 (m, 12H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta =$ 167.7 (C), 167.5 (C), 139.4 (C), 138.7 (C), 129.2 (CH), 128.5 (CH), 127.8 (CH), 127.7 (CH), 126.4 (CH), 75.2 (CH), 73.5 (CH), 57.9 (CH), 54.1 (CH), 41.9 (CH_2), 40.5 (CH_2), 40.4 (CH_2), 13.8 (CH_3), 12.0 (CH_3), 11.9 (CH_3); IR (neat): $\tilde{\nu} = 3400$, 1633 cm^{-1}; elemental analysis calcd (%) for $C_{13}H_{18}ClNO_2$: C 61.05, H 7.09, N 5.48; found: C 60.92, H 7.12, N 5.51; $R_f = 0.2$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-3-hydroxydecanamide (1b): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 4.73$ (br s, 2H), 4.23–3.90 (m, 4H), 3.50–3.16 (m, 8H), 1.85–0.90 (m, 36H), 0.76–0.74 (m, 6H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 168.7$ (C), 167.8 (C), 72.4 (CH), 71.0 (CH), 55.8 (CH), 54.2 (CH), 42.1 (CH_2), 41.9 (CH_2), 40.4 (CH_2), 40.3 (CH_2), 32.9 (CH_2), 32.7 (CH_2), 31.5 (CH_2), 29.1 (CH_2), 28.9 (CH_2), 25.2 (CH_2), 22.3 (CH_2), 14.3 (CH_3), 14.2 (CH_3), 13.8 (CH_3), 12.2 (CH_3), 12.1 (CH_3); IR (neat): $\tilde{\nu} = 3330$, 1615 cm^{-1}; elemental analysis calcd (%) for $C_{14}H_{28}ClNO_2$: C 60.52, H 10.16, N 5.04; found: C 60.44, H 10.20, N 5.12; $R_f = 0.4$, 0.2 (two diastereoisomers) (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-4-phenylpentanamide (1c): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.56-7.05$ (m, 10H), 4.15–3.86 (m, 4H), 3.57–2.65 (m, 12H), 1.65–0.55 (m, 18H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta =$ 169.2 (C), 168.3 (C), 143.4 (C), 142.6 (C), 128.5 (CH), 128.4 (CH), 128.3 (CH), 128.2 (CH), 128.0 (CH), 127.9 (CH), 127.7 (CH), 127.1 (CH), 127.0 (CH), 126.9 (CH), 126.7 (CH), 78.3 (CH), 75.7 (CH), 75.3 (CH), 55.1 (CH), 52.5 (CH), 51.4 (CH), 43.8 (CH), 43.0 (CH), 41.4 (CH_2), 41.0 (CH_2), 40.4 (CH_2), 40.2 (CH_2), 18.5 (CH_3), 18.3 (CH_3), 17.5 (CH_3), 13.6 (CH_3), 13.3 (CH_3), 12.0 (CH_3); IR (neat): $\tilde{\nu} = 3450$, 1620 cm^{-1}; elemental analysis calcd (%) for $C_{15}H_{22}ClNO_2$: C 63.48, H 7.81, N 4.94; found: C 63.39, H 7.96, N 5.01; $R_f = 0.5$, 0.4 (two diastereoisomers) (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2-methyl-3-phenylpropanamide (1d): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.50-7.26$ (m, 10H), 5.25 (d, $J = 3.0$ Hz, 1H), 5.16 (d, $J = 3.0$ Hz, 1H), 3.67–3.19 (m, 10H), 1.64 (s, 6H), 1.43–1.08 (m, 12H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.9$ (C), 170.1 (C), 137.4 (C), 129.4 (CH), 129.0 (CH), 127.8 (CH), 127.6 (CH), 127.2 (CH), 127.0 (CH), 78.6 (CH), 78.4 (CH), 67.8 (C), 42.8 (CH_2), 41.8 (CH_2), 40.5 (CH_2), 20.9 (CH_3), 19.9 (CH_3), 13.4 (CH_3), 12.3 (CH_3), 12.0 (CH_3); IR (neat): $\tilde{\nu} = 3317$, 1604 cm^{-1}; elemental analysis calcd (%) for $C_{14}H_{20}ClNO_2$: C 62.63, H 7.47, N 5.19; found: C 62.47, H 7.49, N 5.14; $R_f = 0.2$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diisopropyl-3-hydroxy-2-methyl-3-phenylpropanamide (1e): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.52-7.27$ (m, 10H), 5.25 (s, 2H), 4.81–4.69 (m, 2H), 3.49–3.35 (m, 4H), 1.72 (s, 6H), 1.63–1.18 (m, 24H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.4$ (C), 167.2 (C), 137.6 (C), 129.6 (CH), 129.3 (CH), 127.5 (CH), 127.2 (CH), 127.0 (CH), 78.5 (CH), 68.2 (C), 50.9 (CH), 49.1 (CH), 47.4 (CH), 46.0 (CH), 20.9 (CH_3), 20.3 (CH_3), 20.2 (CH_3), 19.9 (CH_3), 19.8 (CH_3), 19.7 (CH_3), 19.6 (CH_3), 19.2 (CH_3), 18.7 (CH_3); IR (neat): $\tilde{\nu} = 3410$, 1650 cm^{-1}; elemental analysis calcd (%) for $C_{16}H_{24}ClNO_2$: C 64.53, H 8.12, N 4.70; found: C 64.44, H 8.22, N 4.86; $R_f = 0.4$, 0.3 (two diastereoisomers) (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2-methyldecanamide (1f): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 4.05-4.00$ (m, 1H), 3.85–3.80 (m, 1H), 3.72–3.30 (m, 10H), 1.76 (s, 3H), 1.73 (s, 3H), 1.65–1.01 (m, 30H), 0.96–0.81 (m, 12H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.8$ (C), 170.0 (C), 77.9 (CH), 76.7 (CH), 71.9 (C), 69.1 (C), 42.6 (CH_2), 41.3 (CH_2), 31.6 (CH_2), 31.0 (CH_2), 30.1 (CH_2), 29.3 (CH_2), 29.0 (CH_2), 26.7 (CH_2), 26.6 (CH_2), 24.7 (CH_3), 22.4 (CH_2), 20.2 (CH_3), 13.9 (CH_3), 13.4 (CH_3), 12.0 (CH_3); HRMS calcd for $C_{15}H_{30}ClNO_2$ 291.1965, found 291.1961; IR (neat): $\tilde{\nu} = 3460$, 1618 cm^{-1}; elemental analysis calcd (%) for $C_{15}H_{30}ClNO_2$: C 61.73, H 10.36, N 4.80; found: C 61.69, H 10.39, N 4.96; $R_f = 0.4$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diisopropyl-3-hydroxy-2-methyl-3-(4-methoxyphenyl)propanamide (1g): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.29$ (d, $J = 7.0$ Hz, 4H), 6.73 (d, $J = 7.0$ Hz, 4H), 5.09 (s, 2H), 4.70–4.60 (m, 2H), 3.66 (s, 6H), 3.34–3.27 (m, 4H), 1.59–1.06 (m, 30H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.1$ (C), 158.7 (C), 130.3 (CH), 129.6 (CH), 112.1 (CH), 77.8 (CH), 68.5 (C), 54.6 (CH_3), 50.6 (CH), 48.8 (CH), 47.1 (CH), 45.6 (CH), 20.6 (CH_3), 20.5 (CH_3), 20.0 (CH_3), 19.9 (CH_3), 19.7 (CH_3), 19.5 (CH_3), 19.4 (CH_3), 19.4 (CH_3), 19.3 (CH_3), 19.1 (CH_3); IR (Nujol): $\tilde{\nu} = 3283$, 1650 cm^{-1}; elemental analysis calcd (%) for $C_{17}H_{26}ClNO_3$: C 62.28, H 7.99, N 4.27; found: C 62.24, H 8.08, N 4.20; m.p. = 104 °C; $R_f = 0.4$, 0.3 (two diastereoisomers) (hexane/AcOEt 3:1).

2-Chloro-3-(4-chlorophenyl)-*N,N*-diisopropyl-3-hydroxy-2-methylpropanamide (1h): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.44$ (d, $J = 1.7$ Hz, 4H), 7.27 (d, $J = 1.7$ Hz, 4H), 5.27 (d, $J = 3.0$ Hz, 1H), 5.21 (d, $J = 2.2$ Hz, 1H), 4.79–4.65 (m, 2H), 3.46–3.34 (m, 4H), 1.67 (s, 6H), 1.63–1.09 (m, 24H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.4$ (C), 136.2 (C), 135.5 (C), 133.5 (C), 131.0 (CH), 130.8 (CH), 127.5 (CH), 127.2 (CH), 78.0 (CH), 68.1 (C), 51.0 (CH), 49.2 (CH), 47.6 (CH), 46.1 (CH), 21.0 (CH_3), 20.4 (CH_3), 20.3 (CH_3), 20.0 (CH_3), 19.9 (CH_3), 19.8 (CH_3), 19.7 (CH_3), 19.1 (CH_3); IR (neat): $\tilde{\nu} =$ 3422, 1645 cm^{-1}; $R_f = 0.5$, 0.4 (two diastereoisomers) (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-cyclohexyl-3-hydroxy-2-methylpropanamide (1i): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 4.37$ (d, $J = 6.7$ Hz, 1H), 4.30 (d, $J =$ 6.4 Hz, 1H), 3.34–3.03 (m, 10H), 2.42 (br d, $J = 7.20$ Hz, 1H), 1.73–0.78 (m, 38H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.6$ (C), 170.0 (C), 81.2 (CH), 80.0 (CH), 72.8 (C), 70.7 (C), 42.6 (CH_2), 41.6 (CH_2), 40.0 (CH), 39.1 (CH), 33.3 (CH_2), 32.6 (CH_2), 27.9 (CH_2), 27.8 (CH_2), 26.5 (CH_2), 26.3 (CH_2), 26.1 (CH_2), 26.0 (CH_2), 25.9 (CH_2), 25.4 (CH_3), 22.1 (CH_3), 13.4 (CH_3), 11.8 (CH_3); IR (neat): $\tilde{\nu} = 3440$, 1618 cm^{-1}; elemental analysis calcd (%) for $C_{14}H_{26}ClNO_2$: C 60.96, H 9.50, N 5.08; found: C 60.92, H 9.56, N 5.15; $R_f =$ 0.5 (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2,5,9-trimethyldec-8-enamide (1j): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 4.95-4.86$ (m, 3H), 4.01–3.05 (m, 18H), 1.81–0.71 (m, 48H), 1.44 (s, 3H), 1.41 (s, 6H), 1.05 (t, J = 7.2 Hz, 9H), 0.94 (t, J = 7.2 Hz, 9H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 170.3$ (C), 169.6 (C), 167.6 (C), 130.2 (C), 130.1 (C), 124.5 (CH), 124.3 (CH), 75.4 (CH), 74.8 (CH), 74.4 (CH), 72.1 (C), 72.0 (C), 69.0 (C), 42.4 (CH_2), 41.6 (CH_2), 41.1 (CH_2), 40.2 (CH_2), 38.4 (CH_2), 38.1 (CH_2), 37.7 (CH_2), 37.6 (CH_2), 37.2 (CH_2), 37.1 (CH_2), 29.6 (CH), 29.0 (CH), 28.9 (CH), 25.3 (CH_3), 25.2 (CH_3), 24.9 (CH_2), 24.8 (CH_2), 24.5 (CH_2), 24.4 (CH_2), 20.7 (CH_3), 20.3 (CH_3), 20.2 (CH_3), 20.1 (CH_3), 18.5 (CH_3), 18.4 (CH_3), 17.2 (CH_3), 14.2 (CH_3), 13.2 (CH_3), 12.1 (CH_3), 11.8 (CH_3); IR (neat): $\tilde{\nu} = 3487$, 1650 cm^{-1}; $R_f = 0.5$, 0.3, 0.2 (three diastereoisomers) (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-2-ethyl-3-hydroxyheptanamide (1k): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 4.08-4.04$ (m, 1H), 3.88–3.25 (m, 5H), 2.41–2.22 (m, 2H), 2.21–1.97 (m, 2H), 1.80–1.17 (m, 10H), 1.01 (t, $J = 7.6$ Hz, 3H), 0.89 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 169.3$ (C), 76.5 (CH), 75.8 (C), 42.5 (CH_2), 41.9 (CH_2), 32.4 (CH_2), 29.8 (CH_2), 28.9 (CH_2), 22.5 (CH_2), 13.9 (CH_3), 13.7 (CH_3), 12.2 (CH_3), 10.2 (CH_3); IR (neat): $\tilde{\nu} = 3464$, 1649 cm^{-1}; elemental analysis calcd (%) for $C_{13}H_{26}ClNO_2$: C 59.19, H 9.93, N 5.31; found: C 59.25, H 9.87, N 5.36; $R_f = 0.4$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-3-ethyl-3-hydroxy-2-methylpentanamide (1l): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 5.25-5.17$ (br s, 2H), 4.11–3.81 (m, 4H), 3.50–3.15 (m, 4H), 1.88–1.62 (m, 8H), 1.83 (s, 6H), 1.22–1.11 (m, 12H), 0.97 (t, $J = 7.44$ Hz, 6H), 0.95 (t, $J = 7.44$ Hz, 6H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 171.6$ (C), 78.2 (C), 74.3 (C), 42.9 (CH_2), 41.5 (CH_2), 28.3 (CH_2), 27.8 (CH_2), 23.0 (CH_3), 13.0 (CH_3), 11.4 (CH_3), 8.8 (CH_3), 8.1 (CH_3); IR (neat): $\tilde{\nu} = 3405$, 1611 cm^{-1}; $R_f = 0.4$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-2-(1-hydroxycyclohexyl)ethanamide (1m): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 4.98$ (br s, 2H), 3.93–3.31 (m, 8H), 2.03–1.53 (m, 20H), 1.82 (s, 6H), 1.50–1.13 (m, 12H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta =$ 171.1 (C), 77.1 (C), 73.2 (C), 43.2 (CH_2), 41.7 (CH_2), 30.8 (CH_2), 30.1 (CH_2), 25.2 (CH_2), 22.6 (CH_3), 21.2 (CH_2), 21.1 (CH_2), 13.2 (CH_3), 11.6 (CH_3); IR (neat): $\tilde{\nu} = 3416$, 1605 cm^{-1}; $R_f = 0.4$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2,3-dimethylpentanamide (1n): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 5.09$ (br s, 1H), 4.99 (br s, 1H), 3.95–3.00 (m, 8H), 1.71–1.45 (m, 4H), 1.67 (s, 3H), 1.62 (s, 3H), 1.20 (s, 3H), 1.04 (s, 3H), 1.04–0.86 (m, 12H), 0.79 (t, $J = 7.4$ Hz, 3H), 0.77 (t, $J = 7.4$ Hz, 3H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 171.8$ (C), 171.4 (C), 78.5 (C), 78.1 (C), 73.7 (C), 73.1 (C), 42.3 (CH_2), 41.8 (CH_2), 28.7 (CH_2), 28.0 (CH_2), 23.2 (CH_3), 22.9 (CH_3), 21.2 (CH_3), 19.7 (CH_3), 13.3 (CH_3), 11.7 (CH_3), 7.6 (CH_3), 7.4 (CH_3); IR (neat): $\tilde{\nu} = 3404$, 1605 cm^{-1}; elemental analysis calcd (%) for $C_{11}H_{22}ClNO_2$: C 56.04, H 9.41, N 5.94; found: C 56.09, H 9.35, N 6.02; $R_f =$ 0.5 (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2,3-dimethylhexanamide (1o): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 5.09$ (br s, 1H), 4.98 (br s, 1H), 3.95–2.95 (m, 8H), 1.61 (s, 3H), 1.58 (s, 3H), 1.55–0.65 (m, 26H), 1.17 (s, 3H), 1.01 (s, 3H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 171.6$ (C), 171.3 (C), 78.3 (C), 77.9 (C), 73.5 (C), 73.0 (C), 43.2 (CH_2), 41.7 (CH_2), 38.6 (CH_2), 37.7 (CH_2), 22.9 (CH_3), 22.8 (CH_3), 21.8 (CH_3), 20.3 (CH_3), 16.6 (CH_2), 16.2 (CH_2), 14.2 (CH_3), 14.1 (CH_3), 13.2 (CH_3), 11.6 (CH_3); IR (neat): $\tilde{\nu} = 3410$, 1610 cm^{-1}; elemental analysis calcd (%) for $C_{12}H_{24}ClNO_2$: C 57.70, H 9.68, N 5.61; found: C 57.76, H 9.71, N 5.55; $R_f = 0.5$ (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2,3-dimethyloctanamide (1p): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 5.13$ (br s, 1H), 5.03 (br s, 1H), 3.90–2.90 (m, 8H), 1.80–0.65 (m, 34H), 1.67 (s, 3H), 1.63 (s, 3H), 1.23 (s, 3H), 1.07 (s, 3H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 171.7$ (C), 171.4 (C), 78.4 (C), 78.1 (C), 73.6 (C), 73.1 (C), 43.3 (CH_2), 41.8 (CH_2), 36.3 (CH_2), 35.5 (CH_2), 32.2 (CH_2), 32.0 (CH_2), 23.1 (CH_2), 22.9 (CH_2), 22.7 (CH_3), 22.3 (CH_3), 21.9 (CH_3), 20.4 (CH_3), 13.6 (CH_3), 13.3 (CH_3), 11.7 (CH_3); IR (neat): $\tilde{\nu} = 3409$, 1611 cm^{-1}; $R_f = 0.5$ (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2-methyl-3-phenylbutanamide (1q): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.98-7.26$ (m, 10H), 6.31 (br s, 2H), 3.89–2.97 (m, 8H), 1.99 (s, 3H), 1.94 (s, 3H), 1.77 (s, 3H), 1.67 (s, 3H), 1.22–1.01 (m, 12H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 172.0$ (C), 171.0 (C), 144.0 (C), 142.2 (C), 127.2 (CH), 126.9 (CH), 126.7 (CH), 79.9 (C), 78.6 (C), 74.0 (C), 71.7 (C), 43.6 (CH_2), 42.8 (CH_2), 42.4 (CH_2), 27.3 (CH_3), 25.3 (CH_3), 24.1 (CH_3), 23.8 (CH_3), 13.5(CH_3), 12.0 (CH_3), 11.5 (CH_3); IR (neat): $\tilde{\nu} = 3386$, 1606 cm^{-1}; $R_f = 0.4$, 0.3 (two diastereoisomers) (hexane/AcOEt 5:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2-methyl-3-phenylpentanamide (1r): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.62-7.16$ (m, 10H), 6.08 (br s, 1H), 5.59 (br s, 1H), 4.0–2.5 (m, 8H), 1.89 (s, 3H), 1.53 (s, 3H), 1.20–1.12 (m, 12H), 0.9 (t, $J = 6.7$ Hz, 6H), 0.67 (q, $J = 6.7$ Hz, 4H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 172.0$ (C), 171.0 (C), 140.7 (C), 139.9 (C), 128.8 (CH), 127.9 (CH), 126.8 (CH), 126.6 (CH), 126.5 (CH), 82.5 (C), 80.5 (C), 75.0 (C), 72.0 (C), 43.4 (CH_2), 42.8 (CH_2), 27.4 (CH_2), 26.8 (CH_2), 23.9 (CH_3), 13.7 (CH_3), 13.2 (CH_3), 11.8 (CH_3), 11.2 (CH_3), 7.8 (CH_3), 7.4 (CH_3); IR (neat): $\tilde{\nu} =$ 3356, 1604 cm^{-1}; $R_f = 0.5$ (hexane/AcOEt 3:1).

2-Chloro-*N,N*-diethyl-3-hydroxy-2,3-dimethyl-4-phenylbutanamide (1s): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 7.36-7.18$ (m, 10H), 5.52 (br s, 1H), 5.30 (br s, 1H), 4.14–2.96 (m, 12H), 1.94 (s, 3H), 1.93 (s, 3H), 1.31–1.19 (m, 12H), 1.31 (s, 3H), 1.19 (s, 3H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 171.9$ (C), 171.3 (C), 137.8 (C), 137.4 (C), 130.9 (CH), 130.8 (CH), 127.3 (CH), 125.8 (CH), 125.7 (CH), 79.1 (C), 78.6 (C), 73.3 (C), 72.7 (C), 43.5 (CH_2), 42.1 (CH_2), 41.5 (CH_2), 23.3 (CH_3), 23.2 (CH_3), 22.2 (CH_3), 20.6 (CH_3), 13.5 (CH_3), 11.9 (CH_3); IR (neat): $\tilde{\nu} = 3410$, 1606 cm^{-1}; $R_f = 0.5$ (hexane/AcOEt 3:1).

Synthesis of α,β-unsaturated amides (2): A solution of SmI_2 (1 or 1.6 mmol) in THF (12 mL) was added very slowly dropwise, under a nitrogen atmosphere, to a stirred solution of the corresponding 2-chloro-3-hydroxy-amides **1** (0.4 mmol) in THF (2 mL) at room temperature or $-25\,^\circ$C. After the time indicated in the corresponding Table, the reaction was quenched with aqueous HCl (5 mL of 1M solution). Usual workup provided crude α,β-unsaturated amides **2**, which were purified by column flash chromatography over silica gel (3:1 hexane ethyl acetate) to provide pure compounds **2**.

(*E*)-*N,N*-Diethyl-3-phenylpropenamide (2a):[12] ^{13}C NMR (75 MHz, $CDCl_3$) $\delta = 165.5$ (C), 142.1 (CH), 135.2 (C), 129.2 (CH), 128.2 (CH), 127.5 (CH), 117.5 (CH), 42.1 (CH_2), 40.9 (CH_2), 14.8 (CH_3), 13.0 (CH_3); MS (70 eV): *m/z* (%): 203 (25) $[M]^+$, 131 (100), 103 (67), 77 (55); HRMS calcd for $C_{13}H_{17}NO$ 203.1301, found: 203.1308; IR (neat): $\tilde{\nu} = 3056$, 2950, 1620 cm^{-1}; $R_f = 0.3$ (hexane/AcOEt 1:1).

(*E*)-*N,N*-Diethyldec-2-enamide (2b): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta =$ 6.88–6.74 (m, 1H), 6.10 (d, $J = 14.9$ Hz, 1H), 3.35–3.24 (m, 4H), 2.12 (q, $J = 6.8$ Hz, 2H), 1.37–1.02 (m, 16H), 0.79 (t, $J = 6.7$ Hz, 3H); ^{13}C NMR (50 MHz, $CDCl_3$): $\delta = 165.7$ (C), 146.0 (CH), 120.1 (CH), 41.8 (CH_2), 40.5 (CH_2), 32.2 (CH_2), 31.5 (CH_2), 28.9 (CH_2), 28.8 (CH_2), 28.1 (CH_2), 22.3 (CH_2), 14.5 (CH_3), 13.8 (CH_3), 12.9 (CH_3); MS (70 eV): *m/z* (%): 225 (10) $[M]^+$, 196 (5), 153 (39), 126 (100); HRMS calcd for $C_{14}H_{27}NO$ 225.2092, found: 225.2086; IR (neat): $\tilde{\nu} = 2956$, 2928, 1659 cm^{-1}; $R_f = 0.2$ (hexane/AcOEt 3:1).

(*E*)-*N,N*-Diethyl-4-phenylpent-2-enamide (2c): ^{1}H NMR (300 MHz, $CDCl_3$): $\delta = 7.33-7.20$ (m, 5H), 7.07 (dd, $J = 15.2$, 7.0 Hz, 1H), 6.13 (d, $J = 15.2$ Hz, 1H), 3.68–3.65 (m, 1H), 3.41 (q, $J = 7.0$ Hz, 2H), 3.32 (q, $J =$ 7.0 Hz, 2H), 1.43 (d, $J = 7.0$ Hz, 3H), 1.32–0.94 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta = 165.7$ (C), 149.5 (CH), 143.9 (C), 128.4 (CH), 127.2 (CH), 126.4 (CH), 119.3 (CH), 42.1 (CH), 42.1 (CH_2), 40.7 (CH_2), 20.7 (CH_3), 14.7 (CH_3), 13.0 (CH_3); MS (70 eV): *m/z* (%): 231 (89) $[M]^+$, 159 (92), 131 (85), 126 (100), 91 (81), 77 (36); HRMS calcd for $C_{15}H_{21}NO$ 231.1623, found 231.1627; IR (neat): $\tilde{\nu} = 3008$, 2945, 1647 cm^{-1}; $R_f = 0.1$ (hexane/AcOEt 5:1).

(*E*)-*N,N*-Diethyl-3-phenyl-2-methylpropenamide (2d): ^{1}H NMR (300 MHz, [D$_6$]DMSO, 373 K): $\delta = 7.57-7.27$ (m, 5H), 6.52 (s, 1H), 3.48 (q, $J = 6.7$ Hz, 4H), 2.09 (s, 3H), 1.24 (t, $J = 6.7$ Hz, 6H); ^{13}C NMR (75 MHz, [D$_6$]DMSO, 373 K): $\delta = 171.9$ (C), 135.9 (C), 134.0 (C), 128.4 (CH), 128.0 (CH), 127.1 (CH), 126.8 (CH), 39.8 (CH_2), 15.4 (CH_3), 13.1 (CH_3); MS (70 eV): *m/z* (%): 217 (72) $[M]^+$, 202 (41), 117 (100), 91 (51), 89 (9); HRMS calcd for $C_{14}H_{19}NO$ 217.1466, found: 217.1475; IR (neat): $\tilde{\nu} =$ 3081, 3023, 2974, 1625, 1427, 1381 cm^{-1}; $R_f = 0.4$ (hexane/AcOEt 1:1).

(*E*)-*N,N*-Diisopropyl-2-methyl-3-phenylpropenamide (2e): ^{1}H NMR (300 MHz, [D$_6$]DMSO, 373 K): $\delta = 7.50-7.31$ (m, 5H), 6.44 (s, 1H), 3.97–3.84 (m, 2H), 2.08 (s, 3H), 1.40 (d, $J = 6.7$ Hz, 12H); ^{13}C NMR (75 MHz, [D$_6$]DMSO, 373 K): $\delta = 172.0$ (C), 136.3 (C), 135.7 (C), 128.6 (CH), 128.3 (CH), 127.0 (CH), 126.0 (CH), 47.3 (CH), 20.5 (CH_3), 15.6 (CH_3); MS (70 eV): *m/z* (%): 245 (30) $[M]^+$, 230 (21), 168 (8), 145 (100), 91 (27); HRMS calcd for $C_{16}H_{23}NO$ 245.1779, found: 245.1770; IR (neat): $\tilde{\nu} =$ 3059, 1626, 1532, 1471, 1369 cm^{-1}; $R_f = 0.3$ (hexane/AcOEt 3:1).

(*E*)-*N,N*-Diethyl-2-methyldec-2-enamide (2f): ^{1}H NMR (200 MHz, $CDCl_3$): $\delta = 5.46$ (t, $J = 7.4$ Hz, 1H), 3.34 (q, $J = 7.2$ Hz, 4H), 2.04 (q, $J =$ 6.9 Hz, 2H), 1.78 (s, 3H), 1.50–1.22 (m, 10H), 1.11 (t, $J = 7.2$ Hz, 6H), 0.84 (t, $J = 6.7$ Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): $\delta = 173.7$ (C), 130.8 (C), 130.3 (CH), 41.5 (CH_2), 31.6 (CH_2), 29.1 (CH_2), 29.0 (CH_2), 28.8 (CH_2), 27.3 (CH_2), 22.4 (CH_2), 14.2 (CH_3), 13.9 (CH_3), 12.8 (CH_3); MS (70 eV): *m/z* (%): 239 (2) $[M]^+$, 167 (27), 140 (100), 55 (40), 41 (40); HRMS calcd for $C_{15}H_{29}NO$ 239.2249, found: 239.2242; IR (neat): $\tilde{\nu} = 2928$, 2856, 1624, 1460, 1379 cm^{-1}; $R_f = 0.5$ (hexane/AcOEt 1:1).

(*E*)-*N,N*-Diisopropyl-3-(4-methoxyphenyl)-2-methylpropenamide (2g): ^{1}H NMR (300 MHz, [D$_6$]DMSO, 373 K): $\delta = 7.36$ (d, $J = 8.9$ Hz, 2H), 7.03 (d, $J = 8.9$ Hz, 2H), 6.37 (s, 1H), 3.96–3.80 (m, 2H), 3.88 (s, 3H), 2.06 (s, 3H), 1.38 (d, $J = 6.7$ Hz, 12H); ^{13}C NMR (75 MHz, [D$_6$]DMSO, 373 K): $\delta = 172.3$ (C), 158.7 (C), 133.9 (C), 130.0 (CH), 129.0 (C), 125.7 (CH), 114.2 (CH), 55.3 (CH_3), 47.3 (CH), 20.6 (CH_3), 15.8 (CH_3); MS (70 eV): *m/z* (%): 275 (10) $[M]^+$, 260 (15), 175 (79), 91 (57); HRMS calcd for $C_{17}H_{25}NO_2$ 275.1885, found: 275.1874; IR (neat): $\tilde{\nu} = 3002$, 2967, 1621, 1441, 1369 cm^{-1}; $R_f = 0.2$ (hexane/AcOEt 3:1).

(*E*)-3-(4-Chlorophenyl)-*N,N*-diisopropyl-2-methylpropenamide (2h): ^{1}H NMR (300 MHz, [D$_6$]DMSO, 373 K): $\delta = 7.48$ (d, $J = 8.4$ Hz, 2H), 7.43 (d, $J = 8.4$ Hz, 2H), 6.40 (s, 1H), 3.94–3.83 (m, 2H), 2.06 (s, 3H), 1.38 (d, $J = 6.7$ Hz, 12H); ^{13}C NMR (75 MHz, [D$_6$]DMSO, 373 K): $\delta = 171.7$ (C), 136.6 (C), 135.1 (C), 131.8 (C), 130.4 (CH), 128.3 (CH), 124.7 (CH), 47.3

0947-6539/01/0714-3066 $ 17.50+.50/0 *Chem. Eur. J.* **2001**, *7*, No. 14

(CH), 20.5 (CH_3), 15.6 (CH_3); MS (70 eV): *m/z* (%): 281 (9) $[M+2]^+$, 279 (26) $[M]^+$, 264 (20), 179 (100), 168 (9); HRMS calcd for $C_{16}H_{22}ClNO$ 279.1389, found: 279.1384; IR (neat): $\tilde{\nu}$ = 1626, 1490, 1440, 1370 cm^{-1}; R_f = 0.4 (hexane/AcOEt 3:1).

(*E*)-3-Cyclohexyl-*N*,*N*-diethyl-2-methylpropenamide (2i): ^1H NMR (300 MHz, [D$_6$]DMSO, 373 K): δ = 5.33 (dq, *J* = 1.7, 8.9 Hz, 1H), 3.39 (q, *J* = 7.0 Hz, 4H), 2.43–2.30 (m, 1H), 1.84 (d, *J* = 1.7 Hz, 3H), 1.81–1.68 (m, 5H), 1.50–1.21 (m, 5H), 1.17 (t, *J* = 7.0 Hz, 6H); ^{13}C NMR (75 MHz, [D$_6$]DMSO, 373 K): δ = 172.5 (C), 134.0 (CH), 130.4 (C), 40.4 (CH_2), 36.0 (CH), 32.0 (CH_2), 25.6 (CH_2), 25.1 (CH_2), 14.0 (CH_3), 13.4 (CH_3); MS (70 eV): *m/z* (%): 223 (9) $[M]^+$, 208 (2), 151 (57), 140 (100); HRMS calcd for $C_{14}H_{25}NO$ 223.1936, found: 223.1944; IR (neat): $\tilde{\nu}$ = 2974, 1623, 1457, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2,5,9-trimethyldec-2,8-dienamide (2j): ^1H NMR (300 MHz, [D$_6$]DMSO, 373 K): δ = 5.53–5.48 (m, 1H), 5.21–5.17 (m, 1H), 3.41 (q, *J* = 7.3 Hz, 4H), 2.21–0.93 (m, 7H), 1.83 (s, 3H), 1.75 (s, 3H), 1.68 (s, 3H), 1.17 (t, *J* = 7.3 Hz, 6H), 0.99 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (75 MHz, [D$_6$]DMSO, 373 K): δ = 172.4 (C), 132.9 (C), 130.5 (C), 127.3 (CH), 124.6 (CH), 40.4 (CH_2), 36.4 (CH_2), 34.2 (CH_2), 32.5 (CH), 25.2 (CH_2), 19.3 (CH_3), 17.3 (CH_3), 14.2 (CH_3), 13.4 (CH_3); MS (70 eV): *m/z* (%): 265 (6) $[M]^+$, 250 (10), 193 (< 1), 182 (67), 154 (12); HRMS calcd for $C_{17}H_{31}NO$ 265.2405, found: 265.2415; IR (neat): $\tilde{\nu}$ = 2966, 1624, 1459, 1430, 1379 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2-ethylhept-2-enamide (2k): ^1H NMR (300 MHz, $CDCl_3$): δ = 5.37 (t, *J* = 7.2 Hz, 1H), 3.33 (q, *J* = 7.2 Hz, 4H), 2.25 (q, *J* = 7.4 Hz, 2H), 2.04 (q, *J* = 7.2 Hz, 2H), 1.32–1.18 (m, 4H), 1.08 (t, *J* = 7.2 Hz, 6H), 0.93 (t, *J* = 7.4 Hz, 3H), 0.84 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.9 (C), 136.9 (C), 129.1 (CH), 40.4 (CH_2), 31.1 (CH_2), 26.7 (CH_2), 22.1 (CH_2), 21.7 (CH_2), 13.6 (CH_3), 13.4 (CH_3), 12.4 (CH_3); MS (70 eV): *m/z* (%): 211 (10) $[M]^+$, 182 (10), 154 (82), 139 (51), 69 (100); HRMS calcd for $C_{13}H_{25}NO$ 211.1936, found: 211.1940; IR (neat): 2963, 1610, 1460, 1431, 1380 cm^{-1}; R_f = 0.5 (hexane/AcOEt 1:1).

(*E*)-*N*,*N*-Diethyl-3-ethyl-2-methylpent-2-enamide (2l): ^1H NMR (200 MHz, [D$_6$]DMSO, 350 K): δ = 3.43 (q, *J* = 7.22 Hz, 4H), 2.20 (q, *J* = 7.55 Hz, 2H), 2.09 (q, *J* = 7.55 Hz, 2H), 1.83 (s, 3H), 1.21 (t, *J* = 7.22 Hz, 6H), 1.11 (t, *J* = 7.55 Hz, 3H), 1.06 (t, *J* = 7.55 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.8 (C), 139.6 (C), 125.3 (C), 42.0 (CH_2), 37.7 (CH_2), 25.9 (CH_2), 22.5 (CH_2), 15.5 (CH_3), 14.1 (CH_3), 12.6 (CH_3), 12.5 (CH_3), 12.3 (CH_3); MS (70 eV): *m/z* (%): 197 (12) $[M]^+$, 182 (8), 165 (92), 125 (100), 97 (25); HRMS calcd for $C_{12}H_{23}NO$ 197.1779, found: 197.1778; IR (neat): $\tilde{\nu}$ = 2986, 2936, 1616, 1461, 1425, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-2-Cyclohexylidene-*N*,*N*-diethylpropanamide (2m): ^1H NMR (200 MHz, $CDCl_3$): δ = 3.47–3.12 (m, 4H), 2.05–1.93 (m, 4H), 1.68 (s, 3H), 1.56–1.35 (m, 6H), 1.07–1.00 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.9 (C), 136.1 (C), 122.2 (C), 41.8 (CH_2), 37.6 (CH_2), 31.9 (CH_2), 28.8 (CH_2), 27.2 (CH_2), 27.0 (CH_2), 26.2 (CH_2), 15.0 (CH_3), 14.1 (CH_3), 12.4 (CH_3); MS (70 eV): *m/z* (%): 209 (31) $[M]^+$, 194 (12), 180 (51), 137 (89), 109 (89); HRMS calcd for $C_{13}H_{23}NO$ 209.1779, found: 209.1780; IR (neat): $\tilde{\nu}$ = 2929, 2854, 1625, 1447, 1426, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2,3-dimethylpent-2-enamide (2n): ^1H NMR (200 MHz, $CDCl_3$): δ = 3.71–3.00 (m, 4H), 1.96–1.89 (m, 2H), 1.71 (s, 3H), 1.59 (s, 3H), 1.28–0.77 (m, 9H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.7 (C), 133.9 (C), 125.4 (C), 41.8 (CH_2), 37.5 (CH_2), 28.4 (CH_2), 15.8 (CH_3), 15.7 (CH_3), 14.0 (CH_3), 12.4 (CH_3), 12.0 (CH_3); MS (70 eV): *m/z* (%): 183 (20) $[M]^+$, 168 (11), 154 (57), 111 (100), 83 (57); HRMS calcd for $C_{11}H_{21}NO$ 183.1623, found: 183.1623; IR (neat): $\tilde{\nu}$ = 2968, 2936, 1630, 1461, 1426, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2,3-dimethylhex-2-enamide (2o): ^1H NMR (200 MHz, [D$_6$]DMSO, 350 K): δ = 3.41 (q, *J* = 7.22 Hz, 4H), 2.00 (t, *J* = 7.22 Hz, 2H), 1.80 (s, 3H), 1.73 (s, 3H), 1.58–1.39 (m, 2H), 1.18 (t, *J* = 7.22 Hz, 6H), 0.94 (t, *J* = 7.22 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.7 (C), 132.9 (C), 132.5 (C), 41.8 (CH_2), 37.6 (CH_2), 37.5 (CH_2), 20.7 (CH_2), 16.2 (CH_3), 15.7 (CH_3), 14.0 (CH_3), 13.9 (CH_3), 12.3 (CH_3); MS (70 eV): *m/z* (%): 197 (18) $[M]^+$, 182 (11), 168 (20), 125 (100), 97 (12); HRMS calcd for $C_{12}H_{23}NO$ 197.1779, found: 197.1782; IR (neat): $\tilde{\nu}$ = 2962, 2934, 2872, 1626, 1460, 1426, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2,3-dimethyloct-2-enamide (2p): ^1H NMR (200 MHz, [D$_6$]DMSO, 350 K): δ = 3.41 (q, *J* = 7.22 Hz, 4H), 2.04 (t, *J* = 7.22 Hz, 2H), 1.81 (s, 3H), 1.75 (s, 3H), 1.52–1.36 (m, 6H), 1.20 (t, *J* = 7.22 Hz, 6H), 0.98 (t, *J* = 6.89 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.9 (C), 133.2 (C), 125.7 (C), 41.9 (CH_2), 37.6 (CH_2), 35.7 (CH_2), 31.9 (CH_2), 27.4 (CH_2), 22.4 (CH_2), 16.4 (CH_3), 16.0 (CH_3), 14.1 (CH_3), 13.9 (CH_3), 12.5 (CH_3); MS (70 eV): *m/z* (%): 225 (18) $[M]^+$, 210 (10), 196 (17), 153 (100); HRMS calcd for $C_{14}H_{27}NO$ 225.2092, found: 225.2094; IR (neat): $\tilde{\nu}$ = 2963, 2933, 1629, 1458, 1425, 1380 cm^{-1}; R_f = 0.3 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2-methyl-3-phenylbut-2-enamide (2q): ^1H NMR (200 MHz, [D$_6$]DMSO, 350 K): δ = 7.38–7.30 (m, 5H), 3.48 (q, *J* = 7.22 Hz, 4H), 2.14 (s, 3H), 2.02 (s, 3H), 0.92 (t, *J* = 7.22 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.2 (C), 142.2 (C), 132.6 (C), 128.6 (C), 127.8 (CH), 127.4 (CH), 126.8 (CH), 41.7 (CH_2), 37.5 (CH_2), 19.3 (CH_3), 17.4 (CH_3), 13.7 (CH_3), 11.6 (CH_3); MS (70 eV): *m/z* (%): 231 (12) $[M]^+$, 216 (40), 202 (10), 159 (68), 131 (96), 91 (100); HRMS calcd for $C_{15}H_{21}NO$ 231.1623, found: 231.1627; IR (neat): $\tilde{\nu}$ = 3055, 2975, 2933, 1614, 1458, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2-methyl-3-phenylpent-2-enamide (2r): ^1H NMR (200 MHz, [D$_6$]DMSO, 350 K): δ = 7.35–7.33 (m, 5H), 3.19 (q, *J* = 6.89 Hz, 4H), 2.56 (q, *J* = 7.55 Hz, 2H), 2.02 (s, 3H), 1.04 (t, *J* = 7.55 Hz, 3H), 0.92 (t, *J* = 6.89 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.0 (C), 140.8 (C), 138.7 (C), 127.9 (CH), 127.6 (CH), 127.0 (C), 126.6 (CH), 41.5 (CH_2), 37.1 (CH_2), 26.0 (CH_2), 16.5 (CH_3), 13.7 (CH_3), 12.2 (CH_3), 11.4 (CH_3); MS (70 eV): *m/z* (%): 245 (45) $[M]^+$, 230 (19), 216 (89), 173 (100), 145 (63), 91 (25); HRMS calcd for $C_{16}H_{23}NO$ 245.1779, found: 245.1781; IR (neat): $\tilde{\nu}$ = 3054, 3019, 2968, 2873, 1617, 1459, 1379 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

(*E*)-*N*,*N*-Diethyl-2,3-dimethyl-4-phenylbut-2-enamide (2s): ^1H NMR (200 MHz, [D$_6$]DMSO, 350 K): δ = 7.42–7.26 (m, 5H), 3.45 (q, *J* = 6.56 Hz, 4H), 2.93 (d, *J* = 13.46 Hz, 1H), 2.72 (d, *J* = 13.46 Hz, 1H), 1.87 (s, 3H), 1.63 (s, 3H), 1.21 (q, *J* = 6.56 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ = 172.5 (C), 139.1 (C), 131.4 (C), 128.8 (CH), 128.0 (CH), 127.3 (C), 125.7 (CH), 42.1 (CH_2), 41.5 (CH_2), 37.9 (CH_2), 16.2 (CH_3), 16.0 (CH_3), 14.0 (CH_3), 12.4 (CH_3); MS (70 eV): *m/z* (%): 245 (23) $[M]^+$, 230 (3), 216 (17), 173 (46), 145 (23), 91 (44); HRMS calcd for $C_{16}H_{23}NO$ 245.1779, found: 245.1783; IR (neat): $\tilde{\nu}$ = 3060, 3025, 2973, 2932, 1623, 1494, 1427, 1380 cm^{-1}; R_f = 0.2 (hexane/AcOEt 3:1).

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