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Dimethoxyethane as an Alternative Solvent for Schmidt Reactions. Preparation of Homochiral *N*-(5-Oxazolyl)oxazolidinones from *N*-Acetoacetyl Derivatives of Oxazolidinones

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Abstract.- Dimethoxyethane is an useful solvent for the Schmidt reaction of ketones and β-ketoesters with sodium azide and methanesulfonic acid to afford amides and amidoesters. This solvent is an alternative to the unsafe chlorinated solvents normally used. A β-diketone and several (4*S*)-*N*-(2-alkylacetoacetyl)-4-benzyloxazolidin-2-ones afford oxazoles under those conditions.

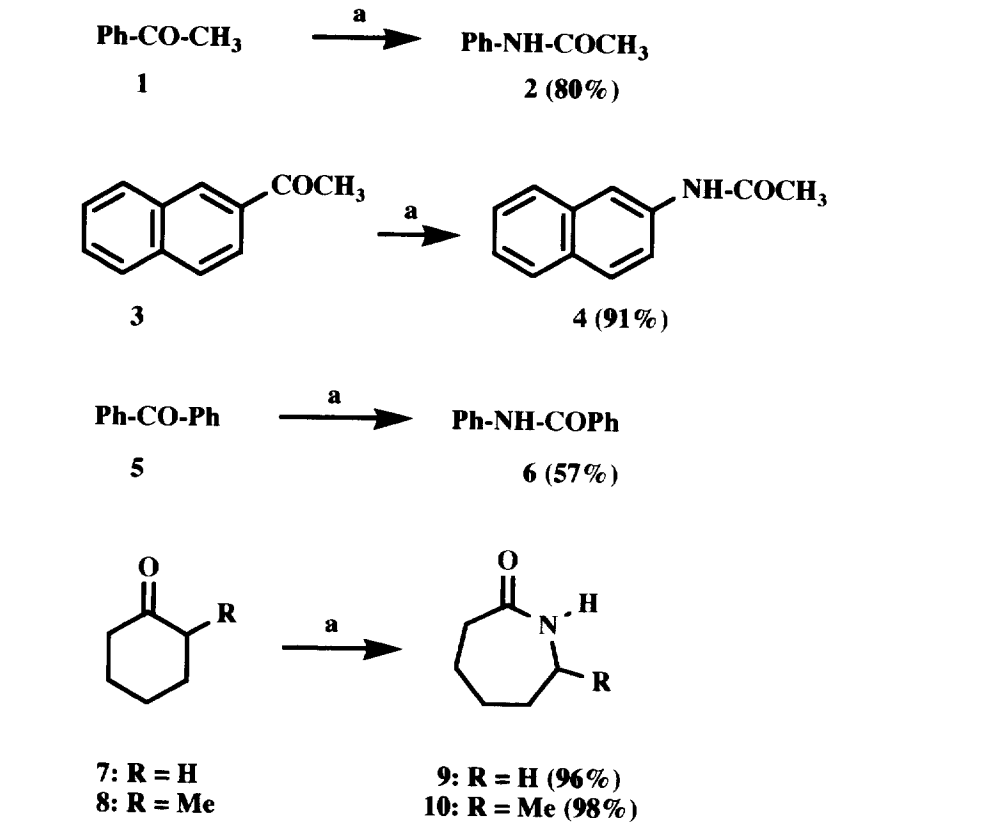
INTRODUCTION

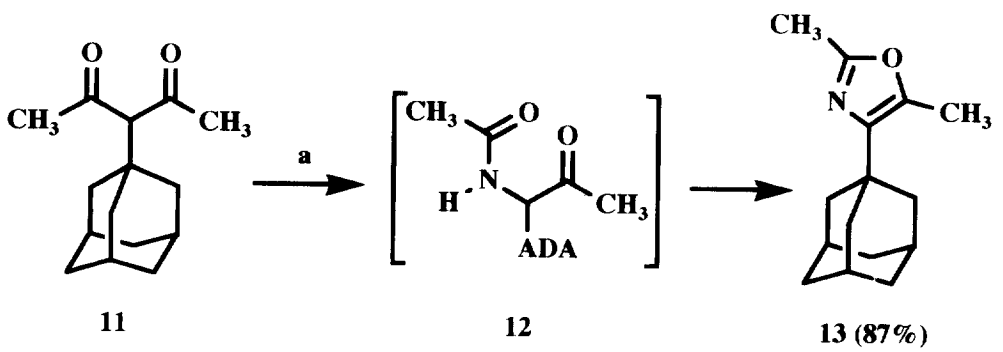
The reaction of ketones with hydrazoic acid to afford amides through a rearrangement involving the formation of dinitrogen as leaving group, is one of the three reactions covered under the name of Schmidt reaction.[1] Hydrazoic acid is generated *in situ* from sodium azide and sulphuric acid or methanesulfonic acid. Chloroform has been recommended in an old review as the solvent of choice to perform Schmidt reactions, benzene being a useful alternative.[2] However, two letters to C&EN warned the chemical community about the hazards involved in using azides in halogenated solvents.[3] Although we have never had bad experiences when performing Schmidt reactions in chloroform[4] we decided to change to safer solvents.

RESULTS

As above mentioned, benzene has been recommended for Schmidt reactions.[2] However, after some experimentation we were not completely satisfied with this alternative solvent from the viewpoint of reaction yields. Morever, benzene freezes at 5°C thus rendering manipulations below this temperature not possible. Also, in some laboratories the use of benzene is strictly regulated. Therefore, we decided to look for a solvent of lower melting point having polarity parameters similar to chloroform. The solution was found in the appendix of the monography by C. Reichardt where one hundred solvents are classified according to the values of the solvatochromic normalized E_T^N parameter.[5] Indeed, the value for dimethoxyethane (0.231) is similar to that for chloroform (0.259), the dielectric constants of both solvents being also not very different.

In our first experiments several simple ketones were converted into the corresponding amides in a very satisfactory manner when working in dimethoxyethane from -30°C to room temperature, generating hydrazoic acid from sodium azide and methanesulfonic acid[6] (Scheme 1). However, when a sterically hindered β-





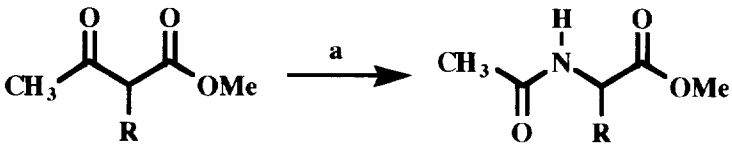
a.- NaN_3, $MeSO_3H$, DME, -30°C to room temperature

SCHEME 1

diketone, 3-(1-adamantyl)pentane-2,4-dione, **11**,[7] was treated under these conditions, 4-(1-adamantyl)-2,5-dimethyloxazole, **13**, was isolated in 87% yield instead of the amidoketone **12**, which cyclizes under the action of the acid. The conversion of amidoketones into oxazoles by strong acids is the Robinson-Gabriel reaction.[8]

Ketoesters **14a-c** were prepared by conventional alkylation of methyl acetoacetate. Methyl 2-benzhydrylacetoacetate, **14d**, was prepared by alkylation of methyl acetoacetate with benzhydryl bromide under cobalt(II) chloride bistriphenylphosphine catalysis, according to a method previously reported.[9] Ketoesters **14a-d** afforded amidoesters **15** as indicated in Scheme 2 when submitted to the Schmidt rearrangement in DME using again methanesulfonic acid. In no case products from cyclization were observed.

Our yields are high and compare well with those reported when using other solvents.[2]



14a	**R = CH_3-**	**15a (47%)**
14b	**R = $PhCH_2CH_2$-**	**15b (100%)**
14c	**R = $PhCH{=}CHCH_2$-**	**15c (79%)**
14d	**R = Ph_2CH-**	**15d (26%)**

a.- NaN_3, $MeSO_3H$, DME, -30°C to rt

SCHEME 2

Chiral derivatives of acetoacetic acid **16** (Scheme 3), featuring (4*S*)-4-benzyloxazolidin-2-one as chiral moiety have been prepared in our group.[10] Compound **16b**, both diastereoisomerically pure or as a mixture, was initially chosen for experiments under different conditions (Table 1), including a) methanesulfonic acid/DME; b) sulfuric acid/DME, and c) sulfuric acid/benzene. When **16b** was treated in dimethoxyethane with sodium azide and sulfuric acid (conditions b, table 1, entries 4 and 5) the amide **17b** was formed in reasonable yields (Scheme 3), albeit epimerization of the chiral intercarbonylic center ocurred (entry 4). However, when methanesulfonic acid was used as the proton source in the same solvent DME (conditions a) the reaction afforded directly 4-benzyl-5-((4*S*)-4-benzyl-2-oxo-3-oxazolidinyl)-2-methyloxazole **18b** as the only isolated product (entry 3). Similar results were obtained with acetoacetic acid derivatives **16a,c,d** as well as with the unsubstituted **16e**, which upon treatment with sodium azide and methanesulfonic acid in DME afforded oxazoles **18a,c-e** exclusively (entries 1, and 7-9). Sulfuric acid in benzene gives worse results (entries 2 and 6)

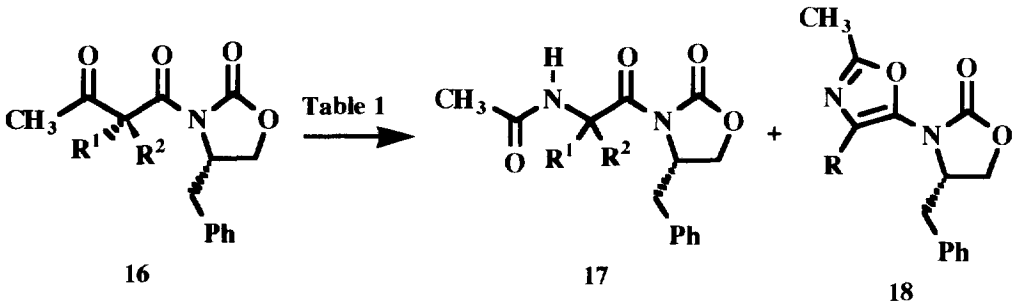
From the results of table 1, it seems that sulfuric acid does not cyclize amides **17** and that methanosulfonic acid does it. However, the generalization is dangerous, since from the results of Scheme 2 it is evident that no cyclization occurs on amidoesters **15** under methanosulfonic acid. Most probably the relief of steric hindrance is the driving force for cyclization when severely hindered compounds such as **12** and **17** are the primary products of the Schmidt rearrangement.

With the standard spectroscopic data at hand, structures **13** and **18a-e** for the heterocyclic compounds were not beyond any reasonably doubt. Indeed, these data might be also consistent with the isomeric isoxazoles **19** and **20a-e**. On the other hand, the reaction of acetylenic ketones with hydrazoic acid has been reported to afford isoxazoles.[11] Therefore, further evidences were required to decide between both sets of azoles. Spectral data of compound **19** prepared by reaction of diketone **11** with hydroxylamine[7] were sufficiently different from those registered from the compound of the Schmidt rearrangement for identity to be ruled out. The SDEPT

Table 1. Schmidt Reactions of Compounds **16**

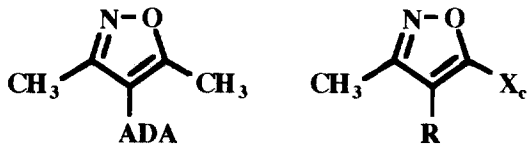
Entry	16	R^1	R^2	Cond.	17 (%)	18 (%)	R
1	**16a**	Me	H	a	-----	**18a** (91)	CH_3-
2	**16a**	--------H, Me------[d]		c	**17a** (14)[d,e]	**18a** (21)	CH_3-
3	**16b**	$PhCH_2$-	H	a	-----	**18b** (27)	$PhCH_2$-
4	**16b**	$PhCH_2$-	H	b	**17b** (50)[e]	-----	
5	**16b**	-----$PhCH_2$, H----[d]		b	**17b** (54)[d,e]	-----	
6	**16b**	-----$PhCH_2$, H----[d]		c	-----	-----	
7	**16c**	H	$PhCH_2CH_2$-	a	-----	**18c** (66)	$PhCH_2CH_2$-
8	**16d**	$PhCH{=}CHCH_2$-	H	a	-----	**18d** (32)	$PhCH{=}CHCH_2$-
9	**16e**	H	H	a	-----	**18e** (45)	H

[a] NaN_3, $MeSO_3H$, DME, -30°C to room temperature; [b] NaN_3, H_2SO_4, DME, -30°C; [c] NaN_3, H_2SO_4, Benzene, 5°C to rt; [d] Mixture of diastereoisomers; [e] Mixture of diastereoisomers as determined by NMR



16 17 18

SCHEME 3



19 **20a-e**

NMR technique[12] was applied to the rest of heterocyclic compounds arising from Schmidt reactions. This technique consists in selective transfer of magnetization from chosen protons to carbons placed two and three bonds away, which are the only ones observed under a well defined set of experimental conditions.[12] As an example, selective transfer from the methyl protons of **18b** at δ 2.37 gave rise to enhancement of only one carbon atom signal: that at 159.1 which can be, therefore, safely assigned to C-2 in the oxazole ring. Note that this carbon atom is the only one within two or three bonds distance of the chosen protons. The isoxazole isomer **20b** was expected to show enhancement of two carbon atom signals: those of C-3 and C-4, at two and three bonds distance from the disturbed protons.

FINAL REMARKS

45 Years elapsed from the review by Wolff in 1946[2] to the moment when two independent warnings were published on the use of chlorinated solvents in the Schmidt reaction,[3] and 70 years elapsed since Schmidt reported his reaction for the first time.[13] Diazidomethane and triazidomethane, formed *in situ* by reaction of halogenated solvents with sodium azide have been proposed as causatives of the reported accidents.[3a] Of course this is not possible when working in DME and it is also difficult to imagine any other dangerous by-products originated by our proposed solvent. Nevertheless, we can not state that an accident will never happen in the future when working in DME. **When manipulating azides appropriate precautions should always be taken.** We, of course, describe below our experiments exactly as they were performed. However, further examination of our own work after it was finished, lead us to believe that still it could be improved from the safety viewpoint in at least two points: a.- avoiding the evaporation step before partitioning the reaction mixtures between water and an organic solvent (*vide infra*); b.- using an organic solvent (for instance diethyl ether) different from dichloromethane in the extractions procedure.

Finally, one referee informed us that traces of metal catalyse an exothermic and autocatalytic reaction between chloroform and nucleophiles, which may have some bearing on the observed hazards.

EXPERIMENTAL

All 1H(13C) spectra were registered at 250 (62.5) MHz in deuteriochloroform unless otherwise stated; J values are in Hz. MS were registered at 70 eV; molecular peaks and peaks more intense than 20% are given. Mp's are uncorrected. [α] Values were determined at room temperature. 99% Methanesulfonic acid was used in all cases.

Schmidt rearrangements of ketones **1**, **3**, **5**, **7**, **8**, and **11**

Acetanilide, **2**. (Typical experiment).

Methanesulfonic acid (9 mL) was added to a solution of acetophenone, **1**, (2.0 g, 16 mmole) in dimethoxyethane (DME) (5 mL) cooled at -30°C. Sodium azide (3.25 g, 49.9 mmole) was then added portionwise under gentle stirring keeping the temperature at -30°C. The solution was allowed to reach slowly room temperature till the evolution of nitrogen ceased (ca. 3 hours). More DME (15 mL) and 30% ammonium hydroxide were added till pH ca. 9 was reached. The solution was evaporated (see final remarks) and the residue was partitioned between dichloromethane and water. The organic layer was dried and evaporated. The residue was purified by passing through a silica gel column with ethyl acetate-hexanes as eluent to afford amide **2** (1.79 g, 80%); mp 110-112°C; IR (KBr) 1665 cm^{-1}.

The following products are described either in commercial catalogs or in the Handbook of Chemistry and Physics or elsewhere: 2-Acetylaminonaphthalene, **4**, mp 132-134°C; benzanilide, **6**, mp 157°C; ε-caprolactame, **9**, mp 65°C; 7-methylazepan-2-one, **10**, mp 83-86°C (Lit.[14] mp 85-86°C).

4-(1-Adamantyl)-2,5-dimethyloxazole, **13**.

Methanesulfonic acid (4.5 mL) was added to a solution of 3-(1-adamantyl)pentane-2,4-dione, **11**,[7] (1.00 g, 4.3 mmole) in DME (2 mL) cooled at -30°C. Sodium azide (0.83 g, 12.8 mmole) was then added portionwise under gentle stirring and keeping the solution temperature at -30°C. The mixture was allowed to reach room temperature while the evolution of nitrogen ceased (ca. 3 hours). Finally the mixture was diluted with more DME 6 mL) and 30% ammonium hydroxide added till pH ca. 9 was reached. The mixture was evaporated (see final remarks) and the residue was partitioned between dichloromethane and water. The organic layer was dried

and evaporated. The residue was purified by passing through a silica gel column to afford **13** (0.86 g, 87%), mp 88-90°C (Lit.[15] mp 92-93°C); IR (KBr): 2908, 2850 cm^{-1}; 1H NMR: 1.74 (sharp absorption, 6H), 1.94 (sharp absorption, 6H), 2.03 (deceptive br s, 3H), 2.33 (s, 3H), 2.34 (s, 3H); 13C NMR: 12.1, 13.7, 28.5, 36.4, 41.7, 140.6, 141.8, 158.0; MS: (m/z) 231 (M, 54), 174 (43), 43 (100).

Preparation of ketoesters **14**.

Ketoesters **14a**, **14b**, and **14c**[16] were prepared by conventional alkylation with methyl iodide, 1-iodo-2-phenylethane, and cinnamyl bromide respectively.

Methyl 2-(2-phenylethyl)-3-oxobutanoate, **14b**. Bp 50°C (oven temp)/0.3-0.4 mmHg; IR (film): 1743, 1716 cm^{-1}; 1H NMR: 2.18 (s, 3H), 2.11-2.21 (m, 2H), 2.60 (m, 2H), 3.43 (t, J = 7.1, 1H), 3.70 (s, 3H), 7.13-7.30 (m, 5H); 13C NMR: 28.6, 29.3, 33.0, 52.0, 58.4, 126.0, 128.0, 140.4, 169.9, 202.5. Anal. Calcd for $C_{13}H_{16}O_3$: C, 70.89; H, 7.32. Found: C, 70.60; H, 7.04.

Methyl 2-acetyl-5-phenyl-4-pentenoate, **14c**. Bp 125-140°C (oven temp)/0.4 mmHg (Lit[16] bp 135°C/2 mmHg); IR (film): 1743, 1715 cm^{-1}; 1H NMR: 2.23 (s, 3H), 2.73 (apparent t, J = 7.3, 2H), 3.60 (t, J = 7.3, 1H), 3.71 (s, 3H), 6.10 (m, 1H), 6.45 (d, J = 15.7, 1H), 7.17-7.32 (m, 5H); 13C NMR: 29.1, 31.4, 52.2, 59.2, 125.5-128.3 (5C), 132.6, 136.8, 169.5, 202.1. Anal. Calcd for $C_{14}H_{16}O_3$: C, 72.39; H, 6.94. Found: C, 72.10; H, 6.57.

Methyl 2-benzhydryl-3-oxobutanoate, **14d**. A mixture of methyl 3-oxobutanoate (0.80 g, 6.89 mmole), benzhydryl bromide (1.70 g, 6.89 mmole), potassium carbonate (4.75 g, 34.4 mmole), cobalt(II) chloride bistriphenylphosphine (0.45 g, 0.69 mmole) and ethanol-free chloroform (7 mL) was heated in a closed reactor at 110°C for 15 h. After cooling the mixture was partitioned between chloroform (50 mL) and 1N HCl (3 x 25 mL). The organic layer was dried and evaporated. The residue was chromatographed through silica-gel with ethyl acetate-hexanes to afford **14d** (1.2 g, 62 %), mp 119-120°C (hexanes); IR (KBr): 1745, 1715 cm^{-1}; 1H NMR (d_6-DMSO): 2.05 (s, 3H), 3.45 (s, 3H), 4.63 (d, J = 12.4, 1H), 5.05 (d, J = 12.4, 1H), 7.25 (m, 10H); 13C NMR (d_6-DMSO): 30.4, 50.4, 52.4, 63.0, 126.7, 127.8 and 127.9, 128.6 and 128.7, 142.2 and 142.5, 168.0, 201.8 (the two phenyl rings are not equivalent in the 13C NMR time scale). Anal. Calcd for $C_{18}H_{18}O_3$: C, 76.57; H, 6.42. Found: C, 76.51; H, 6.04.

Schmidt rearrangements of ketoesters **14a-d**.

Methyl *N*-Acetyl-2-(2-phenylethyl)glycinate, **15b** (Typical experiment).

Methanesulfonic acid (4.5 mL) was dropwise added to a stirred mixture of ketoester **14b** (0.96 g, 4.4 mmole) and DME (3 mL) cooled at -30°C. Sodium azide (0.85 g, 13.0 mmole) was then added portionwise. The evolution of nitrogen ceased in ca. 3 hours and then the mixture was left at room temperature. More DME (9 mL) and 30% ammonium hydroxide were added till pH ca. 9. The mixture was partitioned between dichloromethane and water. The organic layer was dried and evaporated. The residue was purified through silica-gel (ethyl acetate as eluent) to afford **15b** (1.03 g, ca. 100%): IR (KBr): 3252, 1743, 1651, 1638 cm^{-1}; 1H NMR: 1.99 (s, 3H), 1.94-2.26 (m, 2H), 2.65 (m, 2H), 3.71 (s, 3H), 4.67 (m, 1H), 6.18 (br. s, J = 7.3, 1H), 7.15-7.31 (m, 5H); 13C NMR: 23.0, 31.5, 33.7, 51.9, 52.2, 126.0-128.4 (4C), 140.5, 169.8, 172.8. Anal. Calcd for $C_{13}H_{17}NO_3$: C, 66.36; H, 7.28; N, 5.95. Found: C, 66.25; H, 7.15; N, 5.86.

Methyl *N*-acetylalaninate, **15a**. Mp 36-37°C (Lit[17] mp 40-43 °C); bp 45°C/0.4 mmHg; IR (KBr): 3304 (sh), 3299 (sh), 3294, 1744, 1658, 1649 cm^{-1}; 1H NMR: 1.40 (d, J = 7.3, 3H), 2.01 (s, 3H), 3.75 (s, 3H), 4.59 (deceptive quintuplet, J = 7.3, 1H), 6.48 (br s, 1H (NH)); 13C NMR: 18.1, 22.8, 47.8, 52.2, 169.6, 173.4.

Methyl 2-acetylamino-5-phenyl-4-pentenoate, **15c**. Mp 76-78°C; bp 135-140°C (oven temp)/0.3-0.4 mmHg; IR (KBr): 3273, 3271, 1783, 1650 cm^{-1}; 1H NMR: 2.02 (s, 3H), 2.61-2.81 (m, 2H), 3.77 (s, 3H), 4.77 (dt, J = 5.7, 11.3, 1H), 6.03 (apparent quintuplet, J = 7.3, 1H), 6.46 (d, J = 15.7, 1H), 7.20-7.35 (m, 5H). Anal. Calcd for $C_{14}H_{17}NO_3$: C, 68.00; H, 6.93; N, 5.66. Found: C, 67.84; H, 6.83; N, 5.57.

Methyl *N*-acetyl-3,3-diphenylalaninate, **15d**. Mp 166-167°C (pentane-dichloromethane); IR (KBr): 3247, 1746, 1637 cm^{-1}; 1H NMR: 1.82 (s, 3H), 3.41 (s, 3H), 4.33 (d, J = 8.8, 1H), 5.33 (apparent t, J = ca 8.8, 1H), 5.6 (br d, J = ca. 8.8, 1H (NH)), 7.20 (m, 10H); 13C NMR: 22.9, 52.0, 53.5, 55.3, 127.1, 127.2,

128.1, 128.4, 128.5, 128.7, 139.4, 139.9, 169.8, 172.7. Anal. Calcd for $C_{18}H_{19}NO_3$: C, 72.71; H, 6.44; N, 4.71. Found: C, 72.42; H, 6.01; N, 5.02.

Schmidt rearrangements of oxazolidinones **16a-e**.

5-((4*S*)-4-Benzyl-2-oxo-3-oxazolidinyl)-2-methyloxazole, **18e**. (Typical experiment, run 9).

Methanesulfonic acid (4.5 mL) was dropwise added to a stirred solution of oxazolidinone **16e** (1.0 g, 3.8 mmole) in DME (5 mL) cooled at -30°C. Then sodium azide (0.75 g, 11.5 mmole) was portionwise added and the mixture was left to reach room temperature till evolution of nitrogen ceased (ca. 3 hours). More DME (15 mL) and 30% Ammonium hydroxide was added till pH ca. 9. The mixture was evaporated (see final remarks) and the residue was partitioned between dichloromethane and water. The organic layer was dried and evaporated and the residue was digested with diethyl ether to afford 0.44 g (45%) of **18e**: mp 94-95°C (diethyl ether); IR (KBr): 1752 cm^{-1}; 1H NMR: 2.39 (s, 3H), 2.86 (dd, J = 13.7 and 8.2, 1H), 3.12 (dd, J = 13.7 and 4.6, 1H), 4.20 (dd, J = 8.1 and 4.6, 1H), 4.41 (dd, J = 15.7 and 8.1, 1H), 4.45 (m, 1H), 6.88 (s, 1H), 7.10-7.35 (m, 5H); 13C NMR: 13.9, 38.9, 57.9, 67.4, 117.7, 127.2-129.3 (5C), 134.5, 142.1, 154.4, 157.9; SDEPT experiment: transfer from protons at δ 2.39 (CH_3-C-2) enhances the signal at 157.9 (C-2); MS (m/z): 258 (M, 39), 167 (58), 91 (22), 82 (100), 54 (23), 43 (27); $[\alpha]_D$ = + 25 (c = 1.43; $CHCl_3$). Anal. Calcd for $C_{14}H_{14}N_2O_3$: C, 65.09; H, 5.47; N, 10.85. Found: C, 65.15; H, 5.57; N, 10.36.

5-((4*S*)-4-Benzyl-2-oxo-3-oxazolidinyl)-2,4-dimethyloxazole, **18a**

Mp 99-100°C; IR (KBr): 1770 cm^{-1}; 1H NMR: 2.08 (s, 3H), 2.32 (s, 3H), 2.79 (dd, J = 13.5 and 8.5, 1H), 3.10 (dd, J = 13.5 and 4.4 Hz, 1H), 4.1-4.5 (m, 3H), 7.20 (m, 5H); 13C NMR: 10.6, 13.7, 38.7, 58.1, 67.4, 126.8, 128.3, 128.6, 130.7, 134.4, 135.9, 155.0, 158.4; SDEPT experiments: transfer from protons at δ 2.32 (CH_3-C-2) enhances the signal at δ 158.4 (C-2) and pulsing at δ 2.08 (CH_3-C-4) enhances signals at 130.7 and 135.9 (C-4 and C-5 or the reverse). $[\alpha]_D$ = + 40.2 (c = 1.71; $CHCl_3$). Anal. Calcd for $C_{15}H_{16}N_2O_3$: C, 66.16; H, 5.92; N, 10.29. Found: C, 66.21; H, 5.79; N, 10.31.

4-Benzyl-5-((4*S*)-4-Benzyl-2-oxo-3-oxazolidinyl)-2-methyloxazole, **18b**

Oil; IR (film): 1771 cm^{-1}; 1H NMR: 2.37 (s, 3H), 2.54 (dd, J = 13.9 and 9.1, 1H), 2.85 (dd, J = 13.9 and 4.8, 1H), 3.85 (s, 2H), 3.88 (m, 1H), 3.98 (dd, J = 8.6 and 6.2, 1H), 4.07 (dd, J = 16.8 and 8.6, 1H), 6.96-7.33 (m, 10H); 13C NMR: 14.2, 32.3, 39.0, 58.2, 67.6, 126.4-137.6 (14C), 155.3, 159.1; SDEPT experiment: transfer from protons at δ 2.37 (CH_3-C-2) enhances the signal at 159.1 (C-2); MS (m/z): 348 (M, 39), 172 (29), 144 (20), 117 (48), 103 (27), 91 (37), 43 (100); $[\alpha]_D$ = + 27 (c = 2.33, $CHCl_3$). Anal. Calcd for $C_{21}H_{20}N_2O_3$: C, 72.38; H, 5.79; N, 8.04. Found: C, 71.91; H, 5.77; N, 8.09.

5-((4*S*)-4-Benzyl-2-oxo-3-oxazolidinyl)-2-methyl-4-(2-phenylethyl)oxazole, **18c**.

Oil; IR (film): 1774 cm^{-1}; 1H NMR: 2.41 (s, 3H), 2.57 (dd, J = 13.7 and 9.3, 1H), 2.69-2.84 (m, 3H), 2.98 (t, J = 7.7, 2H), 3.86-3.97 (m, 1H), 4.07 (dd, J = 8.8 and 6.4, 1H), 4.25 (apparent t, J = 8.8, 1H), 7.01-7.28 (m, 10H); 13C NMR: 14.3, 27.7, 34.1, 39.0, 58.3, 67.6, 126.0-129.4 (m), 134.7, 136.4, 141.4, 155.3, 159.2; SDEPT experiment: transfer from protons at δ 2.41 (CH_3-C-2) enhances the signal at 159.2 (C-2); MS (m/z): 362 (M, 23), 271 (100), 117 (68), 91 (91), 43 (38).

5-((4*S*)-4-Benzyl-2-oxo-3-oxazolidinyl)-4-cinnamyl-2-methyloxazole, **18d**.

Mp 84-86°C; IR (KBr): 1774 cm^{-1}; 1H NMR: 2.38 (s, 3H), 2.76 (dd, J = 13.7 and 8.6, 1H), 3.02 (dd, J = 13.7 and 4.6, 1H), 3.41 (d, J = 6.9, 2H), 4.04-4.10 (m, 1H), 4.22-4.34 (m, 2H), 6.32 (dt, J = 15.7 and 6.9, 1H), 6.56 (d, J = 15.7, 1H), 7.18-7.39 (m, 10H); 13C NMR: 14.2, 29.6, 39.1, 58.5, 67.7, 125.2-128.8, 132.2, 133.3, 134.6, 136.9, 155.4, 159.2; SDEPT experiment: transfer from protons at δ 2.38 (CH_3-C-2) enhances the signal at 159.2 (C-2); MS (m/z): 374 (M, 54), 332(64), 331 (20), 170 (36), 157 (30), 156 (77), 129 (25), 128 (50), 127 (23), 117 (55), 115 (44), 91 (62), 43 (100).

N-(2-(Acetylamino)propionyl)-(4*S*)-4-Benzyl-2-oxo-3-oxazolidinone, **17a** (Mixture of diastereoisomers).

Mp 183-184°C (dichloromethane-hexanes); IR (KBr): 3264, 1789, 1773, 1705, 1660, 1663 cm^{-1}; 1H NMR: 1.38 and 1.46 (d, J = 6.9, 3H), 2.02 (s, 3H), 2.76 (m), 3.35 (dd, J = 13.5 and 2.6), 4.18 (m), 4.50 (q, J = 6.9) and 4.63 (m), 5.57 (apparent quintuplet, J = 6.9), 6.35 (br d, J = 6.2), 7.25 (m); 13C NMR: 14.9 and

17.9, 22.9 and 26.5, 37.4 and 37.7, 45.9 and 48.2, 55.3 and 55.5, 63.4, 127.3, 128.9, 129.3, 129.4, 135.0, 169.6, 173.5. Anal. Calcd for $C_{15}H_{18}N_2O_4$: C, 62.06; H, 6.25; N, 9.65. Found: C, 62.37; H, 6.07; N, 9.69.

N-(2-(Acetylamino)-3-phenylpropionyl)-(4*S*)-4-Benzyl-2-oxo-3-oxazolidinone, **17b**.(One diastereoisomer of unknown configuration at the *N*-chain, separated from the mixture by digestion in diethyl ether).

Mp 146-148°C; IR (KBr): 3311, 1777, 1714, 1639 cm^{-1}; 1H NMR: 1.96 (s, 3H), 2.78 (dd, J = 13.5 and 9.5, 1H), 2.92 (dd, J = 13.9 and 8.6, 1H), 3.19 (dd, J = 13.9 and 5.5, 1H), 3.27 (dd, J = 13.5 and 3.3, 1H), 4.07 (dd, J = 16.3 and 9.0, 1H), 4.15 (dd, J = 9.0 and 2.7, 1H), 4.56 (m, 1H), 5.96 (dt, J = 8.0 and 5.5, 1H), 6.18 (d, J = 7.3, 1H (NH)), 7.20-7.36 (m, 10H); 13C NMR: 22.8, 37.4, 37.9, 52.9, 55.5, 66.3, 127.0-135.7, 152.6, 169.7, 172.2; $[\alpha]_D$ = + 118 (c = 1.03, $CHCl_3$). Anal. Calcd for $C_{21}H_{22}N_2O_4$: C, 68.84; H, 6.05; N, 7.65. Found: C, 68.42; H, 5.76; N, 7.70.

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