PREPARATION OF CROWN ETHERS WITH ISOXAZOLYL-LARIATS: HOMOLOGATION OF ISOXAZOLE ALDEHYDES, AND A CRITICAL COMPARISON OF LARIAT FUNCTIONAL MOIETIES FOR LANTHANIDE EXTRACTION

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Abstract - A critical comparison of several lariat ether functional moieties is presented. The synthesis of two isoxazolyl-lariat ethers is described. The lariat ether (**2**, n=1) undergoes ß-fragmentation on electron transfer reductive ring-opening with samarium diiodide. The isoxazole moiety was then homologated to overcome this problem, and isoxazole lariat ether (**2**, n=3) was obtained. The isoxazole (**2**, n=3) and ß-diketone (**3**, n=3) crowns were evaluated in lanthanide shift studies and liquid-liquid extraction studies. Finally, lateral metalation and electrophilic quenching with carbon dioxide produced the carboxylic acid (**12**) which proved to be an efficient ligand for the liquid-liquid extraction of lanthanides.

Lariat ethers are molecules which contain a crown ether macrocycle in combination with a pendant lariat capable of complexing a guest molecule.[1] It has been previously reported by Wai[2] that dibenzo-16-crown-5-6-oxyacetic acid is an effective host for extraction of f-block element ion guests into organic solvent. A series of extraction controls, as well as ir and ^{1}H nmr studies of the lanthanum complexes of these lariat ethers, led Wai and co-workers to the conclusion that both lariat and cavity were necessary for extraction success. The report by the groups of Bartsch and Lipscomb, of the structure of the lithium complex of dibenzo-14-crown-4-oxyacetic acid, indicates that the tether n=1 is not sufficiently long for the metal ion to reach both lariat and macrocyclic cavity, and in fact, a water molecule was found in between the lithium ion and the carboxylate group in the crystal structure.[3] Examination of molecular models and computer-aided modeling suggested that for the dibenzo-16-crown-5-6-oxyacetic acid complex with lanthanum, when the carboxylate is bound to the lanthanide ion, the "bottom" of the macrocyclic cavity could not be directly involved with complexation. We concluded that in terms of optimizing extraction efficiency and/or selectivity, it would be useful to compare crown ethers containing lariats capable of bringing both cavity and lariat to bear on binding the metal ion. In connection with our interest in the chemistry of isoxazoles,[4]

we postulated that an isoxazole moiety could serve as a latent bidentate ligand which on ring opening would provide an enaminone or ß-diketonate which could capture a metal ion (i.e, structure (**4**) in Figure 1), and allow for further interaction with the macrocyclic cavity (as in structure (**5**) in Figure 1). Further, the selectivity of this process could be rationally studied by the systematic variation of parameters germane to host-guest complexation utilizing the chemistry of the isoxazole moiety.[4,5] We report herein a critical comparison of two variables considered important for extraction efficiency: tether length and functional moieties.

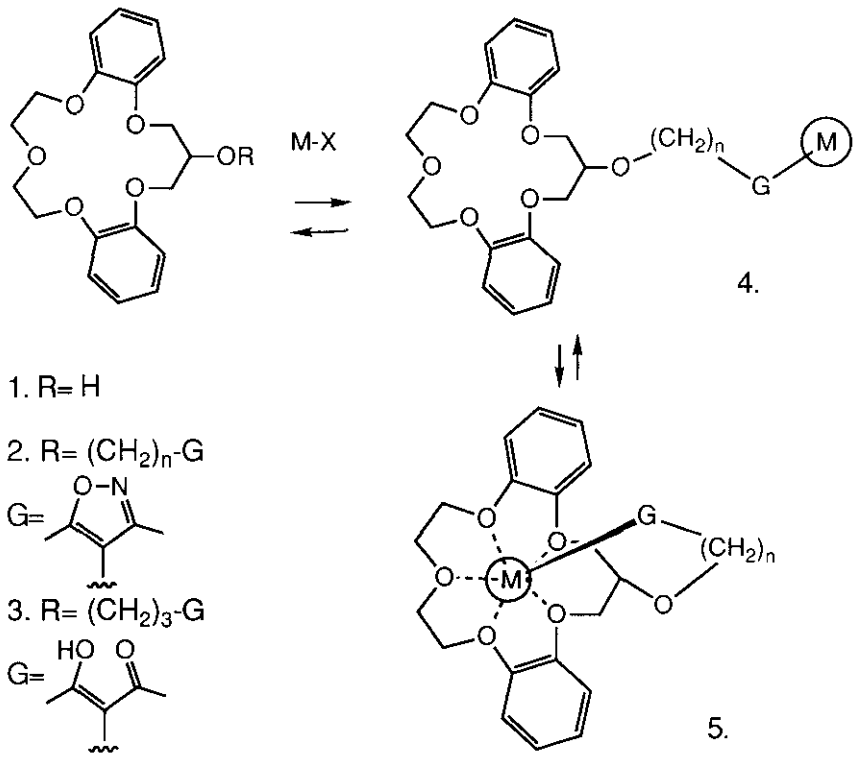


Figure 1. Synthetic scheme and possible conformations of lariat crown ethers.

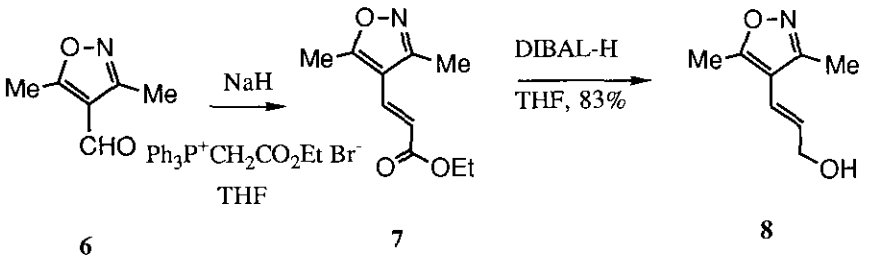
The hydroxydibenzo-16-crown-5 (**1**) in anhydrous THF was treated with sodium hydride, followed by 3,5-dimethyl-4(iodomethyl)isoxazole, and the resultant isoxazole-crown (**2**) was isolated by ptlc (SiO_2, EtOAc/CH_2Cl_2/hexane, 1:1:1) followed by recrystallization to give the desired product (**2**, n=1) as sharp-melting white needles, mp 98-99°C. During studies of complexation designed to use an

enaminone lariat, with tether length n=1, we observed that ring opening of the isoxazole precursor (**2**) with samarium diiodide was accompanied by ß-fragmentation , i.e. via (**4**) or (**5**), to give (**1**). Although this reaction is not without synthetic potential, this ß-fragmentation presented a serious problem for complexation studies.

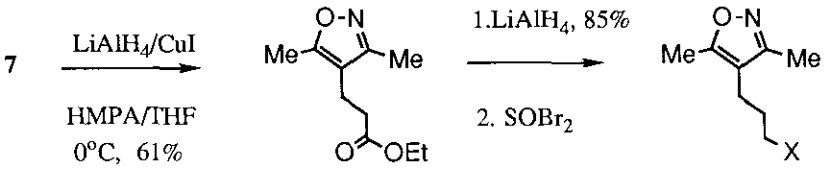
We then turned our attention to an isoxazole functional group with an extended carbon chain at the C-4 position. Our strategy toward this end is illustrated in Figure 2, and included Wittig olefination of known aldehyde (**6**),[4o] followed by selective reduction. Catalytic hydrogenation and dissolving metal reduction are common methods for effecting conjugate reduction of α,ß-unsaturated carbonyl compounds, however, both of these tactics are well known for facile cleavage of the oxygen-nitrogen bond of isoxazoles.[5] We considered, then, the rich chemistry of the hydrides of boron and aluminum. The hydride reduction of unsaturated ester (**7**) is further complicated by two additional possibilities, both 1,6- with respect to the ester moiety, both with literature precedent: hydride attack at the C=N[6] or the O-C=C[7] double bonds. We have found that after considerable experimentation, a copper catalyzed lithium aluminum hydride reduction method does perform selective 1,4-reduction to produce (**9**). Since an authentic sample of allylic alcohol (**8**) was required as an analytical standard, we also report herein that diisobutyl aluminum hydride (Dibal-H) effects clean 1,2-reduction to allylic alcohol (**8**).

Initial attempts involving lithium aluminum hydride under a variety of conditions (solvent, time, temperature), produced mixtures of allylic and saturated alcohols, (**8**) and (**10**) respectively. Cerium trichloride/ sodium borohydride under the standard conditions gave unchanged starting material. Dibal-H cleanly produced the allylic alcohol (**8**) in reproducibly high yields.[8] We then turned to the various recipes for "copper hydride" , we encountered only one, the method of Saegusa,[9a] which produced saturated ester (**9**) in moderate yield and good reproducibility. Even this procedure's success is dependent on careful attention to reaction time and temperature, since temperatures higher than 0°C produce apparent isoxazole ring opening and reaction times greater than 3 hours produce side products which were assigned as arising from aldol condensation. The rest of the synthesis was performed by standard methodology, as outlined below. Reduction of saturated ester (**9**) with lithium aluminum hydride produced the homologated alcohol (**10**) in excellent yield. The corresponding bromide (**11**) could be prepared from alcohol (**10**) by reaction with thionyl bromide. The bromide (**11**) was added to the sodium alkoxide of the hydroxy dibenzo-16-crown-5 (**1**) to give isoxazole crown (**2**, n=3). This key

intermediate (**2**, n=3) was obtained after purification by radial chromatography, followed by recrystallization, as a solid, mp 136-138°C. Reductive ring opening of isoxazole (**2**, n =3) with molybdenum hexacarbonyl or raney nickel, followed by chromatography, produced the crown ß-diketone (**3**).



6 **7** **8**

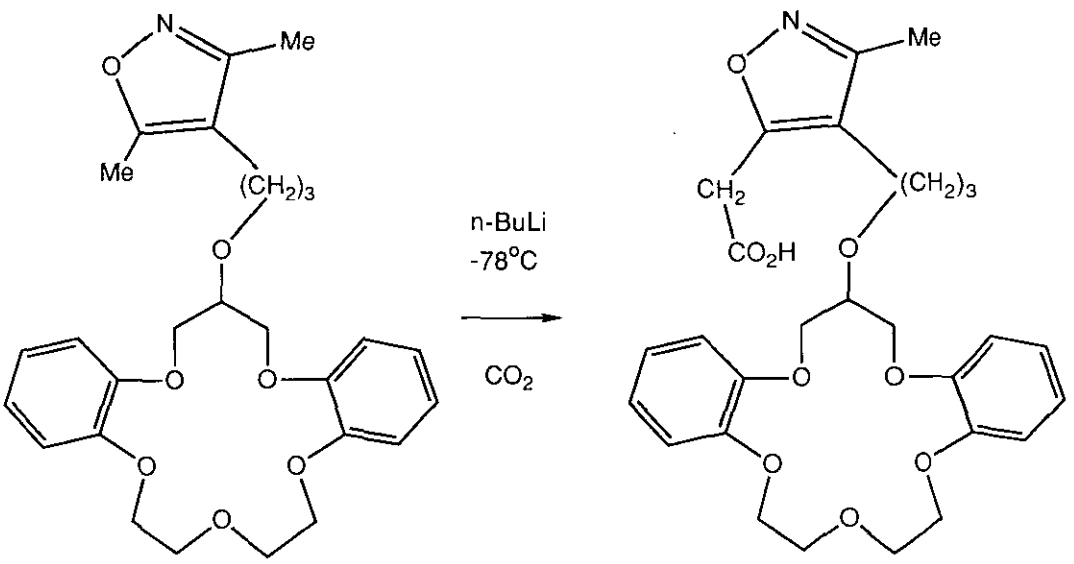


9

10. X=OH

11. X=Br

The compounds, as well as relevant controls, were evaluated both by lanthanide induced shift (LIS) studies, and by the liquid-liquid extraction method of Wai.[2a,10] Using the method of Gokel,[11] the ^{13}C nmr of the complex of **1** with a lanthanide shift reagent ($Yb(fod)_3$) showed that only the carbons of the acetic acid moiety, and the "pivot" carbon were shifted significantly. LIS studies were conducted using lanthanide shift reagents with the isoxazole crown (**2**, n=3), the methyl signal corresponding to C-3 shifts dramatically, while the cavity protons are largely unaffected. This indicates an interaction through the nitrogen lone pair.[12] In liquid-liquid extraction studies, the isoxazole crown (**2**) did not extract lanthanides into the organic phase at neutral pH. Although 70 % of lutetium was extracted at pH 14 with picrate co-anion, this represented only 10% improvement over picrate alone. Only slightly better results were obtained for the ß-diketone (**3**).



2, n=3 **12**

Thus, for lanthanide liquid-liquid extraction efficiency it appeared that the functional group G in the lariat moiety should have a pKa more comparable to the oxy-acetic acid moiety as originally reported by Wai. The synthesis of **12** was accomplished by lateral metalation of the crown isoxazole (**2**, n=3) and electrophilic quenching with carbon dioxide. The extraction efficiency was studied by the partitioning of lanthanum between organic and aqueous phases, and **12** extracts 99.8% of the lanthanum into the organic phase at neutral pH (i.e., $[La^{3+}]$organic/$[La^{3+}]$ aqueous >300). The extraction efficiency for (**12**) is approximately an order of magnitude superior to that of the dibenzo-16-crown-5-6-oxyacetic acid ($[La^{3+}]$organic/$[La^{3+}]$ aqueous *ca.* 20). This observation appears to support the Wai model (i.e., involvement of **5**) in that the lariat tether is both long enough for the metal ion to complex simultaneously with the carboxylate and crown cavity, and the isoxazole ring possesses a built-in bend which preorganizes the conformation of the chelating appendage.

The complexation results reported herein suggest that the lanthanide ion interacts with the crown ether cavity through second sphere waters of hydration.[13] Although the spatial relation between the crown ether moiety and pendant binding group may be quite different for compounds (**2**) and (**12**), we tentatively conclude that the pK_a of the lariat functional group should be approximately 5 for effective liquid-liquid extraction of lanthanide elements. This general synthesis sets the stage for the development

of a new class of lariat ether ligands. Further study is currently under investigation in our laboratories, and our results will be reported in due course.

ACKNOWLEDGEMENT

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EXPERIMENTAL SECTION

Reactions conducted under inert atmosphere were done so after several cycles of evacuation and nitrogen purging. Tetrahydrofuran was distilled from sodium and benzophenone. Dimethyl sulfoxide was distilled from calcium hydride. Radial chromatography was performed on a Harrison Associates Chromatotron. Preparative hplc was performed on a Rainin Rabbit System, using a silica gel column unless otherwise noted. All chromatography solvents were distilled. Hydroxy-sym-dibenzo-16-crown-5 (**1**)was prepared by the method of Bartsch.[10] Commercial reagents were purified by recrystallization or distillation before use. Nmr spectra were obtained on an IBM AF300 (300 MHz for ^{1}H) or a JEOL FX90Q (90 MHz for ^{1}H). Ir spectra were obtained on a Digilab FTS-80 or Qualimatic spectrophotometers. Mass spectra were obtained on a VG Micromass 70/70 HS Mass spectrometer. Combustion Analyses were performed by Desert Analytics , Tucson. AZ.

4-[(sym-Dibenzo-16-crown-5-oxy)methyl]-3,5-dimethylisoxazole (2, n=1).

To sodium hydride (100%, 0.14 g, 6 mmol) was added a THF solution of hydroxy-dibenzo-16-crown-5 (**1**) (1.73 g, 5 mmol), dropwise at room temperature. After 30 min, a solution of freshly prepared 3,5-dimethyl-4-iodomethylisoxazole (1.3 g, 5.5 mmol) in 15 ml of THF was added dropwise over 3 h. Stirring was continued for an additional 10 h, after which time the THF was evaporated *in vacuo*, and water (100 ml) was added. The aqueous layer was extracted with CH_2Cl_2 (3 x 50 ml), and the combined organic layers were washed with 5% aqueous hydrochloric acid, saturated sodium bicarbonate solution, and water. The organic layer was dried over anhydrous sodium sulfate, filtered and concentrated to produce (**2**, n=1) as an oil. Isoxazole-crown (**2**,n=1) was isolated by ptlc (SiO_2, EtOAc/CH_2Cl_2/hexane, 1:1:1) followed by recrystallization from petroleum ether/ CH_2Cl_2 (10:1) to give the desired product (**2**, n=1) as sharp-melting white needles, mp 98-99°C (1.79 g, 79%). ^{1}H Nmr: ∂ 6.94-7.00 (m, 4H); 6.84-6.89 (m, 4H); 4.68 (s, 2H); 4.28-4.33 (dd, J = 7.6 and 2.6 Hz, 2H); 4.12-

4.22(m, 7H); 3.87-4.0 (m, 4H); 2.42 (s, 3H); 2.35 (s, 3H). Mass Spectrum: m/z 455 (23% relative intensity, M^+), 110 (100, 3,5-dimethyl-isoxazole-4-CH_2^+). Anal. Calcd for $C_{25}H_{29}NO_7$: C, 65.93; H, 6.41; N, 3.07. Found: C, 65.97; H, 6.49; N, 2.91.

Ethyl 3-[3',5'-Dimethylisoxazol-4'-yl]prop-2-en-1-onate (7).

To a 250 ml round bottom flask, equipped with a reflux condenser and constant addition funnel, was added sodium hydride (100%, 0.74 g, 30 mmol). Freshly distilled dimethyl sulfoxide (20 ml) was introduced via syringe, and the mixture was heated with stirring to 70-75°C for 45 min. The resulting grey solution of dimsyl sodium was cooled to 0°C and (carbethoxymethyl)triphenylphosphonium bromide (12.87 g, 30 mmol) in DMSO (50 ml) was added dropwise over 5 min.The resulting dark red solution of the ylide was stirred at room temperature for 15 min, after which time a solution of 3,5-dimethylisoxazole-4-carboxaldehyde (**6**) (3.125 g, 25 mmol) in DMSO (10 ml) was added dropwise. The reaction mixture was stirred at room temperature for 3 h, and was then warmed to 60°C for 2 h. After cooling to room temperature, cold water (200 ml) was added, and the mixture was extracted with hexane (5 x 100 ml) . The combined organic extracts were washed with water, and dried over anhydrous sodium sulfate. Filtration, concentration and distillation on a Kugelrohr apparatus gave **7** bp 70°C (0.3 mmHg) (4.592 g, 94%) as an oil which solidified on standing. ^{1}H Nmr: ∂ 7.40 (d, J=16.1 Hz, 1H); 6.12 (d, J=16.1 Hz, 1H); 4.25 (q, J=7.1 Hz, 2H); 2.50 (s, 3H); 2.38(s, 3H); 1.33 (t, J=7.1 Hz, 3H). Anal. Calcd for $C_{10}H_{13}NO_3$: C, 61.52; H, 6.71; N, 7.17. Found: C, 61.32; H, 6.69; N,7.13.

Synthesis of 3-(3',5'-Dimethylisoxazol-4'-yl)prop-2-en-1-ol, (8). Unsaturated ester (7) (571.6 mg, 2.928 mmol) was dissolved in freshly distilled THF(25 ml) and cooled to 0° C with stirring under N_2. DIBAL-H (6.45 ml , 1.0 M in THF) was added dropwise to this cooled solution; and the solution was allowed to warm to room temperature overnight (19 h). Distilled water was added until no further gas evolution was observed and formation of $Al(OH)_3$ was complete. This was then washed with CH_2Cl_2 (200 ml, several portions), and the combined CH_2Cl_2 layers were dried over $MgSO_4$, filtered, and concentrated *in vacuo*. Flash distillation of this residue produced **8** as a colorless oil , bp 75-77° C (372.6 mg, 83% yield). Tlc analysis was carried out (SiO_2, hexane/ CH_2Cl_2/EtOAc, 5:2:2; R_f=0.28). Ir: 3387, 3050, 3028, 2962, 2928, 2865, 1452, 1429, 1212, 1099, 967, 910, 734 cm^{-1}. ^{1}H Nmr (300 MHz): ∂=6.30 (dt, J_{ab}=16.2, J_x=1.5, 1H), 6.05 (dt, J_m=5.4, J_{ab}=16.2, 1H), 4.30 (dd, J_m=5.4, J_x=1.5, 2H), 2.50 (br. s, 1H), 2.40 (s, 3H), 2.31 (s, 3H). ^{13}C Nmr: 165.5, 158.2, 130.3, 118.4, 112.2, 63.5, 11.5, 11.2. Mass Spectrum (EI): m/z=153 (M^+, 37.0% rel. intensity), 136 (6.2), 124

(13.3), 110 (31.8), 97 (100), 82 (24). Anal. Calcd for $C_8H_{11}NO_2$: C, 62.73; H, 7.24; N, 9.14. Found: C, 62.54; H, 7.16 ; N, 9.11

Conjugate reduction, preparation of 9. A 50 ml three neck flask equipped with an airless storage tube was charged with cupric iodide (4 mmol), anhydrous THF (20 ml), and HMPA (1 ml), and cooled to 0°C under nitrogen. Lithium aluminum hydride powder (38 mg, 1 mmol) was introduced to the slurry, on addition a deep black color is produced immediately, after 5 min the unsaturated ester (**7**) (195 mg, 1 mmol) was added dropwise. The reaction mixture was stirred at 0°C for 1 h, after which time water was added and the mixture was extracted with ether (3 x 25 ml). The combined organic layers were washed with water (3 x 10 ml) and dried over anhydrous magnesium sulfate. Filtration, concentration and distillation on a Kugelrohr apparatus produced **9** as an oil , bp 70°C(0.1 mmHg),(0.128 g 65%). An analytical sample was obtained by ptlc (SiO_2, hexane/EtOAc, 4:1, R_f =0.33). ^{1}H Nmr: ∂ 4.07 (q, 2H); 2.59 (t, J =7.1 Hz, 3H); 2.42(m, 2H); 2.29 (s, 3H); 2.19 (s, 3H); 1.97(t, J = 7.1 Hz, 3H). Mass spectrum: m/z 197 (23.25 % rel intensity); 152 (8), 124(19), 110(100). Ir: 2985, 1736($\nu_{C=O}$), 1639, 1179. Anal. Calcd. for $C_{10}H_{15}NO_3$: C, 60.89; H, 7.77; N, 7.10. Found: C, 60.75; H, 7.44; N, 6.94.

3,5-Dimethyl-4-[prop-3'-yl-1'-ol]isoxazole (10). Saturated ester (**9**) (275 mg, 1.4 mmol) was dissolved in 100 ml of freshly distilled THF, and cooled to 0°C under nitrogen. Lithium aluminum hydride (2 ml of a 1M solution in THF) was added via syringe. The solution was stirred at 0°C for 2 h, after which time distilled water was added, and the mixture was extracted with ether (3 X 25 ml). The solution was dried over anhydrous magnesium sulfate, filtered, concentrated *in vacuo* and flash distilled on a Kugelrohr apparatus (95°C/0.1 mm Hg) to give alcohol (**10**) as an oil (0.166 g, 76%). ^{1}H Nmr ($CDCl_3$): ∂ 3.56(t, J = 6.0 Hz, 2H); 2.34 (t, J = 7.4 Hz, 2H); 2.29(s, 3H); 2.19(s, 3H); 1.70 (m, 2H). Ir: 3410, 2930, 2866, 1639, 1452, 1425, 1383, 1196, 1059, 908. Mass spectrum: m/z 155(M^+, 37.6 % rel. intensity), 124(19.3), 110(92), 68 (100). Anal. Calcd for $C_8H_{13}NO_2$: C, 61.91; H, 8.44; N, 9.03. Found: C, 61.54; H, 8.57; N, 9.26.

3,5-Dimethyl-4-[prop-3'-yl-1'-bromo]isoxazole, (11). A 25 ml round bottom flask was charged with alcohol (**10**) (0.155 g, 1 mmol), and methylene chloride (10 ml), and cooled to 0°C. Thionyl bromide (80 µl, 1 mmol) was added slowly by syringe, and the resulting solution was allowed to warm to room temperature overnight. The brown solution was poured into water (50 ml), and extracted with CH_2Cl_2 (3 x 25 ml). The combined organic layers were washed with aqueous 5% HCl, saturated

sodium bicarbonate, brine, and dried over anhydrous sodium sulfate. Filtration and concentration gave an oil which was flash distilled on a Kugelrohr apparatus, bp 70-80°C (0.05 mmHg), to produce **11** as an oil (0.198 g, 91%). ^{1}H Nmr: ∂ 3.38 (t, J= 10 Hz,2H); 2.49(t, J= 7.5 Hz, 2H); 2.34 (s, 3H); 2.22 (s, 3H); 2.00 (tt, J = 10 and 7.5 Hz, 2H). Mass spectrum (EI): m/z 219 (8.17 % rel. intensity), 217(8.2); 110(100), 68 (65.4). Anal. Calcd. for C_8H_{12} NOBr: C, 44.05; H, 5.55; N, 6.42. Found: C, 43.91; H, 5.45; N, 6.42.

4-[3'-{*sym*-Dibenzo-16-crown-5-oxy}-prop-1'-yl]-3,5-dimethylisoxazole (**2**, n=3). To sodium hydride (100%, 0.12 g, 5 mmol) was added a solution of hydroxy-dibenzo-16-crown-5 (**1**) (1.34 g, 4 mmol) in THF dropwise at room temperature. After stirring for 30 min, bromide (**11**) (0.87 g, 4 mmol) in 15 ml of THF was added dropwise over 2 h. The reaction mixture was stirred for 4 h, and then refluxed for 12 h. The THF was concentrated *in vacuo*, water was added, and the mixture was extracted with chloroform (3 x 25 ml). The combined organic layers were washed with 5% aqueous HCl, saturated sodium bicarbonate, and water, and then dried over anhydrous sodium sulfate. Filtration and concentration gave crude **2** (n=3) as a solid. Purification was effected by radial chromatography (SiO_2, hexane / EtOAc, 3:1; tlc: R_f=0.17), followed by recrystallization from petroleum ether/ CH_2Cl_2 (5:1), producing (**2**, n=3) as a white solid, mp 136-138°C (1.31g, 68%). ^{1}H Nmr (300 MHz): ∂ 6.93-6.99 (m, 4H); 6.84-6.89 (m, 4H); 4.28-4.33 (dd, J = 9.2 and 4.3 Hz, 2H); 4.06-4.17(m, 7H); 3.87-4.02(m, 4H, -CH_2OCH_2-); 3.74 (t, J=6.2 Hz, 2H, isoxazole C-4-$CH_2CH_2CH_2O$); 2.47 (t, J = 7.5 Hz, 2H, isoxazole C-4-$CH_2CH_2CH_2O$); 2.32 (s, 3H, isoxazole C-5 CH_3); 2.23 (s, 3H, isoxazole C-3 CH_3); 1.80 (m, 2H, isoxazole C-4-$CH_2CH_2CH_2O$). Mass spectrum (EI): m/z 483 (M^+, 55.1% rel. intensity); 136(100); 110 (isoxazole C-4 CH_2+, 67.33). CI- m/Z 484 ($M+1^+$, 100). Anal. Calcd for $C_{27}H_{33}NO_7$: C, 67.06; H, 6.88; N, 2.90. Found: C, 66.89; H, 6.75; N, 2.80.

Diketone (**3**, n=3). A solution of **2** (n=3) (0.725 g, 1.5 mmol) in acetonitrile (30 ml, which contained 0.25 ml of water) was treated with molybdenum hexacarbonyl (0.2 g) and heated to reflux for 4 h. Celite was added to the cooled solution, and the resulting slurry was filtered, and chromatographed on silica gel (ethyl acetate/hexane, 1:1) to give ß-diketone (**3**) as a solid (0.704 g, 96%), which was recrystallized from hexane/CH_2Cl_2 (5:2),mp 105-107°C. ^{1}H Nmr: ∂ 6.89-6.96 (m, 4H); 6.80-6.86 (m, 4H); 4.25-4.29(dd, J = 9.6 and 4.8 Hz, 2H); 4.10-4.15(m, 7H); 3.84-3.91(m, 4H); 3.74 (m, 2.5H, includes enol C(OH)=C); 2.37 (m, 0.5 H, CO-CH-CO); 2.15 (s, CH_3 C(OH)=C enol form, 3H); 2.14 (s, CH_3CO- keto form, 3H); 1.98 (m, 2H); 1.60 (m, 2H). ^{13}C Nmr: 204.6, 191.2 (enol), 150.46, 148.4, 123.0,

121.2, 118.6, 113.2, 110, 77.5, 71.6, 69.99, 69.6, 68.3, 67.67, 31.1, 29.2, 27.9, 25.2,.24.1, 22.95. Ir: 1720.5, 1702.2 cm^{-1}. Mass Spectrum: m/z 486 (35.9 % rel. intensity, M^+). Anal. Calcd for $C_{27}H_{34}O_8$: C, 66.65; H, 7.04. Found: C, 66.69; H, 6.82.

Raney nickel reduction gave a crude product, after filtration of the catalyst, which appeared to be the enaminone based on ^{13}C nmr: 197.4, 159.55, 150.3, 148.4, 122.9, 121.5, 118.4, 113.2, 104.3, 77.4,.71.45, 70.1, 69.5, 67.6, 31.5, 27.7, 25.4, 21.1. Further purification by chromatography on silica gel, however, resulted in ß-diketone (**3**).

Lateral Metalation, preparation of isoxazole carboxylic acid (12). To a solution of **2** (n=3) (1 g, 2 mmol) in THF (25 ml) at -78°C was added n-butyllithium (1 ml of a 2.25 M solution in hexane). After 2 h , solid CO_2 was added, and the mixture was allowed to warm to room temperature. The mixture was acidified by the addition of aqueous HCl to pH<1, the THF was concentrated *in vacuo*, and the solid residue was chromatographed on silica gel (CH_2Cl_2/methanol, 1:1). The product (**12**) was recrystallized from ethyl acetate, mp 151-152°C (0.55 g, 52%). Ir: 1708.9 cm^{-1}. ^1H Nmr: ∂ 6.90-6.96 (m,4H); 6.82-6.87 (m, 4H); 4.23-4.28(dd, J = 9.8 and 4.6 Hz, 2H); 4.15-4.17 (m, 7H); 3.91-3.94 (m, 4H); 3.70 (s, 2H); 3.66 (t, J= 6 Hz, 2H); 2.47 (t, J = 7.4 Hz, 2H); 2.21 (s, 3H); 1.77 (m, 2H). ^{13}C Nmr: 171, 160.9, 159.9, 150, 148.3, 122.9, 121.4, 118.1, 115.3, 113.4, 77.2, 71.2, 69.4, 68.5, 67.7, 31.5, 29.2, 18.3, 10.2. Mass Spectrum : m/z 527 (0.3 % rel. intensity). Anal. Calcd for $C_{28}H_{33}NO_9$: C, 63.74; H, 6.30; N, 2.65. Found: C, 63.78; H, 6.24; N, 2.64.

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