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Doubly Deprotonated Methyl 3-Nitropropanoate, an Acrylic Ester d^2-Reagent[1)]

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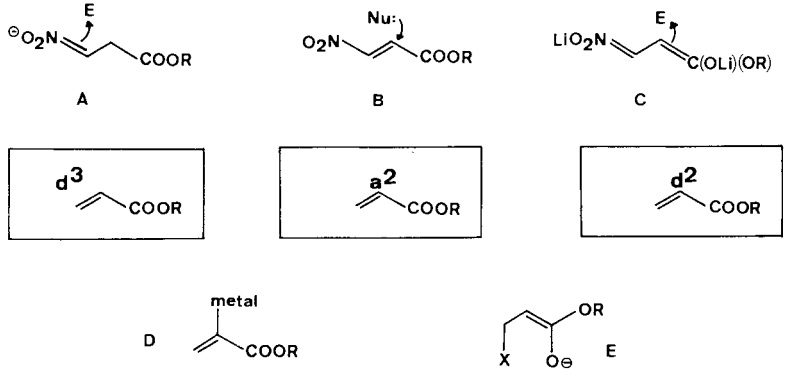
Methyl 3-nitropropanoate can be doubly deprotonated with LDA, both in the α-nitro and in the α-carbonyl position (→ **1**). It is shown that the necessary cosolvent HMPT can be replaced by the cyclic urea DMPU, with almost equal results. The new reagent **1** is alkylated and hydroxyalkylated by alkyl halides and aldehydes, respectively, at the 2-position exclusively (see **2**, **4**, **6**, **7**). A double alkylation to methyl α,α-dialkyl-β-nitropropanoate **5** is possible. Elimination of HNO_2 with DBN or even better with DBU in THF furnishes methyl α-methylenealkanoates **9** and methyl β-hydroxy-α-methylenealkanoates **10**.

Doppelt deprotonierter 3-Nitropropionsäure-methylester, ein Acrylester-d^2-Reagenz[1)]

Überschüssiges LDA deprotoniert β-Nitropropionester sowohl in der α-Nitro- wie in der α-Carbonyl-Stellung zu **1**. Neben dem Solvens THF ist ein aktivierendes Cosolvens nötig; es wird gezeigt, daß das dazu geeignete, aber nicht ungefährliche Hexametapol (HMPT) praktisch ohne Ausbeuteeinbußen durch die cyclischen Harnstoffe DMEU und DMPU ersetzt werden kann, sogar zum Erzeugen von LDA aus dem Amin und Butyllithium. Das neue Reagenz **1** setzt sich mit Alkylhalogeniden und Aldehyden in hohen Ausbeuten zu 2-substituierten 3-Nitropropionaten um (s. **2**, **4**, **6**, **7**). Auch eine doppelte Alkylierung zu α,α-Dialkyl-β-nitropropionaten **5** ist möglich. Eliminierung von HNO_2 zu den α-Methylenestern **9** und zu den β-Hydroxy-α-methylenestern **10** gelingt mit DBN oder DBU in THF. Damit ist **1** ein Acrylester-d^2-Reagenz, siehe das zugehörige Synthon **C**.



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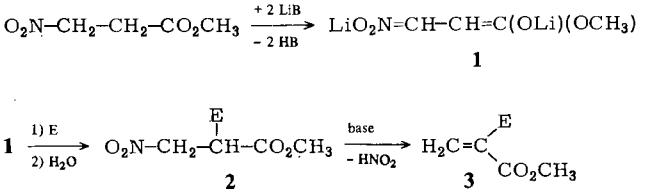
The functionalities of the nitro group (stronger acceptor, more acidifying, leaving group) and of the ester group (weaker acceptor, less acidifying, no leaving group) render the simple compounds alkyl 3-nitropropanoate and -propenoate useful synthetic reagents. Thus, the saturated derivative has been used as an enone[5] or an acrylic ester[6] d^3-reagent **A**, while 3-nitroacrylate is an acrylic ester or α-methylene lactone a^2-reagent **B**[7]. We show in this paper[1] that 3-nitropropanoic ester can be employed as an acrylic ester d^2-reagent **C**, through the dilithio derivative of its doubly deprotonated[8] form, thus offering an alternative to the direct nucleophilic α-acrylations with **D**[9] and to the application of other leaving group-substituted enolates **E**[10].

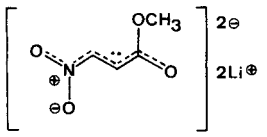
In the following sections we describe the three steps of the sequence converting methyl 3-nitropropanoate to α-substituted acrylates: (i) the double deprotonation furnishing the reagent **1**, (ii) its reactions with electrophiles leading to α-branched β-nitropropanoates of type **2**, and (iii) the HNO_2-elimination to give **3**.



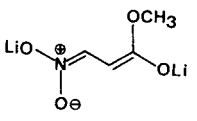
A) Preparation of THF Solutions of the Reagent 1 in the Presence of Different Cosolvents

The non-nucleophilic base lithium diisopropylamide (LDA) is known to deprotonate both esters[11] and nitroalkanes[12]. When methyl 3-nitropropanoate was treated with two equivalents of this base in tetrahydrofuran (THF) at −76°C, an immediate precipitation of a solid ensued, and subsequent addition of benzaldehyde did not lead to the isolation of the expected product. (Since deuterolysis and NMR or MS analysis were not a satisfactory method of following the lithiation in the present case, all optimization experiments were carried out with benzaldehyde as an electrophile; the nitro-hydroxy ester formed is described below.) If, however, two equivalents of an LDA solution in THF/hexamethylphosphoric triamide (HMPT) (5:1) was treated at −76°C with one equivalent of the nitro ester, an exothermic reaction led to a clear, light yellow solution which was routinely stirred for 30 − 60 min before addition of the electrophile. As is evident from the entries 2 − 7 of Table 1, the yield of the adduct to benzaldehyde depends crucially upon the ratio in which the reagent **1** and the electrophile are employed: best results are obtained with ca. 25% *excess of the electrophile.* This was confirmed with other carbonyl compounds and with an alkyl halide as well. Hence, in most subsequent experiments the electrophiles were used in excess. Precious compounds may be recovered, cf. the preparation of **6d** in the experimental section. We have no indication that reaction at the α-nitro, i. e. β-ester carbon causes the strange, hitherto inexplicable necessity of using the electrophile in excess.

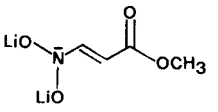
The structure of **1** is unknown; we believe that it is highly unlikely to exist as an ionic six atom-eight electron π-system **1a**, much more reasonable is the Li-nitronate-Li-enolate structure **1b**, also possible a bis(lithiooxy)enamine form **1c** (super-enamine[8]); even less sure is the configuration (*syn-* or *anti-*; the addition to aldehydes is not diastereoselective[13]).



1a



1b



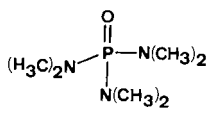
1c

Table 1. Optimization experiments for the generation of reagent **1** from methyl 3-nitropropanoate in THF/cosolvents. Test electrophile: benzaldehyde. Product: methyl 3-hydroxy-2-(nitromethyl)-3-phenylpropanoate (**6c**) (see section A and experimental section). Temperature −76 °C. All yields are calculated from the *minor* component

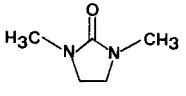
No.	cosolvent	ratio THF/cosolv.	ratio **1**/C_6H_5CHO	adduct yield [%]
1	–	∞	1/1	<5
2	HMPT	5/1	2.4/1	51
3	HMPT	5/1	1.36/1	55
4	HMPT	5/1	1.2/1	65–70
5	HMPT	5/1	1/1	60
6	HMPT	5/1	1/1.27	84
7	HMPT	5/1	1/1.58	86
8	DMPU	5/1	2.4/1	71
9	DMPU	5/1	1.2/1	56
10	DMPU	5/1	1/1.27	71
11	DMPU	2/1	1/1.27	76
12	DMEU[a]	2/1	1/1.27	64

[a] This experiment was carried out at −30 °C, the procedure being identical to that for entry 11 in all other respects.

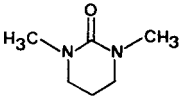
Reportedly[14], the aprotic dipolar solvent HMPT has carcinogenic activity under certain conditions. This restricts its use to small scale applications in research laboratories. It was shown that ureas such as the cyclic derivatives *N,N'*-dimethyl-*N,N'*-ethylenurea (DMEU)*) and -propylenurea (DMPU)*) have physical properties similar to those of HMPT[15,16]. It remained to be demonstrated, whether highly nucleophilic and strongly basic reagents could be handled in the presence of these ureas, or whether carbonyl addition, eliminations, and/or metalations at their α-N−CH_2- and −CH_3-positions occur[15a,17].



HMPT



DMEU



DMPU

In order to check the feasibility of generating **1** in the presence of ureas rather than of HMPT, we have done the following experiments: Addition of *n*-butyllithium to a mixture of THF/DMPU (5:1) at −75 °C caused a highly exothermic reaction, and sub-

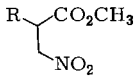
*) Systematic names 1,3-dimethyl-2-imidazolidinone and 3,4,5,6-tetrahydro-1,3-dimethyl-2(1*H*)-pyrimidinone, respectively.

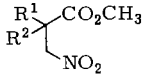
sequent addition of benzaldehyde did not lead to any butylphenylcarbinol. Albeit more slowly, *n*-butyllithium reacted with DMPU even at −90 °C. On the other hand, LDA does not react with a 33% DMPU solution in THF at least below −35 °C. Furthermore, when a mixture of THF/DMPU (ratio 5:1) and diisopropylamine was treated at −35 °C with *n*-butyllithium, an immediate exothermic reaction led to the formation of LDA! To this solution methyl 3-nitropropanoate was added to give the reagent **1** which separated as a solid. At a THF/DMPU ratio of 2:1 only a slightly turbid solution of **1** resulted, and yields of combination with benzaldehyde and other electrophiles were comparable to those obtained in HMPT-containing mixtures, see Table 1, entries 8 – 11 (DMPU), and 12 for a similar effect of DMEU.

Since a heavy precipitation occurs below ca. −30 °C from a 2:1-mixture of THF and DMEU, while a 2:1-mixture of THF and DMPU is still clear and homogenous at −78 °C, we believe that DMPU will become generally more useful than DMEU.

B) Preparation of Branched Nitroesters 2 from the Dilithio Derivative 1 and Electrophiles

Upon treatment of solutions of **1** with primary and secondary iodoalkanes and with allyl and benzyl bromides the alkylated products **4** were isolated in good yields after the usual workup. The monomethylated and -ethylated derivatives **4** could be converted to dilithio compounds once more – *in situ* or after isolation and purification – to give double alkylation products such as **5a** and **b**.

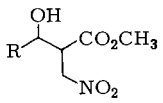


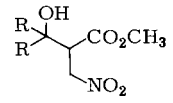


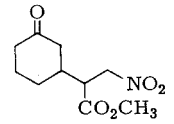
4	R	%
a	CH_3	74
b	$H_2C{=}CHCH_2$	72
c	$n\text{-}C_4H_9$	68
d	$n\text{-}C_6H_{13}$	72

4	R	%
e	$n\text{-}C_8H_{17}$	66
f	$(CH_3)_2CH$	78
g	$C_6H_5CH_2$	80
h	C_2H_5	

5	R^1	R^2	%
a	C_2H_5	$H_2C{=}CHCH_2$	62
b	CH_3	$C_6H_5CH_2$	71







6	R	%
a	C_2H_5	48
b	$n\text{-}C_5H_{11}$	79
c	C_6H_5	84
d	$3,4\text{-}(CH_3O)_2C_6H_3$	60

7	R	R	%
a	CH_3	CH_3	15
b	$-[CH_2]_5-$		27

8 (35%)

The formation of the hydroxy-nitro ester **6c** was used for the optimization experiments of section A. All products **6** are ca. 3:2 mixtures of the two possible diastereomers.

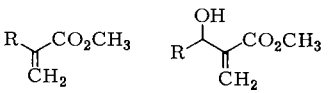
Attempts to kinetically favour one of them by carrying out the reaction at temperatures as low as −100 °C or with very short reaction times at −78 °C were not successful. Likewise, the isomer ratio could not be changed significantly by warming up the reaction mixture to 0 °C and then cooling rapidly to −76 °C before quenching with acid and working up. To ketones such as acetone and cyclohexanone the dianion derivative **1** adds in poor yields, see **7a** and **b**, and with cyclohexenone the Michael adduct **8** is formed.

In view of the importance of α-methylene-γ-lactones[18a], we tried to open epoxides with the reagent **1** and to alkylate it with bromohydrine derivatives; only the latter reaction led to a modest yield of the desired product.

C) Dehydronitration of Nitro Esters of Type 2 to α-Methylene Esters 3 with DBN or DBU

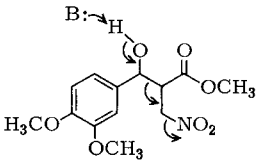
Given a chance, i. e. in the absence of α-hydrogens, or in the presence of groups acidifying the β-hydrogens, the nitro group exhibits a leaving group ability comparable to that of the halides[1b,18b]. In contrast to the strong base LDA, which was used for irreversibly deprotonating the α-nitro position in the generation of the reagent **1**, weakly basic conditions had to be sought for the HNO_2-elimination. We explored the use of the *Eiter* bases[19] 1,5-diazabicyclo[4.3.0]non-5-ene (DBN) and 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU), the special properties of which have been demonstrated in other elimination processes[19]. We find, that DBN in benzene or in dimethylsulfoxide (DMSO) eliminates HNO_2 from the alkylated nitro esters **4** to give excellent yields of the α-alkylated acrylates **9**.

9	R	%
a	$H_2C{=}CHCH_2$	89
b	*n*-C_4H_9	67
c	*n*-C_6H_{13}	65
d	*n*-C_8H_{17}	90
e	$C_6H_5CH_2$	85



10	R	%
a	C_2H_5	80
b	*n*-C_5H_{11}	90
c	C_6H_5	84
d	3,4-$(CH_3O)_2C_6H_3$	67

11



However, when the hydroxy-nitro ester **6d** was treated with DBN/DMSO, 3,4-dimethoxybenzaldehyde was isolated in high yield. Instead of the expected product **10d** of elimination, a fragmentation had taken place, probably as indicated in **11**. In benzene rather than in DMSO, this undesired reversal of our synthesis could be suppressed. Generally best results were obtained with DBU in THF, see the yields given with formula **10**, and the experimental section.

We thank the *Fluka AG* (Buchs) for samples of the ureas DMEU and DMPU, the *Bayer Aktiengesellschaft* (Leverkusen) for providing us with DBN and DBU. – A stipend given to T. M. by the *Sandoz AG* (Basel) is gratefully acknowledged.

Experimental Part

Instruments and presentation of data: Refer to our earlier work[20]. Elemental analyses and spectral data of the compouds are presented in Table 2.

Chemicals: All solvents were distilled (constant boiling fractions from technical grade material). THF was distilled freshly from potassium benzophenone ketyl solution after prior distillation from potassium hydroxide. Diisopropylamine (after preliminary drying for two days over potassium hydroxide), DMSO, HMPT (both after preliminary drying for two days over barium oxide), DMPU, DMEU, DBN and DBU were distilled from calcium hydride under reduced pressure (diisopopylamine at atmospheric pressure) and stored in serum-capped bottles under argon over molecular sieves (diisopropylamine, DMPU, DMEU, DMSO – 4 Å; HMPT – 10 Å; DBN, DBU – none). All electrophiles (except veratraldehyde) were distilled under argon at convenient pressure and stored in serum-capped bottles under argon (aldehydes in refrigerator). Veratraldehyde (Fluka) was used as received. Hexane solution of *n*-butyllithium (Metallgesellschaft AG) was standardised by titration using the diphenylacetic acid method[21]. 3-Nitropropanoic acid was either purchased (Fluka) or prepared according to the published procedure[22].

Unless otherwise mentioned all reactions were carried out under positive argon pressure using standard syringe techniques[23]. All temperatures reported in the metalation experiments are internal temperatures.

Preparation of methyl 3-nitropropanoate: To a solution of 3-nitropropanoic acid (22 g, 180 mmol) in anhydrous methanol (325 ml) was added concentrated sulfuric acid (4.5 ml). The reaction mixture was refluxed for 8 h (protected from moisture), then concentrated to one-fourth of its volume (flash evaporator), ether (250 ml) was added and the organic phase washed with water (thrice with 50 ml portions). After drying the organic phase over $MgSO_4$ the solvent was stripped off in a flash evaporator and the residue vacuum distilled to give a colourless liquid (18 g, 73.5%), b. p. 63 °C/0.5 Torr (Lit.[24] 68 °C/1 Torr), d = 1.24.

General procedure (GPIa – c) for the preparation of 11.2 mmol of reagent **1**: A solution of diisopropylamine (3.6 ml, 25.4 mmol) in the particular solvent system in *Note 1* (60 ml) was cooled to −35 °C. To this cold solution was added *n*-butyllithium in hexane (16 ml, 25.2 mmol), it was stirred for 10 min at about −35 °C and then for 20 min at −76 °C. Methyl 3-nitropropanoate (1.2 ml, 11.2 mmol) was then added all at once (*Note 2*) and routinely stirred for 30 – 60 min (*Note 3* and *4*). Double deprotonation was assumed to be quantitative and molar amounts of reagent **1** actually corresponds to the molar amounts of methyl 3-nitropropanoate.

Note 1: GPIa – THF/HMPT = 5/1; GPIb – THF/DMPU = 5/1; GPIc – THF/DMPU = 2/1.

Note 2: During addition temperature may rise to as high as −50 °C for a brief period but this does not affect the yield as evidenced by the yield of **6c** upon subsequent reaction with benzaldehyde.

Note 3: For GPIb, a suspension was obtained within minutes and subsequent stirring was always for 60 min. For GPIc, only a turbid solution was obtained.

Note 4: Stirring period could be as short as 15 min since subsequent reaction with benzaldehyde, following GPIa, gave comparable yield of **6c**.

General procedure (GPII) for the alkylations of **1** *with alkyl halides:* To the reagent **1** in the particular solvent system (GPIa – c) at −76 °C was added the alkyl halide and the reaction mixture allowed to warm up to −25 °C over 4 h. Glacial acetic acid (4 ml/11.2 mmol of reagent **1**) was added followed after 5 min by water, and the hydrolysed reaction mixture was allowed to warm

Table 2. Elemental analyses, IR and NMR data

Compound (Molecular formula) Elemental analysis C H N	IR (a) Film, (b) nujol mull cm^{-1} (assignment)	^1H and ^{13}C NMR Solvent: (a) CCl_4, (b) $CDCl_3$ δ [ppm] (multiplicity, coupling constant, assignment)
$O_2NCH_2CH_2CO_2CH_3$ ($C_4H_7NO_4$)	(a) 3000, 2960, 2925, 2850, 1740 (C=O), 1555 (NO_2), 1440, 1425, 1405, 1375, (NO_2), 1340, 1305, 1260, 1225–1200, 1180, 1075, 1030, 1005, 975, 960, 870, 850, 655	(b) 2.98 (t, J = 6 Hz, CH_2CO), 3.76 (s, OCH_3), 4.66 (t, J = 6 Hz, CH_2NO_2)
4a ($C_5H_9NO_4$) Calc. 40.82 6.17 9.52 Found 41.31 6.24 8.95	(a) 2980, 2950, 2880, 2845, 1738, (C=O), 1555 (NO_2), 1450, 1437, 1380 (NO_2), 1245, 1204, 1178, 1150, 1079, 984, 956, 899, 838, 756, 709, 642	(a) 1.26 (d, J = 6.7 Hz, CH_3), 3.08–3.44 (m, CHCO), 3.73 (s, OCH_3), 4.38–4.88 (m, CH_2NO_2)
4b ($C_7H_{11}NO_4$) Calc. 48.55 6.40 8.09 Found 50.36 6.33 7.46	(a) 3080, 3005, 2955, 2930, 2870, 1740, (C=O), 1639, 1555, (NO_2), 1440, 1420, 1380 (NO_2), 1270–1150, 1050, 994, 923 (CH=CH_2)	(b) 2.23–2.71 (m, CH_2 γ-NO_2), 3.15–3.51 (m, CH β-NO_2), 3.79 (s, OCH_3), 4.30–4.92 (m, CH_2NO_2), 5.00–5.36 (m, =CH_2), 5.5–5.98 (m, CH=)
4c ($C_8H_{15}NO_4$) Calc. 50.78 7.99 7.40 Found 51.29 8.14 7.32	(a) 2960, 2930, 2870, 1737 (C=O), 1555 (NO_2), 1433, 1377 (NO_2), 1245, 1200, 1183, 1037, 972, 845, 730	(b) 0.76–1.88 (m, n-C_4H_9), 3.08–3.48 (m, CH β-NO_2), 3.80 (s, OCH_3), 4.32–4.96 (m, CH_2NO_2)
4d ($C_{10}H_{19}NO_4$) Calc. 55.28 8.81 6.44 Found 54.78 8.73 6.00	(a) 2960–2920, 2855, 1740 (C=O), 1555 (NO_2), 1455, 1433, 1420, 1380 (NO_2), 1250, 1200, 1170, 1042, 970, 842, 787, 761, 722	(a) 0.86 (t, J = 6.8 Hz, CH_3), 1.15–1.5 (m, $[CH_2]_4$), 1.5–1.8 (m, CH_2 γ-NO_2), 3.0–3.4 (m, CH β-NO_2), 3.73 (s, OCH_3), 4.28–4.85 (m, CH_2NO_2)
4e ($C_{12}H_{23}NO_4$) Calc. 58.75 9.45 5.71 Found 57.98 9.39 5.25	(a) 2955, 2925, 2855, 1740 (C=O), 1555 (NO_2), 1470–1420, 1377 (NO_2), 1280–1150, 1045, 973, 842, 721	(a) 0.88 (t, J = 7 Hz, CH_3), 1.1–1.5 (m, $[CH_2]_6$), 1.48–1.78 (m, CH_2 γ-NO_2), 3.04–3.36 (m, CH β-NO_2), 3.77 (s, OCH_3), 4.38–4.88 (m, CH_2NO_2) ^{13}C-NMR: (b) 14.07 (CH_3), 22.76, 26.78, 29.40, 31.95 ($[CH_2]_7$), 43.14 (CH β-NO_2), 52.17 (OCH_3), 75.41 (CH_2NO_2), 172.87 (C=O)
4f ($C_7H_{13}NO_4$) Calc. 48.00 7.48 8.00 Found 48.20 7.36 7.59	(a) 2985, 2900, 1745 (C=O), 1570 (NO_2), 1480, 1452, 1435, 1390 (NO_2), 1300–1150, 1055, 989, 863, 720	(a) 0.97 (d, J = 7 Hz, 2 CH_3), 1.7–2.3 (m, CH of isopropyl), 2.75–3.23 (m, CH β-NO_2), 3.65 (s, OCH_3), 4.1–4.9 (m, CH_2NO_2)

Table 2 (*continued*)

Compound (Molecular formula) Elemental analysis C H N	IR (a) Film, (b) nujol mull cm^{-1} (assignment)	^1H and ^{13}C NMR Solvent: (a) CCl_4, (b) $CDCl_3$ δ [ppm] (multiplicity, coupling constant, assignment)
4g ($C_{11}H_{13}NO_4$) Calc. 59.19 5.87 6.27 Found 59.36 5.80 6.28	(a) 3080, 3060, 3025, 2955, 2925, 1740 (C=O), 1550 (NO_2), 1494, 1435, 1417, 1377 (NO_2), 1245, 1200, 1172, 1098, 1075, 1040, 970, 845, 743, 700	(a) 2.64 – 3.2 (m, CH_2Ar), 3.24 – 3.52 (m, CH β-NO_2), 3.67 (s, OCH_3), 4.2 – 4.7 (m, CH_2NO_2), 7.08 – 7.4 (m, C_6H_5)
4h ($C_6H_{11}NO_4$) Calc. 44.72 6.88 8.69 Found 46.05 6.99 8.02	(a) 2975, 2955, 2880, 1738 (C=O), 1560 (NO_2), 1460, 1435, 1422, 1377 (NO_2), 1253, 1200, 1174, 970	(a) 0.99 (t, J = 7.1 Hz, CH_3), 1.52 – 1.84 (m, CH_2 γ-NO_2), 3.0 – 3.43 (m, CH β-NO_2), 3.77 (s, OCH_3), 4.3 – 4.93 (m, CH_2NO_2)
5a ($C_9H_{15}NO_4$) Calc. 53.71 6.96 7.51 Found 53.30 6.75 7.44	(a) 3080, 3065, 3035, 2995, 2960, 1740 (C=O), 1555 (NO_2), 1498, 1470, 1420, 1375 (NO_2), 1220, 1125, 1000 – 940, 869, 815, 791, 776, 741, 702	(a) 1.91 (t, J = 7.3 Hz, CH_3), 1.68 (q, J = 7.3 Hz, CH_2 of ethyl), 2.48 (d, J = 7.5 Hz, CH_2 of allyl), 3.78 (s, OCH_3), 4.64 (AB system, J = 12.3 Hz, CH_2NO_2), 5.02 – 5.33 (m, $=CH_2$), 5.5 – 5.98 (m, $-CH=$) ^{13}C NMR: (b) 8.12 (CH_3), 26.46 (CH_2 of ethyl), 36.56 (CH_2 of allyl), 49.97 (C β-NO_2), 52.34 (OCH_3), 77.53 (CH_2NO_2), 120.34 ($=CH_2$), 131.64 (CH=), 173.26 (C=O)
5b ($C_{12}H_{15}NO_4$) Calc. 60.75 6.38 5.90 Found 59.84 6.32 5.73	(a) 3090, 3065, 3035, 2995, 2960, 1740 (C=O), 1555 (NO_2), 1498, 1470, 1375 (NO_2), 1220, 1125, 1000 – 940, 869, 815, 791, 776, 741, 702	(a) 1.27 (s, CH_3), 2.94 (AB system, J = 12.9 Hz, CH_2Ar), 3.86 (s, OCH_3), 4.55 (AB system, J = 13.7 Hz, CH_2NO_2), 7.03 – 7.43 (m, C_6H_5) ^{13}C NMR: (b) 19.87 (CH_3), 42.28 (CH_2 benzylic), 46.97 (C β-NO_2), 52.30 (OCH_3), 86.30 (CH_2NO_2), 127.43, 128.54, 130.26, 135.18 (aromatic), 173.73 (C=O)
6a ($C_7H_{13}NO_5$) Calc. 43.97 6.85 7.33 Found 43.15 6.85 6.82	(a) 3600 – 3300 (OH), 2980, 2945, 2885, 1740 (C=O), 1565 (NO_2), 1465, 1445, 1385 (NO_2), 1255, 1210, 1190, 1125, 1050, 990	(b) 0.98 (t, J = 7.5 Hz, CH_3), 1.33 – 1.73 (m, CH_2 β-hydroxyl), 2.7 (m, OH), 3.16 – 3.53 (m, CH β-NO_2), 3.66 – 4.06 (m, CH α-hydroxyl), 3.75 (s, OCH_3), 4.46 – 5.1 (m, CH_2NO_2) ^{13}C NMR (of diastereomeric mixture): (b) 9.51 and 9.77 (CH_3), 27.39 and 27.78 (CH_2 δ-NO_2), 48.30 and 48.56 (CH β-NO_2), 52.15 and 52.25 (OCH_3), 71.58 and 71.67 (CHOH), 72.26 and 73.07 (CH_2NO_2), 171.04 and 171.77 (C=O)

Table 2 (*continued*)

Compound (Molecular formula) Elemental analysis C H N	IR (a) Film, (b) nujol mull cm^{-1} (assignment)	^1H and ^{13}C NMR Solvent: (a) CCl_4, (b) $CDCl_3$ δ [ppm] (multiplicity, coupling constant, assignment)
6b ($C_{10}H_{19}NO_5$) Calc. 51.49 8.21 6.00 Found 51.40 8.21 5.77	(a) 3600 – 3300 (OH), 2960, 2925, 2855, 1740 (C=O), 1555 (NO_2), 1435, 1375 (NO_2), 1435, 1375 (NO_2), 1280 – 1160, 1120, 1070, 1045, 1020, 967	(b) 0.88 (t, J = 7 Hz, CH_3), 1.1 – 1.75 (broad m, $[CH_2]_4$), 2.4 – 2.65 (m, OH), 3.2 – 3.54 (m, CH β-NO_2), 3.77 (s, OCH_3), 3.65 – 4.25 (m, CH α-hydroxyl), 4.45 – 5.1 (m, CH_2NO_2)
6c ($C_{11}H_{13}NO_5$) Calc. 55.23 5.48 5.85 Found 55.33 5.59 5.87	(a) 3600 – 3400 (OH), 3060, 3030, 2955, 2920, 1742 (C=O), 1570 (NO_2), 1442, 1380 (NO_2), 1204, 1060, 1040, 1028, 968, 912, 850, 770, 745, 700, 655	(b) 2.72 and 3.13 (2 d, J = 4 Hz, OH, diastereomer), 3.3 – 3.75 (m, CH β-NO_2), 3.66 and 3.7 (2 s, OCH_3, diastereomer), 4.25 – 5.05 (m, CH_2NO_2), 5.03 and 5.2 (2 t, J = 4 Hz, CH α-hydroxyl), 7.37 (s, C_6H_5) ^{13}C NMR (of diastereomeric mixture): (b) 50.20 and 50.59 (CH β-NO_2), 52.40 (OCH_3), 71.56, 72.12, 72.31, 72.51 (CH_2NO_2 and CHAr), 125.44, 125.78, 128.27, 128.61, 128.70, 139.80, 139.94 (aromatic), 171.08 (C=O)
6c (single diastereomer) ($C_{11}H_{13}NO_5$)		(b) 2.85 (d, J = 4 Hz, OH), 3.36 – 3.7 (m, CH β-NO_2), 3.64 (s, OCH_3), 4.39 (dd centered at, J = 15 and 3.5 Hz, CH*H*NO_2), 4.86 (dd centered at, J = 15 and 9 Hz, C*H*HNO_2), 5.19 (broad t, CHAr) ^{13}C NMR: (b) 50.82 (CH β-NO_2), 52.53 (OCH_3), 71.81 and 72.35 (CH_2NO_2 and CHAr), 125.63, 128.45, 128.79, 140.17 (aromatic), 171.28 (C=O)
6d ($C_{13}H_{17}NO_7 \cdot H_2O$) Calc. 49.21 6.04 4.41 Found 49.21 6.13 4.41	(b) 3560 (OH), 3500 (OH), 3450 (OH), 2960 – 2900, 2850, 1730 (C=O), 1710 (C=O), 1660, 1630, 1605, 1590, 1550 (NO_2), 1545 (NO_2), 1515, 1465, 1445, 1425, 1380, 1315, 1300, 1260, 1240, 1215, 1200, 1175, 1160, 1140, 1110, 1060, 1040, 1020, 970, 955, 910, 870, 850, 815, 800, 765, 730, 690	(b) 2.92 and 3.3 (2 d, J = 3 Hz, OH, diastereomer), 3.35 – 3.7 (m, CH β-NO_2), 3.67 and 3.7 (2 s, CO_2CH_3, diastereomer), 3.84 (s, $(OCH_3)_2$ ring), 4.36 – 4.96 (m, CH_2NO_2), 4.9 – 5.23 (m, CH α-hydroxyl), 6.8 and 6.85 (2 s, C_6H_3 aromatic) (signals from water not included)

Table 2 (*continued*)

Compound (Molecular formula) Elemental analysis C H N	IR (a) Film, (b) nujol mull cm^{-1} (assignment)	^1H and ^{13}C NMR Solvent: (a) CCl_4, (b) $CDCl_3$ δ [ppm] (multiplicity, coupling constant, assignment)
6d (single diastereomer) ($C_{13}H_{17}NO_7 \cdot H_2O$)	(b) 3570 (OH), 3450 (OH), 2980, 2925, 2855, 1710 (C=O), 1660, 1605, 1590, 1555 (NO_2), 1520, 1465, 1445, 1420, 1380, 1260, 1215, 1205, 1180, 1155, 1140, 1040, 1020, 965, 950, 865, 855, 815, 630, 615	(b) 3.13 (d, J = 4 Hz, OH), 3.35 – 3.7 (m, CH β-NO_2), 3.74 (s, CO_2CH_3), 3.87 (s, $(OCH_3)_2$ ring), 4.4 – 4.65 (m, CH_2NO_2), 4.9 – 5.1 (dd, J = 4 and 7.5 Hz, CH α-hydroxyl), 6.82 (s, C_6H_3 aromatic) (signals from water not included)
7a ($C_7H_{13}NO_5$) Calc. 43.97 6.85 7.33 Found 44.11 6.63 7.78	(a) 3600 – 3300 (OH), 1735 (C=O), 1560 (NO_2), 1443, 1382 (NO_2), 1255, 1210, 1140, 1050, 970, 925, 910	(a) 1.20 (s, CH_3), 1.30 (s, CH_3), 2.57 (s, OH), 3.06 – 3.33 (m, CH β-NO_2), 3.77 (s, OCH_3), 4.55 – 4.8 (m, CH_2NO_2)
7b ($C_{10}H_{17}NO_5$) Calc. 51.94 7.41 Found 52.58 7.42	(a) 3600 – 3300 (OH), 2940, 2860, 1725 (C=O), 1550 (NO_2), 1435, 1375 (NO_2), 1270 – 1130, 1030, 982, 960, 788, 762	(a) 1.15 – 1.8 (m, $[CH_2]_5$), 2.37 (broad s, OH), 3.15 – 3.35 (m, CH β-NO_2), 3.78 (s, OCH_3), 4.58 – 5.05 (m, CH_2NO_2)
8 ($C_{10}H_{15}NO_5$) Calc. 52.40 6.60 6.11 Found 51.14 6.23 6.23		(a) 1.0 – 2.4 (m, $CH_2CO[CH_2]_3$), 2.6 – 3.4 (m, CH β-NO_2 and CH γ-NO_2), 3.69 and 3.72 (2 s, OCH_3, diastereomer), 4.3 – 5.05 (m, CH_2NO_2)
9a ($C_7H_{10}O_2$)	(a) 3090, 2970, 2920, 2860, 1720 (C=O), 1630, 1440, 1260, 1220, 1150, 1095, 1020, 950, 920, 820, 800	(a) 3.04 (broad d, J = 7 Hz, CH_2), 3.75 (s, OCH_3), 4.97 – 5.39 (m, $=CH_2$ δ-C=O), 5.53 (m, =CH β-C=O, *trans* to ester), 5.59 – 6.05 (m, CH= γ-C=O), 6.15 (broad s, =CH β-C=O, *cis* to ester) (Lit.[25])
9b ($C_8H_{14}O_2$) Calc. 67.57 9.92 Found 66.90 9.66	(a) 2960, 2935, 2880, 1725 (C=O), 1632, 1441, 1288, 1214, 1140, 1090, 1020, 948, 821 (Lit.[33])	(b) 0.94 (t, J = 7 Hz, CH_3), 1.15 – 1.6 (m, $[CH_2]_2$), 2.25 (m centered at, CH_2 of allyl), 3.75 (s, OCH_3), 5.48 (m centered at, =CH), 6.07 (m centered at, =CH) (Lit.[33])

Table 2 (*continued*)

Compound (Molecular formula) Elemental analysis C H	IR (a) Film, (b) nujol mull cm^{-1} (assignment)	^1H and ^{13}C NMR Solvent: (a) CCl_4, (b) $CDCl_3$ δ [ppm] (multiplicity, coupling constant, assignment)
9c ($C_{10}H_{18}O_2$) Calc. 70.54 10.66 Found 70.01 10.67	(a) 2965 – 2920, 2860, 1725 (C=O), 1631, 1533, 1465 – 1430, 1403, 1378, 1331, 1290, 1250, 1195, 1150, 1094, 1000, 960, 817, 725, 685	(a) 0.88 (broad t, CH_3), 1.15 – 1.65 (m, $[CH_2]_4$), 2.1 – 2.4 (m, CH_2 of allyl), 3.70 (s, OCH_3), 5.43 (m centered at, =CH), 6.04 (m centered at, =CH)
9d ($C_{12}H_{22}O_2$) Calc. 72.68 11.18 Found 72.70 11.17	(a) 2965, 2935, 2805, 1729 (C=O), 1633, 1465, 1442, 1203, 1155, 948, 823 (Lit.[31])	(a) 0.90 (t, J = 7 Hz, CH_3), 1.32 (m centered at, $[CH_2]_6$), 2.33 (m centered at, CH_2 of allyl), 3.80 (s, OCH_3), 5.57 (m centered at, =CH), 6.12 (m centered at, =CH) (Lit.[31])
9e ($C_{11}H_{12}O_2$) Calc. 74.97 6.86 Found 74.11 6.72	(a) 3080, 3040, 3025, 3000, 2950, 2840, 1720 (C=O), 1630, 1605, 1558, 1532, 1491, 1435, 1279, 1252, 1200, 1132, 1071, 1027, 993, 947, 830, 812, 748, 700, 598	(b) 3.62 (broad s, CH_2Ar), 3.73 (s, OCH_3), 5.43 (m centered at, =CH), 6.23 (m centered at, =CH), 7.24 (m centered at, C_6H_5) (Lit.[32])
10a ($C_7H_{12}O_3$) Calc. 58.32 8.39 Found 57.94 8.58	(a) 3550 – 3400 (OH), 2970, 2940, 2880, 1720 – 1700 (C=O), 1630, 1460, 1440, 1400, 1380, 1320, 1300 – 1260, 1200, 1160, 1100, 1055, 1020, 990, 960, 880, 855, 820, 780, 730, 715, 675	(b) 0.93 (t, J = 7.5 Hz, CH_3), 1.4 – 1.9 (m, CH_2), 2.4 – 2.8 (broad s, OH), 3.79 (s, OCH_3), 4.2 – 4.5 (broad m, CH α-hydroxyl), 5.8 (m, =CH *trans* to ester), 6.25 (s, =CH *cis* to ester)
10b ($C_{10}H_{18}O_3$) Calc. 64.49 9.74 Found 64.55 9.90	(a) 3500 – 3400 (OH), 2955, 2930, 2860, 1720 (C=O), 1630, 1440, 1400, 1380, 1330, 1310 – 1250, 1195, 1160, 1115, 1070, 1030, 995, 950, 905, 855, 820	(b) 0.7 – 1.1 (broad t, CH_3), 1.1 – 1.9 (m, $[CH_2]_4$), 2.77 (broad d, OH), 3.78 (s, OCH_3), 4.4 (broad q, CH α-hydroxyl), 5.8 (m, =CH *trans* to ester), 6.22 (s, =CH *cis* to ester)
10c ($C_{11}H_{12}O_3$) Calc. 68.74 6.29 Found 68.59 6.33	(a) 3500 – 3400 (OH), 3090, 3060, 3035, 2950, 2900, 1720 (C=O), 1630, 1490, 1450, 1440, 1400, 1315, 1280, 1200, 1150, 1080, 1040, 1025, 960, 915, 860, 840, 820, 770, 720, 700, 680, 600	(b) 2.6 – 3.1 (broad s, OH), 3.7 (s, OCH_3), 5.55 (s, CH α-hydroxyl), 5.8 (m, =CH *trans* to ester), 6.32 (s, =CH *cis* to ester), 7.33 (m, C_6H_5)
10d ($C_{13}H_{16}O_5$)	(a) 3500 (OH), 3020, 2960, 2910, 2840, 1720 (C=O), 1630, 1595, 1560, 1515, 1465, 1440, 1420, 1380, 1335, 1265, 1240, 1200, 1155, 1145, 1030, 960, 860, 820, 760	(b) 3.28 (broad s, OH), 3.7 (s, CO_2CH_3), 3.84 (s, $(OCH_3)_2$ ring), 5.5 (s, CH-Ar), 5.87 (m, =CH *trans* to ester), 6.3 (broad s, =CH *cis* to ester), 6.8 – 7 (m, C_6H_3 aromatic)

up to room temperature. Water and ether were added, the organic layer separated and the aqueous layer extracted thrice with ether. The combined organic layers were washed successively with water, saturated $NaHCO_3$ solution, and water, dried over Na_2SO_4 or $MgSO_4$, solvent flash-evaporated and finally purified by either ordinary column chromatography or flash chromatography using silica gel. Further purification may be achieved by Kugelrohr or short path distillation.

A detailed procedure for the preparation of compound **4e** according to GPII is presented below followed by a list of compounds similarly prepared along with the general procedure to prepare reagent **1**, electrophile, electrophile/**1** ratios, type of chromatography, solvent system for elution, % yield, and physical constant (b. p./refractive index) (listed in that order).

Preparation of methyl 2-(nitromethyl)decanoate (**4e**): To the reagent **1** (11.2 mmol, prepared according to GPIa) at −76 °C was added rapidly *n*-octyl iodide (2.6 ml, 14.4 mmol, 28.5% excess) and the reaction mixture allowed to warm up to −25 °C over 4 h. Glacial acetic acid (4 ml) was added followed after 5 min by water (10 ml), and the hydrolised reaction mixture was allowed to warm up to room temperature. Water (20 ml) and ether (20 ml) were added, the organic layer was separated and the aqueous layer extracted with ether (thrice with 40 ml portions). The combined organic layers were washed successively with water (twice with 80 ml portions), saturated $NaHCO_3$ solution (twice with 30 ml portions), and water (twice with 80 ml portions), dried over $MgSO_4$, and the solvent was flash evaporated. Purification of the crude product by flash chromatography using 15% ether in pentane as eluant yielded **4e** (1.8 g, 66%), b. p. 105 °C/0.1 Torr, n_D^{22} = 1.4460. Results of additional experiments with this electrophile are presented in the following list.

Methyl 2-(nitromethyl)propanoate (**4a**): GPIa, CH_3I, 1/1, column chromatography, ether/pentane (1/1), 74%, b. p. 85 °C/2 Torr.

Methyl 2-(nitromethyl)-4-pentenoate (**4b**): GPIa, $H_2C=CHCH_2Br$, 1/1, column chromatography, ether/pentane (1/1.5), 72%, b. p. 90 °C/0.4 Torr.

Methyl 2-(nitromethyl)hexanoate (**4c**): GPIa, *n*-C_4H_9I, 1/1, column chromatography, pentane/ether (2/1), 68%.

Methyl 2-(nitromethyl)octanoate (**4d**): GPIa, *n*-$C_6H_{13}I$, 1/1, column chromatography, ether/pentane (1/1), 72%.

Methyl 2-(nitromethyl)decanoate (**4e**): GPIa, *n*-$C_8H_{17}I$, 1/1.12, flash chromatography, ether/pentane (1/9), 54%; GPIb, *n*-$C_8H_{17}I$, 1/1.12, flash chromatography, ether/pentane (1/9), 52%; GPIc, *n*-$C_8H_{17}I$, 1.29/1, flash chromatography, ether/methylene chloride (1.5/8.5), 67%.

Methyl 3-methyl-2-(nitromethyl)butanoate (**4f**): GPIa, $(CH_3)_2CHI$ (after addition the reaction mixture was warmed up to room temperature and then stirred at room temperature for 8 h), 1/1, column chromatography, pentane/ether (2/1), 78%, b. p. 100 °C/1.8 Torr, $n_D^{21.5}$ = 1.4391.

Methyl 2-(nitromethyl)-3-phenylpropanoate (**4g**): GPIa, $C_6H_5CH_2Br$, 1/1, column chromatography, ether/pentane (1/1), 80%, b. p. 130 °C/0.2 Torr, n_D^{22} = 1.5145.

Preparation of methyl 2-ethyl-2-(nitromethyl)-4-pentenoate (**5a**): To the reagent **1** (5.0 mmol, GPIa) at −78 °C was added ethyl iodide (0.78 g, 5.0 mmol) and the reaction mixture allowed to warm up to 0 °C over 4 h. After cooling the reaction mixture again to −78 °C, a solution of LDA (5.0 mmol) in THF (25 ml) was added and then allowed to warm up to −30 °C over 3 h. The reaction mixture was again cooled to −78 °C, allyl bromide (0.61 g, 5.0 mmol) added and stored at −15 °C for 15 h. After hydrolysis with glacial acetic acid (3 ml) at −78 °C the reaction mixture was worked up according to GPII. The crude product was column chromatographed on silica gel

using pentane/ether (1.5/1) to obtain **5a** (0.64 g, 62%), b. p. 95 °C/0.5 Torr, n_D^{22} = 1.4577, and the monoalkylated product, *methyl 2-(nitromethyl)butanoate*, **4h**, (0.20 g, 24%).

Preparation of methyl 2-methyl-2-(nitromethyl)-3-phenylpropanoate (**5b**): A solution of diisopropylamine (1.2 ml, 8.4 mmol) in a mixture of THF (20 ml) and HMPT (5 ml) was cooled to −35 °C and a hexane solution of *n*-butyllithium (5.2 ml, 8.2 mmol) was added. After stirring at this temperature for 10 min, the solution was cooled to −78 °C and stirred for another 20 min. To the LDA solution was added **4a** (0.60 g, 4.1 mmol), the reaction mixture allowed to warm up to −30 °C over 3 h and again cooled to −78 °C. Benzyl bromide (0.70 g, 4.1 mmol) was added and the reaction mixture stored at −15 °C for 15 h. After hydrolysis with glacial acetic acid (1.5 ml) at −78 °C, the reaction mixture was worked up according to GPII. The crude product was short path distilled under vacuum to give **5b** (0.72 g, 71%), b. p. 120 °C/0.13 Torr, n_D^{22} = 1.5140.

General procedure (GPIII) for hydroxyalkylation of **1** *with aldehydes and ketones:* To the reagent **1** in the particular solvent system (GPIa–c) at −76 °C was added the electrophile (maximum rise in temperature by 10 °C) and the reaction mixture stirred at −76 °C for appropriate length of time (GPIa and GPIc – 1 h, GPIb – 1.5 to 2 h; exceptions ketones, see individual cases). It was then cooled to −90 °C and hydrolysed with glacial acetic acid (4 ml/11.2 mmol of the reagent **1**) followed after 5 min by water. After warming up the reaction mixture to room temperature more water and ether were added. The organic layer was separated and the aqueous layer extracted few times with ether. The combined organic layers were washed successively with water, saturated $NaHCO_3$ solution, and water, dried over $MgSO_4$ and the solvent flash evaporated. The crude product was purified by either column chromatography or flash chromatography using silica gel.

A detailed procedure for the preparation of compound **6c** according to GPIII is presented below followed by a list of compounds similarly prepared along with the general procedure to prepare reagent **1**, electrophile, electrophile/**1** ratios, type of chromatography, solvent system for elution, % yield, and physical constant (m. p./b. p./refractive index) (listed in that order).

Preparation of methyl 3-hydroxy-2-(nitromethyl)-3-phenylpropanoate (**6c**): To the reagent **1** (11.2 mmol, prepared according to GPIa) at −76 °C was added benzaldehyde (1.5 ml, 14.2 mmol, 27% excess). The reaction mixture was then stirred at −76 °C for 1 h, cooled to −90 °C, and glacial acetic acid (4 ml) was added – the temperature rose to −67 °C for a short period. After 5 min water (10 ml) was added and the cooling bath removed. After the hydrolysed reaction mixture had warmed up to room temperature, more water (20 ml) was added followed by ether (30 ml). The organic layer was separated, and the aqueous layer was extracted with ether (thrice with 40 ml portions). The combined organic layers were washed with water (twice with 70 ml portions), saturated $NaHCO_3$ solution (once with 30 ml portion) followed by water (once with 70 ml portion), dried over $MgSO_4$ and the solvent flash evaporated. The crude product was flash chromatographed using 8% ether in methylene chloride as eluant to give **6c** as a pale yellow oil (2.24 g, 83.7%), b. p. 150 °C/0.001 Torr. One of the two diastereomers was isolated by careful column chromatography of the mixture on silica gel using methylene chloride as eluant. Results of additional experiments with benzaldehyde as electrophile are presented in Table 1 and the appropriate reaction periods in different solvent systems are as mentioned in GPIII.

Methyl 3-hydroxy-2-(nitromethyl)pentanoate (**6a**): GPIa, C_2H_5CHO, 1.24/1, flash chromatography, ether/methylene chloride (1/9), 48%, b. p. 140 °C/0.05 Torr; GPIc, C_2H_5CHO, 1.24/1, flash chromatography, ether/methylene chloride (1/9), 51%, b. p. 160 °C/0.5 Torr.

Methyl 3-hydroxy-2-(nitromethyl)octanoate (**6b**): GPIa, *n*-$C_5H_{11}CHO$, 1.53/1, flash chromatography, ether/methylene chloride (0.5/9.5), 79%, b. p. 170 °C/0.15 Torr; GPIb, *n*-

$C_5H_{11}CHO$, 1.53/1, flash chromatography, ether/methylene chloride (0.5/9.5), 72%, b. p. 145°C/0.01 Torr.

Methyl 3-(3,4-dimethoxyphenyl)-3-hydroxy-2-(nitromethyl)propanoate (**6d**): GPIa, 3,4-$(CH_3O)_2$-C_6H_3CHO, 1.29/1, flash chromatography, ether/methylene chloride (first 0.5/9.5 and then 2/8), 60% [29% of the added electrophile recovered], m. p. 85–92°C, careful crystallisation from methylene chloride/hexane furnished one pure diastereomer as fine colourless needles, m. p. 102–104°C; GPIc, 3,4-$(CH_3O)_2C_6H_3CHO$, 1.29/1, flash chromatography, ether/methylene chloride (first 0.5/9.5 and then 2/8), 56% [29.5% of added electrophile recovered].

Methyl 3-hydroxy-3-methyl-2-(nitromethyl)butanoate (**7a**): GPIa, $(CH_3)_2CO$ (warmed to −20°C over 4 h after addition), 1/1, column chromatography, methylene chloride followed by ethyl acetate, 15%, n_D^{23} = 1.4528.

Methyl 2-(1-hydroxycyclohexyl)-3-nitropropanoate (**7b**): GPIa, cyclohexanone (16 h at −76°C after addition), 1/1, column chromatography, methylene chloride followed by ethyl acetate, 27%.

Preparation of methyl 3-nitro-2-(3-oxocyclohexyl)propanoate (**8**): To the reagent **1** (5.0 mmol, GPIa) at −76°C was added 2-cyclohexen-1-one (0.48 g, 5.0 mmol). Stirring at this temperature for 5 h yielded a thick suspension. After acidic hydrolysis and work-up (according to GPIII) the crude product was chromatographed on alumina (activity grade 3) using ether as eluant to obtain **8** (0.40 g, 35%), b. p. 170°C/0.5 Torr, n_D^{20} = 1.4860.

General procedure (GPIV) for dehydronitration using DBN/benzene: To a solution of the nitro compound in benzene (5 ml/mmol of the nitro compound) was added 1,5-diazabicyclo[4.3.0]-non-5-ene (DBN). The solution was stirred at room temperature for the indicated time period. Within 5 min crystals separated and the reaction mixture turned brownish. Cold (≈ 10°C) 5% phosphoric acid (10 ml/mmol of the nitro compound) was added to the reaction mixture which was then extracted thrice with ether. The ethereal layer was washed twice with water, once with saturated $NaHCO_3$ solution, followed by once with water, dried over Na_2SO_4, and the solvent flash evaporated. The crude product was purified by bulb-to-bulb distillation.

Compounds prepared using the above procedure are presented below with the ratio of the nitro compound to DBN, stirring period, % yield and physical constant (b. p./refractive index) (listed in that order).

Methyl 2-methylene-4-pentenoate (**9a**): 1/1.08, 3 h, 89%, b. p. 80°C/25 Torr. (Lit.[25] 150–151°C/ambient pressure).

Methyl 2-methylenehexanoate (**9b**): 1/1.07, 3 h, 67%, b. p. 100°C/20 Torr, n_D^{22} = 1.4315 (Lit.[26] b. p. 82.0–83.0°C/30 Torr, n_D^{25} = 1.4286.

Methyl 3-hydroxy-2-methylene-3-phenylpropanoate (**10c**): 1/1.28, 0.5 h, 46%, b. p. 125°C/0.06 Torr (Lit.[27] 103–105°C/0.1 Torr).

General procedure (GPV) for dehydronitration using DBN/DMSO: To a solution of the nitro compound in DMSO (5 ml/mmol of the nitro compound) was added DBN. The mixture was heated at 70°C for the indicated time period. After adding cold (≈ 10°C) 5% phosphoric acid (10 ml/mmol of the nitro compound), it was extracted thrice with ether. The ethereal layer was washed thrice with water followed by once with brine, dried over Na_2SO_4, and the solvent was flash evaporated. The crude product was first purified by column chromatography followed by bulb-to-bulb distillation.

Compounds prepared according to the above procedure are presented below with the ratio of the nitro compound to DBN, heating period, eluant, % yield, and physical constant (b. p./refractive index) (listed in that order).

Methyl 2-methyleneoctanoate (**9c**): 1/1.1, 45 min, pentane/ether (1.5/1), 65%, b. p. 135°C/15 Torr, n_D^{23} = 1.4377 (Lit.[28] b. p. 86°C/10 Torr).

Methyl 2-methylenedecanoate (**9d**): 1/1.12, 30 min, ether/hexane (1/3), 90%, b. p. 90°C/ 2 Torr, n_D^{25} = 1.4400 (Lit.[29] b. p. 75°C/0.75 Torr).

Methyl 2-methylene-3-phenylpropanoate (**9e**): 1/1.15, 45 min, ether/pentane (1/2), 85%, b. p. 62°C/0.7 Torr, n_D^{24} = 1.5227 (Lit.[30] b. p. 73°C/0.6 Torr, n_D^{28} = 1.5063).

General procedure (GPVI) for dehydronitration using DBU/THF: To a solution of the nitro compound in THF (5 ml/mmol of the nitro compound) was added 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU). On stirring at room temperature for the indicated time period, fine crystals separated within a minute of addition of DBU. After addition of cold (≈10°C) 5% phosphoric acid (10 ml/mmol of the nitro compound) and three extractions with ether the ethereal layer was washed thrice with water, twice with saturated $NaHCO_3$ solution, and once with water, dried over $MgSO_4$, and the solvent was flash evaporated. The crude product was purified by bulb-to-bulb distillation.

Compounds prepared according to the above procedure are presented below with the ratio of the compound to DBU, stirring period, % yield, and physical constant (b. p.) (listed in that order).

Methyl 3-hydroxy-2-methylenepentanoate (**10a**): 1/1.5, 40 min, 80%, b. p. 70°C/0.05 Torr (Lit.[27] 55 – 56°C/2 Torr).

Methyl 3-hydroxy-2-methyleneoctanoate (**10b**): 1/1.07, 15 min, 90%, b. p. 130°C/0.05 Torr.

Methyl 3-hydroxy-2-methylene-3-phenylpropanoate (**10c**): 1/1.14, 15 min, 84%, b. p. 130°C/0.07 Torr (Lit.[27] 103 – 105°C/0.1 Torr).

Methyl 3-(3,4-dimethoxyphenyl)-3-hydroxy-2-methylenepropanoate (**10d**): 1/1.11, 20 min, 67%, very high b. p. – could not be distilled (purified by column chromatography on silica gel using chloroform as eluant. In one run ≈20% of veratraldehyde was also isolated).

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