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Generation and Conjugate Additions of *o*-Quinone Methides Under Mild Base Conditions: Rapid Synthesis of *N*-Substituted Aryl Glycine Derivatives

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A one-step approach was observed to give *N*-substituted aryl glycine derivatives in good to excellent yields (up to 93 %) from (*ortho*-hydroxymethyl)aryl benzoates. A cascade mechanism was proposed for the generation and in situ conjugate addition of the *ortho*-quinone methides. This mechanism is strongly supported by our subsequent findings that tertiary amines could promote the process. Different functional groups on the (*ortho*-hydroxymethyl)aryl benzoates and various amines were investigated to explore the scope of this cascade process. The substituents on the substrates strongly affected the reaction time and yield, and various primary and secondary amines were used as nucleophiles. The addition of tertiary amines enhanced the addition process for less basic nucleophiles.

Introduction

As a class of useful transient intermediates, *o*-quinone methides are widely employed in the syntheses of various organic compounds[1] and have been reported as crucial cytotoxins that are responsible for the functioning of agents such as antitumor drugs, antibiotics, and DNA alkylators in biochemistry and medical chemistry.[2] *o*-Quinone methides can undergo several important reactions, including conjugate additions as well as intermolecular and intramolecular cycloadditions. On account of this high reactivity, the field of research to develop methods to generate *o*-quinone methides has been extensive for decades.[3] In the past decade, methods to generate *o*-quinone methides relied mainly on thermal initiation,[4a–4c] oxidation processes,[4d] photochemical facilitation,[4e–4h] a retro-Diels–Alder reaction,[4i] and either strong acids[4j–4l] or powerful bases.[4m,4n] Despite their extensive applications, these methods still have some limitations, which include the multiple steps needed to build the *o*-quinone methide precursors, harsh reaction conditions, and low yields. As a consequence, the demand for alternate efficient methods has encouraged the extra development of new ways to generate *o*-quinone methides. Recently, several other approaches were reported that include a fluoride-induced desilylation,[5a,5b] the utilization of transition-metal complexes,[5c] a Knoevenagel-type condensation,[5d] and a base-mediated desulfonylation.[5e] Considering their importance as active intermediates and their short lifetime as a result of their potential for dimerization, the further development of efficient and practical methods, which minimize time, cost, employment of special reagents, and steps, to generate *o*-quinone methide intermediates still remains highly desirable.

Non-proteinogenic aryl glycines and their derivatives are a class of attractive substances that are used as building blocks in natural product syntheses and as biologically active compounds in drug research.[6] Among different aromatic units, aryl glycine acids are used to efficiently produce benzoxazines,[7] tetrahydroisoquinolines,[8] and several other natural products.[9] Moreover, enantiopure aryl glycine derivatives could serve as chiral ligands in the preparation of transition-metal complexes.[6a,10] As the classical Mannich procedure is only suitable to synthesize a few aryl glycines that are derived from highly electron-rich aromatics,[11] alternate approaches to prepare these compounds have been developed. In general, the synthetic routes, which start from 2-imidoylphenols,[10] O'Donnell's Schiff bases,[12] an *N*,*O*-acetal,[13] or arylglyoxylates[14] often require multistep procedures, and the approaches from arylzinc reagents[15] and glycine cation equivalents[16] are limited to secondary amines. Herein, we report an undiscovered *o*-quinone methide generation process that starts from (*ortho*-hydroxymethyl)aryl benzoates and takes place under very mild conditions to allow for the efficient syntheses of various *N*-substituted (*ortho*-hydroxy)aryl glycine esters.

Results and Discussion

During the deprotection process to remove the benzoyl group of (*ortho*-hydroxymethyl)aryl benzoate **1**, we found that the substance decomposed under various classical inorganic base conditions. However, when *n*-propylamine was used as the base in toluene,[17] a phenolic product did not

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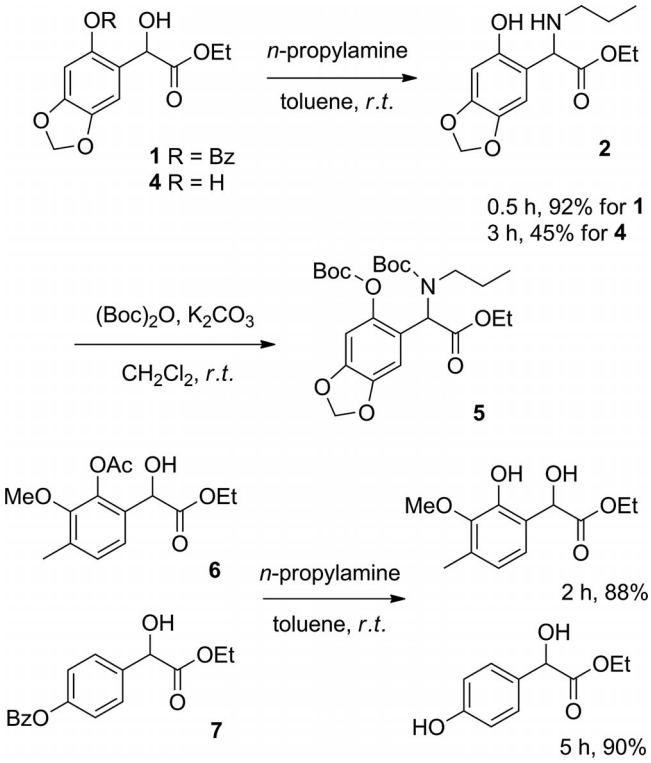
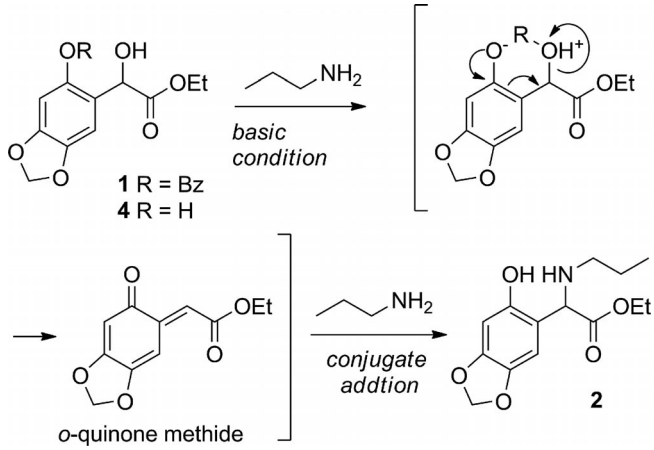
form, but instead, the much less polar product **2** (compare to **1** by TLC analysis) was obtained in high yield. It was difficult to determine the exact structure of **2** by spectroscopic analysis, but we treated it with di-*tert*-butyl dicarbonate to give compound **5** in 95% yield, and we eventually identified **2** as the *N*-propyl aryl glycine ester. It is worth noting that benzoyl *n*-propylamide was not detected,[17] but a benzoic acid amine salt was observed during the reaction process. When we treated (*ortho*-hydroxy)-benzyl alcohol **4** with *n*-propylamine under the same conditions, *N*-propyl aryl glycine ester **2** was also obtained although in a much lower yield (45%). Furthermore, when compounds **6** and **7** were treated under the same conditions, the corresponding phenolic products were afforded in high yields (see Scheme 1). These results indicate that compound **1** underwent a new reaction in the presence of *n*-propylamine, instead of a simple deprotection, and that the benzoyl group and *ortho*-positioned carbinol substituent were vital factors of this cascade process. Because the acetyl group of compound **6** is directly cleaved with *n*-propylamine, we believe that the benzoyl group is more stable than the acetyl group under these conditions, and it is, therefore, more difficult for the benzoyl group to undergo an aminolysis by treatment with an amine.

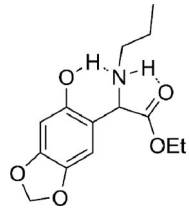


Scheme 1. Initial screening of suitable substrates for the cascade process (Boc = *tert*-butoxycarbonyl).

On the basis of the structure of compound **2**, we propose that an *o*-quinone methide was generated as an intermediate during an intramolecular rearrangement of **1** and that this intermediate was subsequently trapped in situ by *n*-propylamine to produce the product.[3] In this transformation, *n*-propylamine has two roles, that is, the reagent that promotes the rearrangement and the nucleophile of the conjugate addition (see Scheme 2). This rearrangement process with the benzoyl group is somewhat similar to the generation strategy by the Pettus group, which used *tert*-butylcarbonyl-protected phenones that were initiated by using an organometallic reagent under low temperature.[18] However, the rearrangement with the benzoyl group requires much milder conditions than those for the *tert*-butylcarbonyl group, which allows for the generation and consumption of the *ortho*-quinone methides under ambient conditions. Furthermore, compound **2** is less polar than (*ortho*-hydroxymethyl)aryl benzoate **1**, as the typical absorption peaks from the OH and NH groups do not exist in its IR spectrum. Therefore, we surmised that two strong intramolecular hydrogen bonds exist in this structure to contribute to the reduced polarity, (see Scheme 3).



Scheme 2. Suggested reaction mechanism in which *n*-propylamine serves both as base and nucleophile.



Scheme 3. Two intramolecular hydrogen bonds of compound **2** lead to its reduced polarity. This is supported by IR analysis. The typical OH (3500–3200 cm^{-1}) and NH (3500–3300 cm^{-1}) absorption peaks are not present in spectrum (see Supporting Information).

To test the scope of this cascade process, we developed a new protocol for the syntheses of *N*-substituted aryl glycine esters. Starting from various substituted phenols and the combination of phenols with glyoxylate by using a Friedel–Crafts reaction,[19] we carried out the selective protection of phenolic hydroxy group[20] and the *n*-propylamine-mediated cascade process. The results are shown in Table 1. It can be seen that the reactivity of the (*ortho*-hydroxymethyl)aryl benzoates is strongly affected by the substituent groups on the aromatic ring. Substrates **1a**, **1b**, and **1c**, which contain

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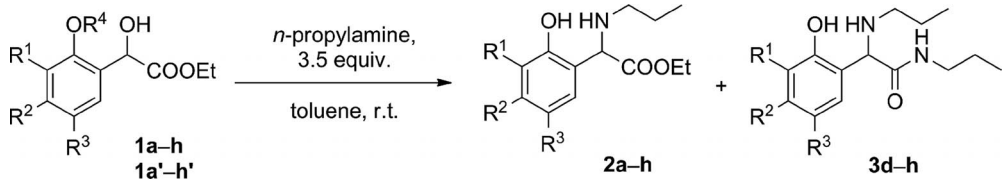
Table 1. Survey of substituents on the aromatic ring.



Substrate	R^1	R^2	R^3	R^4	Product	Time [h]	% Yield[a]
1a	Me		OCH_2O	Bz	**2a**	0.5	93
1a′	Me		OCH_2O	H	**2a**	3	49
1b	H	OMe	OMe	Bz	**2b**	0.5	92
1b′	H	OMe	OMe	H	**2b**	3	45
1c	H	OMe	H	Bz	**2c**	2	89
1c′	H	OMe	H	H	**2c**	3	33
1d	OMe	Me	H	Bz	**2d** + **3d**	5	63 (24)
1d′	OMe	Me	H	H	**2d**	3	15
1e	H	Me	H	Bz	**2e** + **3e**	8	56 (30)
1e′	H	Me	H	H	**2e**	3	12
1f	H	H	Me	Bz	**2f** + **3f**	15	30 (53)
1f′	H	H	Me	H	**2f**	3	8
1g	H	H	H	Bz	**2g** + **3g**	24	23 (59)
1g′	H	H	H	H	**2g**	3	5
1h	H	H	Cl	Bz	**2h** + **3h**	36	12 (67)
1h′	H	H	Cl	H	–	3	–

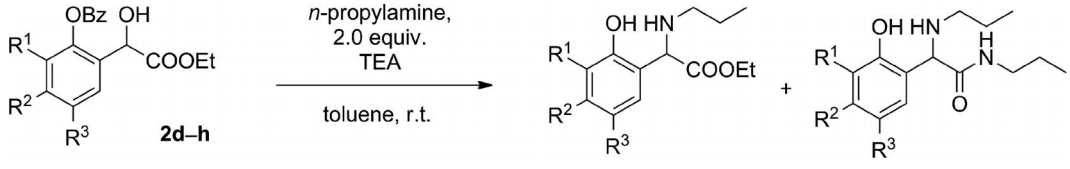
[a] Isolated yield.

a strong electron-donating group *para* to the carbinol, required a shorter reaction time, and the aminolysis of ethyl ester was not observed. Substates **1d** and **1e**, which contain a weak electron-donating group *para* to the carbinol, required a longer reaction time and afforded a small amount of the amidation product. For substrates such as **1f**–**1h** that do not contain an electron-donating group *para* to the carbinol or have an electron-withdrawing group on the aromatic ring, a much longer reaction time was needed. In these cases, most of the products underwent further amidation, but the total yields of both products remained high.

We subsequently discovered that the amidation of electron-deficient substances could be efficiently avoided by the addition of tertiary amines such as triethylamine or diisopropylethylamine. The basicity of reaction system would increase by this addition, and as a result, this which would stimulate the generation of the *ortho*-quinone methide, keep the concentration of the nucleophile at a relatively low level, and slow down the amidation process. With the addition of up to 2 equiv. of triethylamine and 2 equiv. of *n*-propylamine in the reaction system, the reaction times of **1d**–**1f** were reduced to less than 3 h, and further amidation was effectively controlled (see Table 2). This fact supported the anionic *o*-quinone methide generation mechanism that we previously proposed and suggested that those electron-deficient aryl benzoate derivatives needed more basic conditions to generate the *o*-quinone methides quickly.

As shown in Table 1, the yields of the reactions that started from the (*ortho*-hydroxymethyl)aryl phenols are lower than the corresponding benzoates under the same reaction conditions. As the substituents on the aromatic ring of the phenols are the same as those of the corresponding aryl benzoates, we believe that the acidity of phenolic hydroxy group decreased the basicity of the system and,

Table 2. Investigation of addition of tertiary amine to suppress amidation.



Substrate	R^1	R^2	R^3	TEA [equiv.][a]	Product	Time [h]	% Yield[b]
1d	OMe	Me	H	1	**2d**	1.5	86
1e	H	Me	H	1.5	**2e** + **3e**	1.5	81 (3)
1f	H	H	Me	2	**2f** + **3f**	2	78 (5)
1g	H	H	H	2	**2g** + **3g**	3	74 (10)
1h	H	H	Cl	2	**2h** + **3h**	4	71 (12)

[a] TEA = triethylamine. [b] Isolated yield.

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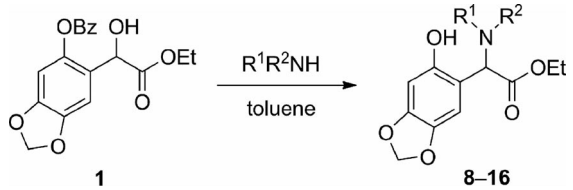
thereby, hindered the generation of the *o*-quinone methide. This hypothesis is supported by the results in Table 1, in which the yields of the reactions of various aryl phenols decreased with the increasing acidity of phenolic hydroxy group. No reaction occurred when there was an electron-withdrawing group *para* to the phenolic hydroxy group (e.g., **1h′**). This could be a consequence of the increased acidity of the phenolic hydroxy group, which formed a salt directly with the amine instead of underwent a rearrangement reaction. It is worth noting that the self-polymerization of *o*-quinone methides was not observed in all cases. This could be a result of the ester moiety in the substance, which reduced the electron density of the *o*-quinone methides and, therefore, lowered the rate of self-polymerization.

To explore the scope of the amines in this reaction, (*ortho*-hydroxymethyl)aryl benzoate **1** was treated with different primary and secondary amines (see Table 3). When primary amines were used, the reaction times depended on their basicity. Strongly basic amines underwent the cascade process directly to give the corresponding *N*-substituted aryl glycine esters **8**, **9**, and **11**. Those nucleophiles that were less basic needed a longer reaction time and a slighter higher temperature, or they were not sufficiently basic to generate the *o*-quinone methide. This was the case with 2-chloroaniline and 3-[(*tert*-butyldimethylsilyl)oxy]aniline, and in such a circumstance, an additional amount of a tertiary amine promoted the generation of the *o*-quinone methide to afford the corresponding *N*-substituted aryl glycine esters in high yields. Secondary amines required a shorter reaction time on account of their increased basicity. When (*R*)-1-phenylethan-1-amine was used as nucleophile, two epimers were obtained in a ratio of over 2:1, indicating a possible utilization for the syntheses of enantiopure aryl glycine derivatives.

Table 3. Survey of amines as nucleophile.



1 **8–16**

R^1	R^2	Product	Temp	Time [h]	% Yield
CH_2=$CHCH_2$	H	**8**	r.t.	2	92
$PhCH_2$	H	**9**	r.t.	2.5	91
Ph	H	**10**	40 °C	2	88
(*R*)-$PhCHCH_3$	H	**11**[a]	r.t.	2	90[b]
m-*t*$BuMe_2SiOPh$	H	**12**	r.t.	2	88[c]
o-ClPh	H	**13**	r.t.	2	91[c]
$–CH_2CH_2OCH_2CH_2–$		**14**	r.t.	0.5	89
$–CH_2CH_2CH_2CH_2–$		**15**	r.t.	0.5	91
Et	Et	**16**	r.t.	0.5	86

[a] A pair of epimers with a diastereomeric ratio of 2:1. [b] Total yield of two epimers. [c] With additional 1 equiv. of triethylamine. This reaction did not occur without this additional tertiary amine.

Conclusions

In summary, we have described a new mild protocol, which is mediated by amines, for the generation of *o*-quinone methides from (*ortho*-hydroxymethyl)aryl benzoates. This method was applied it to the syntheses of various *N*-substituted (*ortho*-hydroxy)aryl glycine esters. The proposed reaction mechanism for this process involves a base-mediated rearrangement of the benzoyl group to afford an *o*-quinone methide, which can undergo an in situ 1,4-conjugate addition with primary and secondary amines. The mild reaction conditions, simple workup, and wide substrate scope combine to make this a useful addition to *ortho*-quinone methide chemistry. Detailed mechanistic studies of this process and its utilization in organic synthesis are in progress in our laboratory.

Experimental Section

General Procedure to the Syntheses of *N*-Substituted Aryl Glycine Derivatives: To a stirred solution of the (*ortho*-hydroxymethyl)aryl benzoate (1.0 mmol) in toluene (5 mL) was added the primary or secondary amine (3.5 mmol). The reaction mixture was stirred at room temperature, and TLC was used to monitor the reaction. When TLC showed complete consumption of substrates, the reaction mixture was diluted with ethyl acetate (50 mL). The resulting solution was washed with water (2× 50 mL) and brine (50 mL) and then dried with sodium sulfate. After filtration and evaporation of the solvent under reduced pressure, the crude product was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, gradient 20:1 to 4:1 v/v) to afford the *N*-substituted aryl glycine derivative.

Improved General Procedure to the Syntheses of *N*-Substituted Aryl Glycine Derivatives: To a stirred solution of the (*ortho*-hydroxymethyl)aryl benzoate (1.0 mmol) in toluene (5 mL) were added the primary or secondary amine (2.0 mmol) and triethylamine (2.0 mmol). The reaction mixture was stirred at room temperature, and TLC was used to monitor the reaction. When the substrates were completely consumed, the reaction was diluted with ethyl acetate (50 mL). The resulting solution was washed with water (2× 50 mL) and brine (50 mL) and then dried with sodium sulfate. After filtration and evaporation of the solvent under reduced pressure, the crude product was purified by flash chromatography on silica gel (petroleum ether/ethyl acetate, gradient 20:1 to 4:1 v/v) to afford the *N*-substituted aryl glycine derivative.

Ethyl 2-(6-Hydroxybenzo[*d*][1,3]dioxol-5-yl)-2-(propylamino)acetate (2): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 6.55 (s, 1 H, PhH), 6.38 (s, 1 H, PhH), 5.87 (s, 2 H, OCH_2O), 4.32 (s, 1 H, α-H), 4.27–4.11 (m, 2 H, OCH_2CH_3), 2.60 (t, $^3J_{H,H}$ = 6.8 Hz, 2 H, $NCH_2CH_2CH_3$), 1.58 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, $NCH_2CH_2CH_3$), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH_2CH_3), 0.94 (t, $^3J_{H,H}$ = 7.3 Hz, 3 H, $NCH_2CH_2CH_3$) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 171.08, 153.15, 148.23, 140.24, 110.87, 108.80, 100.92, 99.17, 64.76, 61.82, 48.94, 22.55, 14.06, 11.54, 8.48 ppm. IR (film): $\tilde{\nu}$ = 3055, 2966, 2917, 1733, 1632, 1503, 1479, 1385, 1265, 1191, 1039, 938, 896, 853, 738, 704 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{20}NO_5$ [M + H]$^+$ 282.1341; found 282.1346.

Ethyl 2-(6-Hydroxy-7-methylbenzo[*d*][1,3]dioxol-5-yl)-2-(propylamino)acetate (2a): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 6.39 (s, 1 H, PhH), 5.87 (d, $^2J_{H,H}$ = 1.6 Hz, 2 H, OCH_2O), 4.30 (s, 1 H,

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α-H), 4.28–4.11 (m, 2 H, OCH_2CH$_3$), 2.59 (t, $^3J_{H,H}$ = 6.8 Hz, 2 H, NCH_2CH$_2$CH$_3$), 2.09 (s, 3 H, PhMe), 1.57 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.93 (t, $^3J_{H,H}$ = 7.3 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.21, 151.40, 146.50, 139.19, 110.34, 108.53, 105.86, 100.54, 64.84, 61.60, 48.82, 22.51, 13.98, 11.47, 8.48 ppm. IR (film): ṽ = 2965, 2933, 2876, 1737, 1645, 1586, 1500, 1470, 1423, 1380, 1259, 1201, 1094, 1026, 938, 848, 735, 702 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{22}NO_5$ [M + H]$^+$ 296.1498; found 296.1502.

Ethyl 2-(2-Hydroxy-4,5-dimethoxyphenyl)-2-(propylamino)acetate (2b): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 6.59 (s, 1 H, PhH), 6.42 (s, 1 H, PhH), 4.37 (s, 1 H, α-H), 4.27–4.11 (m, 2 H, OCH_2CH$_3$), 3.83 (s, 3 H, PhOMe), 3.82 (s, 3 H, PhOMe), 2.63 (t, $^3J_{H,H}$ = 6.8 Hz, 2 H, NCH_2CH$_2$CH$_3$), 1.58 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.95 (t, $^3J_{H,H}$ = 7.3 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.18, 152.19, 149.99, 141.70, 113.33, 109.97, 101.29, 64.70, 61.59, 56.65, 55.63, 49.03, 22.58, 13.96, 11.47 ppm. IR (film): ṽ = 2961, 2935, 2874, 1735, 1620, 1511, 1463, 1383, 1301, 1210, 1120, 1027, 855 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{24}NO_5$ [M + H]$^+$ 298.1654; found 298.1655.

Ethyl 2-(2-Hydroxy-4-methoxyphenyl)-2-(propylamino)acetate (2c): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 6.94 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 6.35 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 6.34 (s, 1 H, PhH), 4.41 (s, 1 H, α-H), 4.24–4.10 (m, 2 H, OCH_2CH$_3$), 3.73 (s, 3 H, PhOMe), 2.64–2.54 (m, 2 H, NCH_2CH$_2$CH$_3$), 1.56 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.20 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.93 (t, $^3J_{H,H}$ = 7.3 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.13, 160.57, 158.80, 129.97, 112.06, 105.10, 101.83, 64.29, 61.36, 54.82, 48.72, 22.41, 13.78, 11.31 ppm. IR (film): ṽ = 3320, 2962, 2935, 2875, 2838, 1733, 1622, 1589, 1511, 1463, 1386, 1289, 1265, 1227, 1201, 1160, 1119, 1101, 1059, 1033, 962, 836, 795, 736, 703, 639, 584, 471 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{22}NO_4$ [M + H]$^+$ 268.1549; found 268.1552.

Ethyl 2-(2-Hydroxy-3-methoxy-4-methylphenyl)-2-(propylamino)-acetate (2d): ^{1}H NMR (500 MHz, CDCl$_3$, 293 K): δ = 6.69 (d, $^3J_{H,H}$ = 8.4 Hz, 1 H, PhH), 6.60 (d, $^3J_{H,H}$ = 8.4 Hz, 1 H, PhH), 4.45 (s, 1 H, α-H), 4.27–4.14 (m, 2 H, OCH_2CH$_3$), 3.83 (s, 3 H, PhOMe), 2.65–2.55 (m, 2 H, NCH_2CH$_2$CH$_3$), 2.24 (s, 3 H, PhMe), 1.59–1.53 (m, 2 H, NCH$_2$CH_2CH$_3$), 1.23 (t, $^3J_{H,H}$ = 5.6 Hz, 3 H, OCH$_2$CH_3), 0.93 (t, $^3J_{H,H}$ = 6.0 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.21, 150.76, 146.48, 131.89, 123.89, 120.44, 118.84, 64.60, 61.70, 59.86, 49.04, 22.57, 15.86, 14.04, 11.53 ppm. IR (film): ṽ = 3054, 2965, 2932, 2854, 2305, 1732, 1611, 1465, 1389, 1265, 1238, 1111, 1073, 1020, 896, 739, 704 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{24}NO_4$ [M + H]$^+$ 282.1705; found 282.1711.

Ethyl 2-(2-Hydroxy-4-methylphenyl)-2-(propylamino)acetate (2e): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 6.92 (d, $^3J_{H,H}$ = 7.6 Hz, 1 H, PhH), 6.64 (s, 1 H, PhH), 6.61 (d, $^3J_{H,H}$ = 7.6 Hz, 1 H, PhH), 4.42 (s, 1 H, α-H), 4.27–4.11 (m, 2 H, OCH_2CH$_3$), 2.64–2.54 (m, 2 H, NCH_2CH$_2$CH$_3$), 2.27 (s, 3 H, PhMe), 1.61–1.56 (m, 2 H, NCH$_2$CH_2CH$_3$), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.93 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.25, 157.49, 139.55, 129.28, 119.90, 117.56, 116.94, 64.74, 61.64, 48.98, 22.59, 21.12, 13.99, 11.48 ppm. IR (film): ṽ = 3319, 2961, 2928, 2874, 1732, 1625, 1583, 1513, 1463, 1369, 1330, 1265, 1227, 1159, 1117, 1059, 1027, 955, 862, 799, 759, 735, 590, 552, 516, 467, 430 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{22}NO_3$ [M + H]$^+$ 252.1600; found 252.1599.

Ethyl 2-(2-Hydroxy-5-methylphenyl)-2-(propylamino)acetate (2f): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 6.98 (d, $^3J_{H,H}$ = 8.2 Hz, 1 H, PhH), 6.85 (s, 1 H, PhH), 6.72 (d, $^3J_{H,H}$ = 8.2 Hz, 1 H, PhH), 4.41 (s, 1 H, α-H), 4.28–4.16 (m, 2 H, OCH$_2$CH$_3$), 2.65–2.54 (m, 2 H, NCH_2CH$_2$CH$_3$), 2.25 (s, 3 H, PhMe), 1.57 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.93 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.23, 155.30, 130.0, 129.94, 128.13, 119.70, 116.78, 65.08, 61.72, 49.07, 22.64, 20.46, 14.05, 11.53 ppm. IR (film): ṽ = 3319, 2961, 2926, 2873, 1735, 1598, 1500, 1460, 1369, 1261, 1231, 1159, 1117, 1026, 957, 858, 819, 772, 542 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{22}NO_3$ [M + H]$^+$ 252.1600; found 252.1598.

Ethyl 2-(2-Hydroxyphenyl)-2-(propylamino)acetate (2g): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 7.18 (m, 1 H, PhH), 7.05 (d, $^3J_{H,H}$ = 7.2 Hz, 1 H, PhH), 6.81 (m, 2 H, PhH), 4.46 (s, 1 H, α-H), 4.27–4.09 (m, 2 H, OCH_2CH$_3$), 2.66–2.55 (m, 2 H, NCH_2CH$_2$CH$_3$), 1.58 (hex, $^3J_{H,H}$ = 7.1 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.22 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.93 (t, $^3J_{H,H}$ = 7.3 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 171.18, 157.79, 129.55, 129.47, 120.02, 119.08, 117.07, 65.09, 61.79, 49.11, 22.66, 14.04, 11.55 ppm. IR (film): ṽ = 3054, 2964, 2933, 2849, 1732, 1590, 1491, 1470, 1408, 1265, 1229, 1155, 1103, 1026, 896, 854, 739, 704 cm^{-1}. HRMS (ESI+): calcd. for $C_{13}H_{20}NO_3$ [M + H]$^+$ 238.1443; found 238.1444.

Ethyl 2-(5-Chloro-2-hydroxyphenyl)-2-(propylamino)acetate (2h): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 7.13 (dd, $^3J_{H,H}$ = 8.8 Hz, $^4J_{H,H}$ = 2.1 Hz, 1 H, PhH), 7.05 (d, $^4J_{H,H}$ = 2.1 Hz, 1 H, PhH), 6.74 (d, $^3J_{H,H}$ = 8.8 Hz, 1 H, PhH), 4.39 (s, 1 H, α-H), 4.28–4.13 (m, 2 H, OCH_2CH$_3$), 2.65–2.53 (m, 2 H, NCH_2CH$_2$CH$_3$), 1.57 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 0.94 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 170.47, 156.45, 129.34, 129.24, 123.50, 121.27, 118.30, 64.67, 62.01, 49.08, 22.53 13.97, 11.46 ppm. IR (film): ṽ = 3323, 3055, 2965, 2935, 2876, 1735, 1585, 1483, 1387, 1369, 1265, 1227, 1203, 1113, 1024, 957, 881, 858, 826, 739, 704, 650, 539 cm^{-1}. HRMS (ESI+): calcd. for $C_{13}H_{18}NO_3ClNa$ [M + Na]$^+$ 294.0873; found 294.0871.

2-(2-Hydroxy-3-methoxy-4-methylphenyl)-*N*-propyl-2-(propylamino)-acetamide (3d): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 6.70 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 6.66 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 5.81 (br. s, 1 H, CONH), 4.23 (s, 1 H, α-H), 3.83 (s, 3 H, PhOMe), 3.21–3.08 (m, 2 H, CONHCH_2CH$_2$CH$_3$), 2.66–2.49 (m, 2 H, NCH_2CH$_2$CH$_3$), 2.27 (s, 3 H, PhMe), 1.63–1.50 (m, 2 H, NCH$_2$CH_2CH$_3$), 1.50–1.35 (m, 2 H, CONHCH$_2$CH_2CH$_3$), 0.93 (t, $^3J_{H,H}$ = 5.6 Hz, 3 H, NCH$_2$CH$_2$CH_3), 0.81 (t, $^3J_{H,H}$ = 6.0 Hz, 3 H, CONHCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 170.61, 150.72, 146.78, 132.26, 123.60, 120.78, 119.47, 65.70, 59.65, 49.54, 41.21, 22.41, 22.38, 15.77, 11.41, 10.85 ppm. IR (KBr): ṽ = 3418, 2963, 2933, 2875, 1655, 1532, 1463, 1394, 1269, 1240, 1153, 1111, 1073, 1020, 966, 932, 793, 771, 573 cm^{-1}. HRMS (ESI+): calcd. for $C_{16}H_{27}N_2O_3$ [M + H]$^+$ 295.2022; found 295.2025.

2-(2-Hydroxy-4-methylphenyl)-*N*-propyl-2-(propylamino)acetamide (3e): ^{1}H NMR (400 MHz, CDCl$_3$, 293 K): δ = 6.92 (d, $^3J_{H,H}$ = 7.2 Hz, 1 H, PhH), 6.70 (s, 1 H, PhH), 6.73–6.63 (m, 2 H, PhH), 5.70 (br. s, 1 H, CONH), 4.22 (s, 1 H, α-H), 3.20–3.10 (m, 2 H, CONHCH_2CH$_2$CH$_3$), 2.63–2.50 (m, 2 H, NCH_2CH$_2$CH$_3$), 2.30 (s, 3 H, PhMe), 1.61–1.50 (m, 2 H, NCH$_2$CH_2CH$_3$), 1.46–1.35 (m, 2 H, CONHCH$_2$CH_2CH$_3$), 0.92 (t, $^3J_{H,H}$ = 6.8 Hz, 3 H, NCH$_2$CH$_2$-CH_3), 0.80 (t, $^3J_{H,H}$ = 7.0 Hz, 3 H, CONHCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, CDCl$_3$): δ = 170.78, 157.68, 140.15, 129.12, 120.29, 118.16, 117.41, 65.87, 49.62, 41.35, 22.51, 22.45, 21.16, 11.48, 10.95 ppm. IR (neat): ṽ = 3277, 3206, 2961, 2932, 2873,

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1644, 1611, 1573, 1511, 1474, 1456, 1383, 1266, 1223, 1150, 1114, 1073, 984, 965, 909, 882, 812, 757, 687, 586, 532, 486, 485 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{25}N_2O_2$ [M + H]$^+$ 265.1916; found 265.1920.

2-(2-Hydroxy-5-methylphenyl)-*N*-propyl-2-(propylamino)acetamide (3f): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.05 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 6.86 (s, 1 H, PhH), 6.80 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 5.70 (br. s, 1 H, CONH), 4.23 (s, 1 H, α-H), 3.21–3.08 (m, 2 H, CONHCH_2CH$_2$CH$_3$), 2.63–2.50 (m, 2 H, NCH_2CH$_2$CH$_3$), 2.28 (s, 3 H, PhMe), 1.57 (hex, $^3J_{H,H}$ = 7.3 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.42 (hex, $^3J_{H,H}$ = 7.1 Hz, 2 H, CONHCH$_2$CH_2CH$_3$), 0.93 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, NCH$_2$CH$_2$CH_3), 0.81 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, CONHCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.70, 155.45, 130.52, 129.71, 128.68, 120.26, 117.45, 66.12, 49.74, 41.41, 22.54, 22.51, 20.42, 11.52, 10.98 ppm. IR (KBr): $\tilde{\nu}$ = 3276, 3105, 2958, 2930, 2873, 1640, 1617, 1578, 1471, 1454, 1424, 1383, 1347, 1322, 1286, 1254, 1225, 1154, 1130, 1113, 1049, 985, 963, 946, 900, 851, 819, 805, 730, 662, 602, 562, 535, 475 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{25}N_2O_2$ [M + H]$^+$ 265.1916; found 265.1919.

2-(2-Hydroxyphenyl)-*N*-propyl-2-(propylamino)acetamide (3g): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.26–7.21 (m, 1 H, PhH), 7.05 (d, $^3J_{H,H}$ = 7.2 Hz, 1 H, PhH), 6.88–6.84 (m, 2 H, PhH), 5.73 (br. s, 1 H, CONH), 4.26 (s, 1 H, α-H), 3.15 (q, $^3J_{H,H}$ = 6.5 Hz, 2 H, CONHCH_2CH$_2$CH$_3$), 2.63–2.50 (m, 2 H, NCH_2CH$_2$CH$_3$), 1.56 (hex, $^3J_{H,H}$ = 7.3 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.40 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, CONHCH$_2$CH_2CH$_3$), 0.93 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, NCH$_2$CH$_2$CH_3), 0.80 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, CONHCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.57, 157.95, 129.97, 129.27, 120.55, 119.47, 117.64, 66.12, 49.69, 41.40, 22.53, 22.45, 11.50, 10.95 ppm. IR (neat): $\tilde{\nu}$ = 3300, 3070, 2963, 2933, 2875, 1653, 1589, 1533, 1490, 1458, 1411, 1383, 1259, 1152, 1102, 830, 754 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{23}N_2O_2$ [M + H]$^+$ 251.1760; found 251.1752.

2-(5-Chloro-2-hydroxyphenyl)-*N*-propyl-2-(propylamino)acetamide (3h): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.18 (dd, $^3J_{H,H}$ = 8.8 Hz, $^4J_{H,H}$ = 2.2 Hz, 1 H, PhH), 7.05 (d, $^4J_{H,H}$ = 2.1 Hz, 1 H, PhH), 6.80 (d, $^3J_{H,H}$ = 8.8 Hz, 1 H, PhH), 5.88 (br. s, 1 H, CONH), 4.22 (s, 1 H, α-H), 3.24–3.10 (m, 2 H, CONHCH_2CH$_2$CH$_3$), 2.62–2.48 (m, 2 H, NCH_2CH$_2$CH$_3$), 1.56 (hex, $^3J_{H,H}$ = 7.3 Hz, 2 H, NCH$_2$CH_2CH$_3$), 1.43 (hex, $^3J_{H,H}$ = 7.2 Hz, 2 H, CONHCH$_2$CH_2CH$_3$), 0.93 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, NCH$_2$CH$_2$CH_3), 0.83 (t, $^3J_{H,H}$ = 7.4 Hz, 3 H, CONHCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.97, 156.59, 129.85, 128.68, 124.03, 122.33, 119.09, 65.57, 49.73, 41.54, 22.53, 22.53, 11.51, 11.01 ppm. IR (KBr): $\tilde{\nu}$ = 3277, 3123, 2960, 2933, 2875, 1668, 1639, 1599, 1577, 1499, 1477, 1451, 1421, 1382, 1361, 1344, 1315, 1274, 1249, 1220, 1170, 1146, 1112, 1071, 983, 962, 932, 908, 882, 815, 759, 726, 642, 605, 579, 528, 481 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{22}N_2O_2Cl$ [M + H]$^+$ 285.1370; found 285.1369.

Ethyl 2-[(*tert*-Butoxycarbonyl)(propyl)amino]-2-{6-[(*tert*-butoxycarbonyl)oxy]benzo[*d*][1,3]dioxol-5-yl}acetate (5): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 6.80 (br. s, 1 H, PhH), 6.71 (br. s, 1 H, PhH), 5.99 (d, $^2J_{H,H}$ = 2.8 Hz, 2 H, OCH$_2$O), 5.63 (br. s, 1 H), 5.57 (br. s, 1 H), 4.24–4.17 (m, 2 H, OCH_2CH$_3$), 3.16–2.92 (m, 2 H, NCH_2CH$_2$CH$_3$), 1.53 (s, 9 H, *t*BuO), 1.47 (s, 9 H, *t*BuO), 1.30–1.20 (m, 5 H, OCH$_2$CH_3), 0.74 (t, $^3J_{H,H}$ = 7.3 Hz, 3 H, NCH$_2$CH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.44, 147.85, 145.32, 144.04, 108.60, 107.87, 103.95, 101.91 83.71, 61.24, 58.27, 57.63, 47.65, 28.29, 27.53, 22.28, 21.79, 14.05, 11.24 ppm. IR (neat): $\tilde{\nu}$ = 2977, 2931, 1760, 1694, 1634, 1506, 1485, 1394, 1368, 1294, 1248, 1140, 1096, 1036, 1000, 935, 913, 858, 779, 743, 721, 519, 461, 443 cm^{-1}. HRMS (ESI+): calcd. for $C_{24}H_{35}NO_9Na$ [M + Na]$^+$ 504.2210; found 504.2207.

Ethyl 2-(Allylamino)-2-(6-hydroxybenzo[*d*][1,3]dioxol-5-yl)acetate (8): ^{1}H NMR (500 MHz, $CDCl_3$, 293 K): δ = 6.52 (s, 1 H, PhH), 6.40 (s, 1 H, PhH), 5.88 (s, 2 H, OCH$_2$O), 5.90–5.81 (m, 1 H, NCH$_2$CH=CH$_2$), 5.20 (dd, $^3J_{H,H}$ = 4.8 Hz, $^2J_{H,H}$ = 0.8 Hz, 1 H, NCH$_2$CH=CHH), 5.18 (br. s, 1 H, NCH$_2$CH=CHH), 4.38 (s, 1 H, α-H), 4.26–4.13 (m, 2 H, OCH_2CH$_3$), 3.34 (ddt, $^2J_{H,H}$ = 11.2 Hz, $^3J_{H,H}$ = 4.6, $^4J_{H,H}$ = 1.0 Hz, 1 H), 3.20 (dd, $^2J_{H,H}$ = 11.2 Hz, $^3J_{H,H}$ = 5.6 Hz, 1 H), 1.23 (t, $^3J_{H,H}$ = 5.6 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 171.04, 153.06, 148.30, 140.34, 134.09, 118.01, 110.61, 108.99, 100.95, 99.21, 63.46, 61.86, 48.88, 14.04 ppm. IR (film): $\tilde{\nu}$ = 3416, 3385, 2917, 2849, 1732, 1631, 1503, 1478, 1443, 1384, 1301, 1189, 1156, 1111, 1067, 1037, 935 cm^{-1}. HRMS (ESI+): calcd. for $C_{14}H_{18}NO_5$ [M + H]$^+$ 280.1185; found 280.1192.

Ethyl 2-(Benzylamino)-2-(6-hydroxybenzo[*d*][1,3]dioxol-5-yl)acetate (9): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.35–7.20 (m, 5 H, benzylPhH), 6.52 (s, 1 H, PhH), 6.42 (s, 1 H, PhH), 5.82 (d, $^2J_{H,H}$ = 1.8 Hz, 2 H, OCH$_2$O), 4.31 (s, 1 H, α-H), 4.22–4.07 (m, 2 H, OCH_2CH$_3$), 3.84 (d, $^2J_{H,H}$ = 13.1 Hz, 2 H, benzylH), 3.65 (d, $^2J_{H,H}$ = 13.2 Hz, 2 H, benzylH), 1.18 (t, $^3J_{H,H}$ = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.92, 153.00, 148.40, 140.43, 137.44, 128.77, 128.53, 127.78, 110.54, 109.14, 100.99, 99.26, 63.37, 61.88, 50.54, 14.03 ppm. IR (film): $\tilde{\nu}$ = 3319, 2916, 2849, 1731, 1631, 1501, 1478, 1409, 1384, 1299, 1185, 1151, 1111, 1066, 1038, 936, 856, 754, 700 cm^{-1}. HRMS (ESI+): calcd. for $C_{17}H_{17}NO_5Na$ [M + Na]$^+$ 338.1004; found 338.1010.

Ethyl 2-(6-Hydroxybenzo[*d*][1,3]dioxol-5-yl)-2-(phenylamino)acetate (10): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.20–7.16 (m, 2 H, NH$_2$PhH), 6.83 (m, 1 H, NH$_2$PhH), 6.73 (s, 1 H, PhH), 6.77–6.69 (m, 2 H, NH$_2$PhH), 6.43 (s, 1 H, PhH), 5.88 (s, 2 H, OCH$_2$O), 4.94 (s, 1 H, α-H), 4.33–4.09 (m, 2 H, OCH_2CH$_3$), 1.27 (t, $^3J_{H,H}$ = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 171.44, 151.38, 148.39, 145.43, 141.36, 129.33, 129.33, 120.56, 115.48, 115.48, 112.89, 108.01, 101.19, 99.68, 62.47, 60.67, 14.02 ppm. IR (KBr): $\tilde{\nu}$ = 3442, 3262, 2986, 2903, 1731, 1631, 1602, 1500, 1488, 1442, 1433, 1306, 1232, 1195, 1168, 1154, 1117, 1103, 1069, 1043, 950, 932, 896, 871, 844, 820, 801, 752, 719, 692, 620, 613, 578, 547, 490 cm^{-1}. HRMS (ESI+): calcd. for $C_{17}H_{17}NO_5Na$ [M + Na]$^+$ 338.1004; found 338.1010.

Ethyl 2-(6-Hydroxybenzo[*d*][1,3]dioxol-5-yl)-2-{[(*R*)-1-phenylethyl]-amino}acetate (11, mixture of epimers): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.39–7.24 (m, 7 H, PhH), 7.17 (d, $^3J_{H,H}$ = 7.3 Hz, 1 H, PhH), 6.43 (s, 0.5 H, PhH), 6.36 (s, 2.5 H, PhH), 5.89 (d, $^2J_{H,H}$ = 5.4 Hz, 1 H, OCH$_2$O), 5.84 (s, 2 H, OCH$_2$O), 4.31 (s, 1 H, α-H), 4.37–4.16 (m, 2 H, OCH_2CH$_3$), 4.14–4.03 (m, 1 H, OCH_2CH$_3$), 4.00 (s, 0.5 H, α-H), 3.82 (q, $^3J_{H,H}$ = 6.5 Hz, 1 H, α-H), 3.73 (q, $^3J_{H,H}$ = 6.8 Hz, 0.5 H, α-H, PhH), 1.47 (t, $^3J_{H,H}$ = 7.0 Hz, 4.5 H, PhCHMe), 1.27 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH$_2$CH_3), 1.14 (t, $^3J_{H,H}$ = 7.2 Hz, 1.5 H, PhCHMe) ppm. IR (film): $\tilde{\nu}$ = 3054, 2985, 2926, 2305, 1730, 1633, 1503, 1480, 1265, 1235, 1156, 1114, 1039, 939, 896, 856, 739, 704, 546 cm^{-1}. HRMS (ESI+): calcd. for $C_{19}H_{22}NO_5$ [M + H]$^+$ 344.1498; found 344.1506.

Ethyl 2-({3-[(*tert*-Butyldimethylsilyl)oxy]phenyl}amino)-2-(6-hydroxybenzo[*d*][1,3]dioxol-5-yl)acetate (12): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 7.02 (s, $^3J_{H,H}$ = 8.0 Hz, 1 H, PhH), 6.72 (s, 1 H, PhH), 6.42 (s, 1 H, PhH), 6.38–6.33 (m, 2 H, PhH), 6.22 (br. s, 1 H, PhH), 5.90 (d, $^2J_{H,H}$ = 3. 9 Hz, 2 H, OCH$_2$O), 4.91 (s, 1 H, α-H), 4.32–4.19 (m, 2 H, OCH_2CH$_3$), 1.25 (t, $^3J_{H,H}$ = 7.0 Hz, 3 H, OCH$_2$CH_3), 0.93 (s, 9 H, SiMe$_2$*t*Bu), 0.11 (s, 6 H, SiMe_2*t*Bu) ppm.

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^{13}C NMR (100 MHz, $CDCl_3$): δ = 171.35, 156.61, 151.36, 148.40, 146.61, 141.41, 129.97, 112.83, 112.47, 108.92, 108.07, 107.39, 101.18, 99.72, 62.50, 60.81, 25.61, 14.02 ppm. IR (neat): $\tilde{\nu}$ = 3404, 2956, 2930, 2896, 1731, 1602, 1504, 1483, 1441, 1409, 1390, 1370, 1295, 1259, 1196, 1121, 1039, 1003, 981, 938, 839, 782, 689, 665, 573, 493, 454 cm^{-1}. HRMS (ESI+): calcd. for $C_{23}H_{31}NO_6SiNa$ [M + Na]$^+$ 468.1818; found 468.1810.

Ethyl 2-[(2-Chlorophenyl)amino]-2-(6-hydroxybenzo[*d*][1,3]dioxol-5-yl)acetate (13): ^{1}H NMR (400 MHz, [D$_6$]DMSO, 293 K): δ = 9.76 (s, 1 H, OH), 7.27 (d, $^3J_{H,H}$ = 7.7 Hz, 1 H, PhH), 7.11–7.07 (m, 1 H, PhH), 6.82 (s, 1 H, PhH), 6.72 (d, $^3J_{H,H}$ = 8.1 Hz, 1 H, PhH), 6.64–6.60 (m, 1 H, PhH), 6.46 (s, 1 H, PhH), 5.90 (s, 2 H, OCH_2O), 5.66 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, NH), 5.42 (d, $^3J_{H,H}$ = 8.0 Hz, 1 H, α-H), 4.17–4.02 (m, 2 H, OCH_2CH_3), 1.12 (t, $^3J_{H,H}$ = 7.0 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (100 MHz, [D$_6$]DMSO): δ = 171.32, 150.07, 147.30, 142.08, 139.93, 128.96, 127.97, 118.35, 117.67, 115.36, 112.13, 107.45, 100.90, 97.70, 61.06, 54.08, 13.94 ppm. IR (KBr): $\tilde{\nu}$ = 3414, 3329, 3072, 2978, 2095, 1712, 1629, 1595, 1501, 1444, 1371, 1327, 1285, 1262, 1210, 1171, 1136, 1104, 1035, 1020, 965, 937, 878, 862, 841, 816, 779, 751 (m), 721, 699, 609, 568, 533, 472, 440 cm^{-1}. HRMS (ESI+): calcd. for $C_{17}H_{16}ClNO_5Na$ [M + Na]$^+$ 372.0615; found 372.0628.

Ethyl 2-(6-Hydroxybenzo[*d*][1,3]dioxol-5-yl)-2-morpholinoacetate (14): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 6.52 (s, 1 H, PhH), 6.39 (s, 1 H, PhH), 5.87 (s, 2 H, OCH_2O), 4.24–4.09 (m, 2 H, OCH_2CH_3), 3.93 (s, 1 H, α-H), 3.76 (br. t, $^3J_{H,H}$ = 4.4 Hz, 4 H, OCH_2CH_2N), 2.59 (br. s, 4 H, OCH_2CH_2N), 1.23 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.19, 152.34, 148.66, 140.46, 109.03, 108.29, 100.99, 98.74, 73.22, 66.53, 66.53, 61.23, 50.84, 50.84, 13.89 ppm. IR (neat): $\tilde{\nu}$ = 3191, 2966, 2855, 1736, 1632, 1559, 1504, 1480, 1454, 1408, 1388, 1369, 1329, 1300, 1269, 1237, 1187, 1141, 1117, 1072, 1034, 936, 889, 856, 768, 710, 684, 658, 524, 494 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{19}NO_6Na$ [M + Na]$^+$ 332.1110; found 332.1115.

Ethyl 2-(6-Hydroxybenzo[*d*][1,3]dioxol-5-yl)-2-(pyrrolidin-1-yl)acetate (15): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 10.31 (br. s, 1 H, OH), 6.55 (s, 1 H, PhH), 6.38 (s, 1 H, PhH), 5.86 (s, 2 H, OCH_2O), 4.21–4.09 (m, 2 H, OCH_2CH_3), 3.91 (s, 1 H, α-H), 2.76–2.68 (m, 2 H, NCH_2CH_2), 2.63–2.55 (m, 2 H, NCH_2CH_2), 1.89–1.81 (m, 4 H, NCH_2CH_2), 1.22 (t, $^3J_{H,H}$ = 7.2 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.70, 152.82, 148.22, 139.93, 110.09, 107.64, 100.76, 98.44, 72.30, 60.90, 51.74, 51.74, 23.34, 23.34, 13.81 ppm. IR (neat): $\tilde{\nu}$ = 3396, 2975, 2886, 1732, 1626, 1542, 1504, 1479, 1456, 1244, 1181, 1036, 931, 853, 800, 769, 697 cm^{-1}. HRMS (ESI+): calcd. for $C_{15}H_{20}NO_5$ [M + H]$^+$ 294.1341; found 294.1346.

Ethyl 2-(Diethylamino)-2-(6-hydroxybenzo[*d*][1,3]dioxol-5-yl)acetate (16): ^{1}H NMR (400 MHz, $CDCl_3$, 293 K): δ = 6.46 (s, 1 H, PhH), 6.41 (s, 1 H, PhH), 5.87 (s, 2 H, OCH_2O), 4.50 (s, 1 H, α-H), 4.28–4.16 (m, 2 H, OCH_2CH_3), 2.82–2.67 (m, 4 H, NCH_2CH_3), 1.27 (t, $^3J_{H,H}$ = 7.1 Hz, 3 H, OCH_2CH_3), 1.08 (t, $^3J_{H,H}$ = 7.2 Hz, 6 H, NCH_2CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.01, 153.21, 148.25, 140.18, 110.02, 107.64, 100.93, 98.93, 68.12, 60.97, 43.37, 43.34, 14.12, 11.53, 11.53 ppm. IR (neat): $\tilde{\nu}$ = 3384, 2923, 2508, 1731, 1626, 1504, 1456, 1385, 1242, 1169, 1126, 1102, 1035, 930, 880, 832, 799, 779, 760, 697, 662, 577, 472 cm^{-1}. Because this compound is quite unstable (see ref.[3a]), the HRMS (ESI+) molecular peak was not found.

Supporting Information (see footnote on the first page of this article): ^{1}H and ^{13}C NMR, IR, and HRMS spectra of compounds **2**, **2a**–**2h**, **3d**–**3h**, and **5**–**15** as well as additional ^{1}H-^{1}H COSY and NOESY of compounds **2** for initial structure elucidation.

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