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DBU-Catalyzed Michael Reaction of Enones with 1,3-Diketones and the Subsequent Iodine-Mediated Transformation of the Adducts to Polysubstituted Phenols

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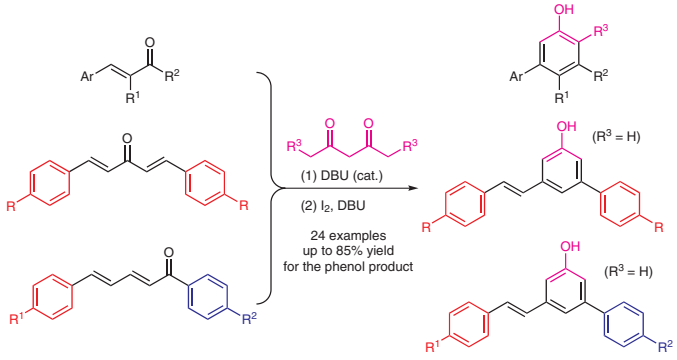

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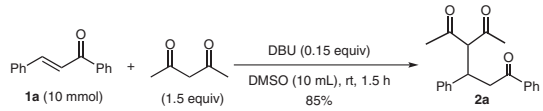
Abstract An efficient DBU-catalyzed Michael reaction of enones with 1,3-diketones has been developed for the gram-scale preparation of the Michael adducts. It is attractive that most of the adducts can be obtained with high purity through simple filtration. A convenient I_2-mediated transformation of the adducts to polysubstituted phenols has also been exploited. This conversion is remarkable with the cyclization and aromatization processes by using DBU as the base and I_2 as the oxidant. Furthermore, hydroxylated (*E*)-stilbene derivatives can be easily prepared by using this method. The readily available starting materials, metal-free and mild conditions make this approach simple and practical.

Key words polysubstituted phenol, 1,3-diketone, enone, iodine, DBU

Polysubstituted phenols are a class of important organic compounds and key skeletons found in a variety of bioactive compounds, natural products, agricultural and fine chemicals, and functional polymers.[1] Therefore, it is of continuous interest to develop an efficient and simple approach to access polysubstituted phenols. The strategies for their synthesis can be classified as two main types based on the starting materials: (1) Using aromatic precursors including direct conversion of the hydrogen, halo, or amino group on the aromatic ring into hydroxyl group[2] and metal-catalyzed cross-coupling reaction of phenols or halogenated phenols.[3] (2) Using nonaromatic precursors including benzannulation of vinylketenes,[4] furan-tethered or β-ketoester-tethered alkynes,[5] cyclopropenes or cyclopropenones,[6] cyclobutenones,[7] and cyclocondensations of enones with substituted acetones.[8] Among these versatile starting materials, enones are readily available as bulk chemicals. The reaction of *N*-acetonylpyridinium bromide, 1-(benzotriazol-1-yl)propan-2-one, or 2-fluoro-β-ketoesters with enones led to the formation of 3,5- or 3,4,5-substituted phenols.[8a–d] However, these approaches always suffer from pre-installation of directing groups, high reaction temperature, long reaction time, and most of the products were restricted to 3,5-diarylphenols. As for the direct construction of phenols from 1,3-diketones/β-ketoesters and enones under basic conditions, a tethered auxiliary group such as nitro or isocyanide was required.[8e,f] The reaction of 1,3-diarylpropan-2-ones with chalcones or cinnamaldehydes gave access to sterically hindered polyarylphenols;[8g] however, the two aryl groups were necessary for the success of reaction. Recently, oxidative metal-catalyzed aromatization of cyclohex-2-enones or cyclohexones into phenols has made extensive progress.[9] Not long ago, a metal-free iodine-catalyzed approach to phenols using DMSO as the oxidant was reported.[10] However, these cyclohex-2-enones should be prepared from enones beforehand through 2–3 steps of reaction and a long reaction time was always required. In our previous work, we have reported the base-controlled conversion of Michael adducts of enones with malonates into cyclopropane, α-hydroxymalonate, and oxetane derivatives with high selectivity in the presence of I_2.[11a] Later, we realized the I_2-mediated synthesis of azetidines, 2,4-dioxo-1,3-diazabicyclo[3.2.0] compounds, and polysubstituted dihydrofurans/furans using a similar approach.[11b,c] Li and Gao reported the I_2-mediated construction of dihydropyrroles from enones and β-enamine carbonyl compounds.[11d] As part of our on-going study in the iodine-promoted reaction,[12] we report here an efficient I_2-mediated conversion of the Michael adducts of enones with 1,3-diketones into various polysubstituted phenols.

During the preparation of raw material **2a**, we found a good method for its large-scale preparation with no requirement of column chromatographic separation. Using DBU as the base catalyst, the reaction of 5 mmol of chalcone **1a** with 1.5 equivalents of acetylacetone in DMSO was completed within 1.5 hours [for more details of the screen-

ing of conditions, see the Supporting Information (SI)]. After quenching with dilute hydrochloric acid, addition of ethanol and water, and then filtration gave the product **2a** in 85% yield with very high purity (Scheme 1).

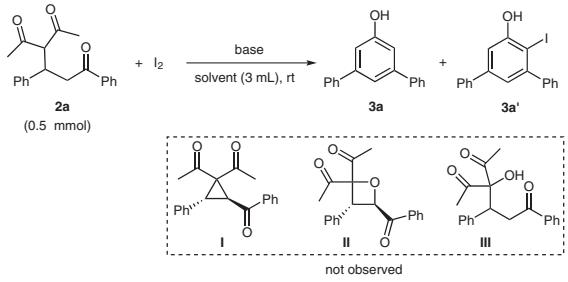


Scheme 1 Large-scale preparation of Michael adduct of aceteylacetone with chalcone **1a**

Our study was initiated with the reaction of Michael adduct **2a** with I_2 using Na_2CO_3, NaOAc, or DBU as the base according to our previously used conditions (Table 1).[11] No desired cyclopropane **I**, oxetane **II**, or α-hydroxylacetylacetone **III** was generated (Table 1, entries 1–3). To our surprise, when DBU was used as the base the unexpected 3,5-diphenylphenol (**3a**) and 2-iodo-3,5-diphenylphenol (**3a′**) was obtained in 26% and 16% yield, respectively (entry 3). However, considerable amount of **2a** remained unreacted. Although increasing the amount of DBU to 4 equivalents improved the yield of **3a** to 38%, the selectivity was still unsatisfactory (**3a**:**3a′** = 1.41:1, entry 4). Later, various solvents such as DMF, EtOH, CH_2Cl_2, THF, CH_3CN, DMSO, and EtOAc were screened with DBU as the base (entries 5–10). The results showed that CH_3CN was the best solvent, affording **3a** in 82% yield with the best selectivity as **3a**:**3a′** up to 9:1. It was attractive that the reaction proceeded rapidly and was completed within 30 minutes (entry 7). The product **3a′** was proven to be generated from the further iodination of **3a** with iodine under basic conditions. The slow dissolution of iodine in CH_3CN decreased its concentration in the reaction mixture, which was probably the main reason for the formation of less by-product **3a′**. Other bases such as DMAP, Et_3N, piperidine, morpholine, and pyrrolidine were also evaluated with CH_3CN as the solvent (entries 11–15). No reaction occurred when using DMAP or Et_3N as the base. With piperidine or morpholine as the base, the reaction proceeded very slowly. Even prolonging the reaction time to 18 hours, considerable amount of **2a** remained unreacted. When pyrrolidine was used as the base, although the reaction proceeded quickly, partial retro-Michael reaction of **2a** to chalcone occurred and the yield as well as selectivity was unsatisfactory. Finally, the optimal reaction conditions were established by employing DBU as the base and CH_3CN as the solvent for the conversion of **2a** into **3a** (entry 7).

Broad substrate compatibility for the two-step synthesis of 3,5-disubstituted phenols from enones and acetylacetone is shown in Table 2. Most of the Michael addition reaction proceeded well to give the adducts **2** in good yields with no requirement of column chromatography separation. Only the products **2k–m** and **2o** needed to be isolated by column chromatography. When R^1 is an electron-rich

Table 1 Screening of the Reaction Conditions

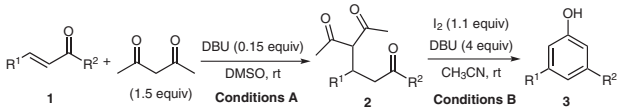


Entry	Base	**2a**/I_2/base	Solvent	Time (h)	Yield of **3a** (%)	Yield of **3a′** (%)
1	Na_2CO_3	1:1.1:2.2	DMF	7	0	0
2	NaOAc	1:0.2:0.2	THF	7	0	0
3	DBU	1:1.1:2.2	EtOH	0.5	26	16
4	DBU	1:1.1:4	EtOH	0.5	38	27
5	DBU	1:1.1:4	CH_2Cl_2	1	46	20
6	DBU	1:1.1:4	THF	1	40	27
7	**DBU**	**1:1.1:4**	**CH_3CN**	**0.5**	**82**	**9**
8	DBU	1:1.1:4	DMSO	1	42	26
9	DBU	1:1.1:4	DMF	1	51	23
10	DBU	1:1.1:4	EtOAc	1	28	31
11	DMAP	1:1.1:4	CH_3CN	18	trace	0
12	Et_3N	1:1.1:4	CH_3CN	18	0	0
13	piperidine	1:1.1:4	CH_3CN	18	25	17
14	pyrrolidine	1:1.1:4	CH_3CN	0.5	33	19
15	morpholine	1:1.1:4	CH_3CN	18	21	trace

aryl group, a longer reaction time was required. By changing R^2 to a methyl group, only a trace amount of the Michael addition product was obtained in the first step of the reaction. As for the second step of I_2-mediated cyclization to phenol, most of the reactions proceeded quickly (0.5–1 h) and the corresponding 3,5-disubstituted phenols were obtained in good yields when R^1 and R^2 were both aryl groups (Table 2, entries 1–12). No dramatic electronic effect of the substituent on the phenyl ring was observed. A furyl and thienyl group substituted phenol also could be prepared in good yields (entries 11 and 12). When R^1 was a methyl group or an ester group, although the Michael addition reaction furnished **2m** or **2o** in excellent yield, the second-step of reaction gave a complex mixture (entries 13 and 15).

When R^2 was a strong electron-deficient aryl group, no Michael addition product was obtained (Scheme 2). Instead, the cyclization products **4p** (**4q**) and **5p** (**5q**) were produced through the further nucleophilic addition to carbonyl group due to its enhancement of electrophilicity. The keto and enol form products were hard to separate on a silica gel column due to the tautomerization (recrystallization twice from ethanol provided the pure enol form product **5p** and

Table 2 Generality for the DBU-Catalyzed Michael Addition of Enones with Acetylacetone and the Subsequent I_2-Mediated Transformation to Phenols



Conditions A: 5 mmol of **1** and 4 mL of DMSO **Conditions B:** 0.5 mmol of **2** and 3 mL of CH_3CN

Entry	Substrate	R^1	R^2	Time (h)	Product	Yield of **2** (%)	Time (h)	Product	Yield of **3** (%)
1	**1a**	Ph	Ph	1.5	**2a**	85	0.5	**3a**	81
2	**1b**	4-MeC_6H_4	Ph	3	**2b**	80	1	**3b**	77
3	**1c**	4-$MeOC_6H_4$	Ph	6	**2c**	65	0.5	**3c**	73
4	**1d**	4-$NMe_2C_6H_4$	Ph	12	**2d**	40	0.5	**3d**	75
5	**1e**	3,4-$OCH_2OC_6H_3$	Ph	18	**2e**	76	1.5	**3e**	83
6	**1f**	4-ClC_6H_4	Ph	1	**2f**	86	0.5	**3f**	80
7	**1g**	4-$NO_2C_6H_4$	Ph	3	**2g**	87	4.5	**3g**	76
8	**1h**	Ph	4-$MeOC_6H_4$	5	**2h**	80	1	**3c**	75
9	**1i**	Ph	4-MeC_6H_4	1.5	**2i**	81	2	**3b**	73
10	**1j**	Ph	4-ClC_6H_4	1	**2j**	71	0.5	**3f**	70
11	**1k**	2-furyl	4-ClC_6H_4	2	**2k**[a]	82	0.5	**3k**	69
12	**1l**	2-thienyl	4-ClC_6H_4	2	**2l**[a]	74	0.5	**3l**	80
13	**1m**	Me	Ph	0.5	**2m**[a]	90	5	**3m**	complex
14	**1n**	Ph	Me	10	**2n**	trace	0.5	**3m**	63
15	**1o**	CO_2Me	Ph	0.5	**2o**[a]	90	5	**3o**	complex

[a] Isolated by column chromatography.

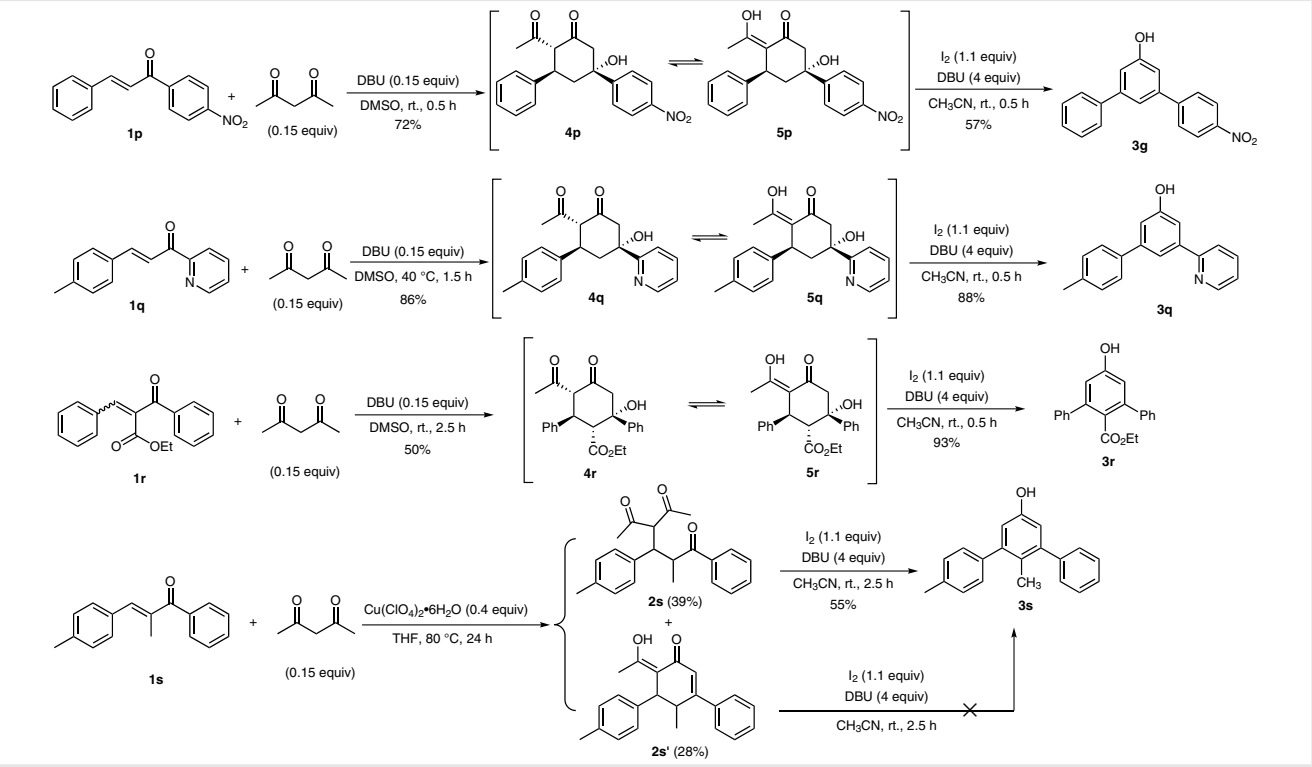
the keto form product **4q**, respectively). Next, treating the mixture of **4p** and **5p** with I_2/DBU, the corresponding phenol **3g** was obtained in 57% yield. Likewise, a 2-pyridyl group substituted phenol **3q** was generated in 88% yield.

In order to extend our methods to the synthesis of 3,4,5-trisubstituted phenols, an electron-withdrawing ester group and a methyl group was introduced at 2-position of enone, respectively (**1r** and **1s**, Scheme 2). The Michael reaction of acetylacetone with **1r** gave the similar result as that of **1p** and **1q**, giving the cyclization products **4r** and **5r** (recrystallization from ethanol provided the keto form product **4r**). However, the reaction of acetylacetone with **1s** catalyzed by DBU only gave a trace amount of product. We found that the $Cu(ClO_4)_2$ could catalyze the addition reaction and furnished 39% yield of the Michael adduct **2s** accompanied by the further condensation product **2s′** in 28% yield. The subsequent I_2-mediated transformation of **4r**/**5r** and **2s** afforded the corresponding phenols **3r** and **3s** in 93% and 55% yield, respectively. However, the reaction of **2s′** with I_2 in the presence of DBU did not provide the phenol **3s**.

Inspired by these good results, we next turned our attention to the synthesis of 3-hydroxylated (*E*)-stilbenes through the developed method. Hydroxylated stilbenes are widespread in nature and have been reported to show a range of biological activities such as antioxidant, antitumor, and cardioprotection. (*E*)-Resveratrol and (*Z*)-combretastatin A-4 are the two representative compounds.[13] (*E*)-Resveratrol has been suggested as an anticancer agent via the inhibition of cell proliferation and (*Z*)-combretastatin A-4 also displayed prominent antitumor activity. Therefore, the synthesis of new hydroxylated stilbene derivatives and their bioactivity evaluation have received much attention and interests in medicinal chemistry.[14] To our knowledge, most of the strategies relied on the construction of the C(vinyl)–Ar bond through Pd-catalyzed cross couplings or the creation of the C=C bonds by means of Wittig type reaction.

The 1,5-diarylpenta-1,4-dien-3-ones **6**, which could be easily prepared from the condensation of acetone with substituted benzaldehydes, was subjected to the reaction with acetylacetone and gave a mixture of Michael adducts **7** and the cyclization products **8**/**9** in good yields. Electron-donating group on the phenyl ring resulted in the need of a much longer reaction time. Treating the mixture of **7**, **8**, and **9** with I_2/DBU afforded the desired hydroxylated stilbene derivatives **10a–d** in good yields (Table 3).

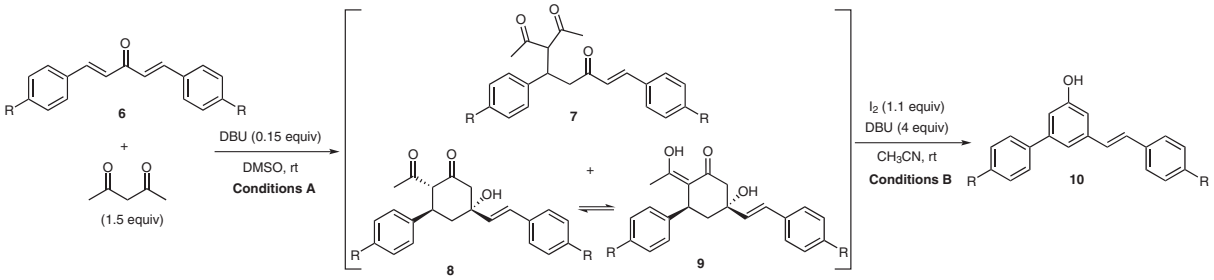
From the structural perspective of compounds **10**, both aryl groups are the same. To introduce different aryl groups in phenols **10**, the unsymmetrical 1,5-diarylpenta-1,4-dien-3-one **6** with a methoxy- and nitro group on the 4-position of each phenyl ring was subjected to the reaction. However, the Michael addition step gave a very complex



Scheme 2 Substrate scope expansion

mixture and the I_2-mediated transformation gave a mixture of two kinds of phenols with poor selectivity. To achieve the goal, 1,5-diarylpenta-2,4-dien-1-ones **11** containing different aryl substituents, which could be easily obtained through the condensation reaction of aryl methyl ketones with cinnamaldehyde derivatives, were used in the reaction. The Michael addition step was similar to that of **6** and gave a mixture of Michael adducts **12** and the cyclization products **13**/**14** in moderate to good yields, albeit a much longer reaction time was needed. Treating the mixture of **12**, **13**, and **14** with I_2/DBU also could deliver the corresponding hydroxylated stilbene derivatives **15** with differ-

Table 3 Synthesis of Hydroxylated Stilbene Derivatives from 1,5-Diarylpenta-1,4-dien-3-ones

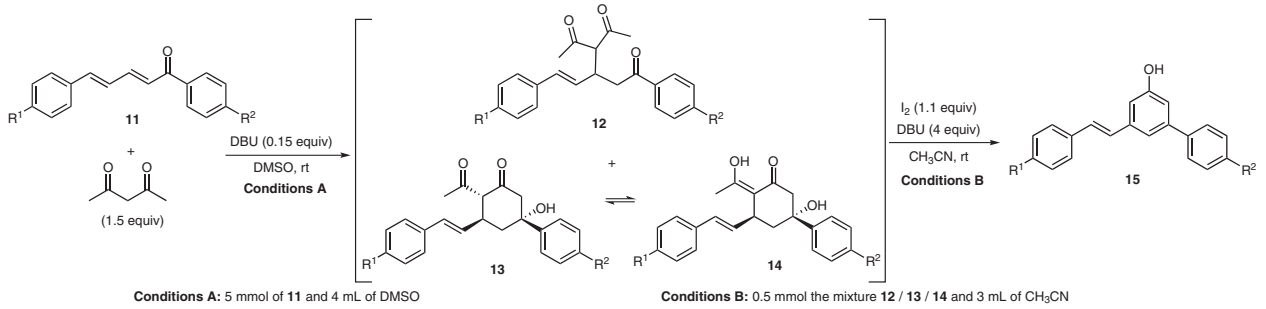


Conditions A: 5 mmol of **6** and 4 mL of DMSO

Conditions B: 0.5 mmol of the mixture **7** / **8** / **9** and 3 mL of CH_3CN

Entry	Substrate	R	Time (h)	Product	Yield of **7** + **8** + **9** (%)	Time (h)	Product	Yield of **10** (%)
1	**6a**	H	1.5	**7a**, **8a**, **9a**	88	1	**10a**	71
2	**6b**	OMe	15	**7b**, **8b**, **9b**	90	0.5	**10b**	79
3	**6c**	Me	8	**7c**, **8c**, **9c**	77	1	**10c**	75
4	**6d**	Cl	2	**7d**, **8d**, **9d**	87	0.5	**10d**	73

Table 4 Synthesis of Hydroxylated Stilbene Derivatives from 1,5-Diarylpenta-2,4-dien-1-ones



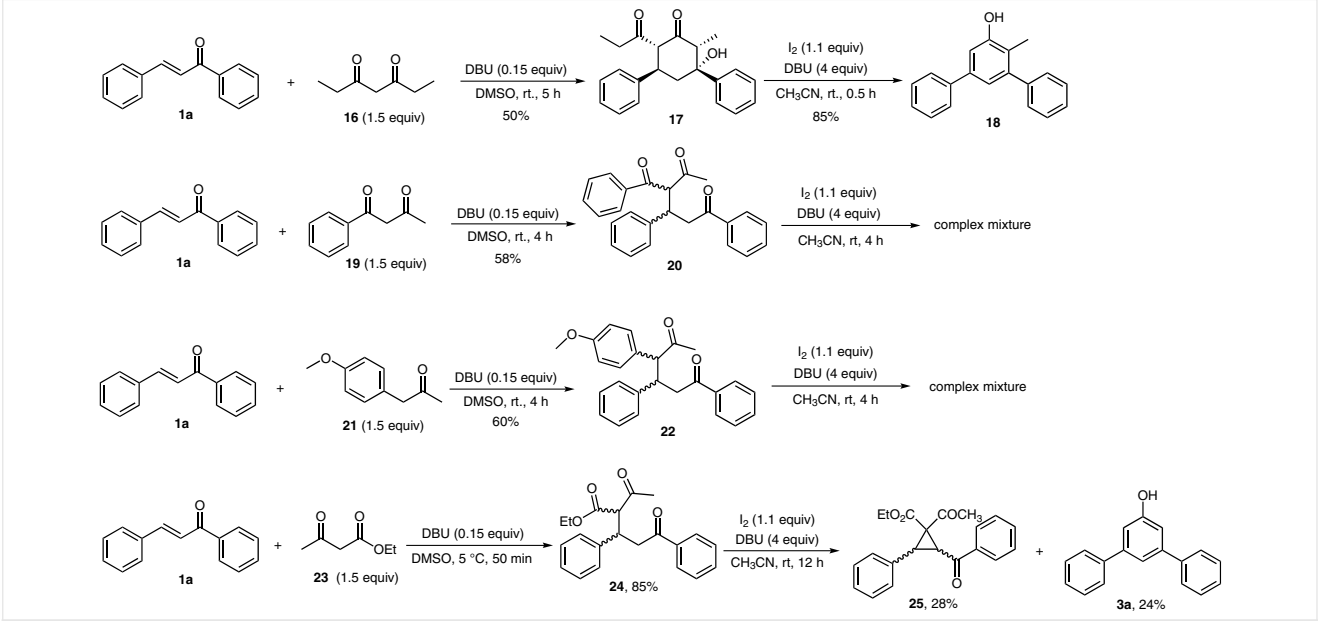
Conditions A: 5 mmol of **11** and 4 mL of DMSO

Conditions B: 0.5 mmol the mixture **12** / **13** / **14** and 3 mL of CH_3CN

Entry	Substrate	R^1	R^2	Time (h)	Products	Yield of **12** + **13** + **14** (%)	Time (h)	Product	Yield of **15** (%)
1	**11a**	H	H	14	**12a**, **13a**, **14a**	71	1.5	**10a**	50
2	**11b**	H	Me	24	**12b**, **13b**, **14b**	79	6	**15b**	25
3	**11c**	H	MeO	24	**12c**, **13c**, **14c**	67	9	**15c**	32
4	**11d**	H	Cl	7	**12d**, **13d**, **14d**	83	1.5	**15d**	55
5	**11e**	H	NO_2	8	**12e**, **13e**, **14e**	77	1	**15e**	63
6	**11f**	Br	H	13	**12f**, **13f**, **14f**	75	1	**15f**	53
7	**11g**	MeO	H	21	**12g**, **13g**, **14g**	70	0.5	**15g**	41

ent substituents on the two phenyl rings (Table 4). Although the yields were not satisfactory, the advantage of this method depended on the variability of the two aryl groups. When R^2 is an electron-donating group such as methyl or methoxy, the second step of reaction needed a much longer time and the yield was very low (Table 4, entries 2 and 3).

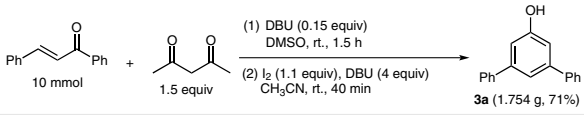
The feasibility of synthesizing diverse phenols using different substituted acetones was also investigated (Scheme 3). Excitingly, the addition of 3,5-heptanedione (**16**) with chalcone **1a** gave the cyclization product **17**, which could be converted into the 2,3,5-trisubstituted phenol **18** in 85% yield under I_2/DBU conditions. When one of the acetyl groups in acetylacetone was replaced by benzoyl or 4-me-



Scheme 3 Attempts to prepare phenols from different substituted acetones

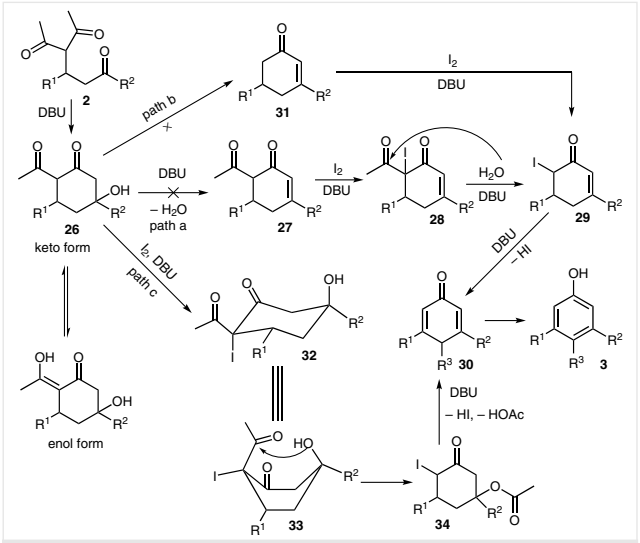
thoxyphenyl group, the Michael reaction occurred normally to give the products **20** and **22**, respectively. But in the second step of reaction, both of them gave a complex mixture, simultaneously with low conversion of **20**/**22**. When ethyl acetoacetate (**23**) was used instead of acetylacetone, the Michael addition proceeded well to give **24** in 85% yield in 50 minutes. The reaction of **24** with I_2/DBU gave the main cyclopropane product **25** within 40 minutes. By extending the reaction time to 12 hours, **25** and **3a** could be generated in 28% and 24% yield, respectively. But, the treatment of **25** with DBU did not produce phenol **3a**, which proves that **3a** is not formed from **25**.

To make the experimental operation easier, the synthesis of 3,5-diphenylphenol (**3a**) from chalcone and acetylacetone without isolation of the Michael adduct was tried. Upon completion of the Michael addition, the product was extracted with ethyl acetate. After drying and concentration, the crude product was treated with I_2/DBU in CH_3CN. However, only a moderate yield of **3a** (51%) was obtained. The reason was that the surplus acetylacetone could react with iodine, resulting in the consumption of iodine and base. In order to illustrate the practicability of this method, a gram-scale reaction was carried out with 10 mmol of **1a** and 15 mmol of acetylacetone, giving **3a** in 71% yield (Scheme 4).

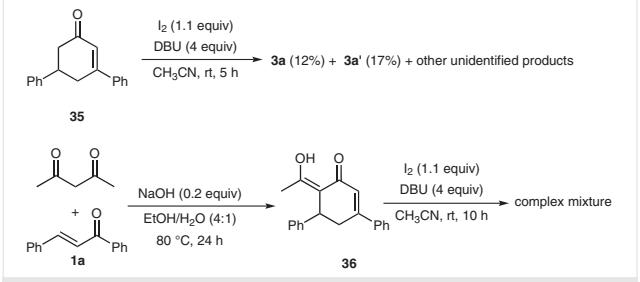


Scheme 4 Gram-scale synthesis of **3a**

A tentative reaction mechanism is proposed in Scheme 5. Intramolecular nucleophilic addition to carbonyl group leads to the formation of **26** or its enol form. It was sure that the iodine played an important role here because in the absence of iodine the cyclization proceeded extremely slowly. The underlying cause is unclear at present. Three possible reaction pathways might exist in the next reaction. In path a, dehydration under basic conditions affords **27**, which undergoes iodination to give **28**. The follow-up deacetylation and dehydroiodination under basic conditions gives **30**, which is equal to the phenol **3**. In path b, dehydration and deacetylation of **26** delivers cyclohexenone **31**, which undergoes iodination and dehydroiodination to furnish the phenol **3**. In order to verify the two possible reaction pathway, cyclohexenones **35** and **36** were prepared and subjected to the reaction conditions, respectively (Scheme 6, see SI). Although oxidative dehydrogenation of cyclohexenones to access corresponding phenols had been well reported, the reaction of **35** with I_2/DBU only gave **3a** and **3a′** in 12% and 17% yield, respectively, and most of **35** was recovered simultaneously. In the case of **36**, almost no **3a** was formed as determined by TLC.[15] The fact that reaction of **2s′** with I_2/DBU did not produce the phenol product **3s** was similar to that of **36**. There results ruled out the possibility of involving **27** or **31** as an intermediate and also illustrated the deacetylation must occur after the formation of C=C bonds. Besides, the reaction of **20** or **22** with I_2/DBU did not produce the corresponding phenol indicates that the acetyl is essential to the reaction and has some interaction with the hydroxyl group. Based on these results, we propose another possible reaction pathway c. Iodination at the α-position of two carbonyl groups gives **32**. Interconversion of chair conformation into boat conformation **33** and the subsequent intramolecular nucleophilic substitution generates intermediate **34**. Elimination of acetic acid and hydrogen iodide under basic conditions affords the phenol **3**.



Scheme 5 Proposed reaction mechanism



Scheme 6 Control experiments

In conclusion, we have developed an efficient DBU-catalyzed addition reaction of 1,3-diketones with enones. Most of the products were isolated in high purity via simple filtration; this is attractive for their large-scale preparation. A novel methodology for the transformation of the Michael adducts to polysubstituted phenols under I_2/DBU conditions is exploited. Furthermore, through elaborate selection of the enone substrates, hydroxylated stilbene derivatives also can be easily prepared. The cheap reagents, no require-

ment of heating, and mild metal-free conditions make this protocol very simple, practical, and easy to handle.

^{1}H and ^{13}C NMR (broadband decoupled) were recorded on 300 and 500 MHz (75 and 125 MHz for ^{13}C NMR) spectrometers. Melting points were determined on a micromelting point apparatus and are uncorrected. Flash column chromatography was performed on silica gel (200–300 mesh). HRMS were obtained on an Thermo Scientific LTQ Orbitrap XL equipped with an ESI source (positive mode).

Michael Addition Products 2a–j and Phenols 3a–g; General Procedure

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **1** (5 mmol), acetylacetone (750 mg, 7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (5 mL). The mixture was stirred at rt until the completion of reaction as determined by TLC (if the precipitated solid prevented stirring, the mixture was kept standing). After quenching with dil HCl, the mixture was dispersed in EtOH (10 mL) and H_2O (15 mL). The solid was filtered, washed with EtOH/H_2O (1:1), and then dried to give **2a–j**.

Step 2: I_2 (139.70 mg, 0.55 mmol) was added in one portion to a stirred mixture of **2** (0.5 mmol) and DBU (304 mg, 2 mmol) in CH_3CN (3 mL). The reaction mixture was stirred at rt until the completion of the reaction as determined by TLC. The mixture was diluted with EtOAc (30 mL), then quenched with aq $Na_2S_2O_3$ (15 mL, 10 mg/mL) and 1 N dil HCl (15 mL). The aqueous phase was further extracted with EtOAc (2 × 20 mL). The combined organic layers were washed with sat. aq $NaHCO_3$. The organic phase was dried (anhyd Na_2SO_4) and concentrated in vacuo. The residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding products.

2a[16]

White solid; yield: 1.312 g (85%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.82 (d, *J* = 7.1 Hz, 2 H), 7.52 (tt, *J* = 7.4, 1.3 Hz, 1 H), 7.40 (t, *J* = 7.5 Hz, 2 H), 7.20–7.26 (m, 4 H), 7.11–7.19 (m, 1 H), 4.33 (d, *J* = 11.0 Hz, 1 H), 4.22 (ddd, *J* = 11.1, 8.8, 4.1 Hz, 1 H), 3.33 (dd, *J* = 16.4, 8.7 Hz, 1 H), 3.19 (dd, *J* = 16.3, 4.1 Hz, 1 H), 2.28 (s, 3 H), 1.89 (s, 3 H).

2b[16]

White solid; yield: 1.290 g (80%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.83 (d, *J* = 7.1 Hz, 2 H), 7.52 (tt, *J* = 7.4, 1.2 Hz, 1 H), 7.41 (t, *J* = 7.5 Hz, 2 H), 7.10 (d, *J* = 8.2 Hz, 2 H), 7.04 (d, *J* = 8.0 Hz, 2 H), 4.30 (d, *J* = 11.1 Hz, 1 H), 4.18 (ddd, *J* = 11.1, 8.9, 4.1 Hz, 1 H), 3.29 (dd, *J* = 16.2, 8.9 Hz, 1 H), 3.17 (dd, *J* = 16.3, 4.1 Hz, 1 H), 2.28 (s, 3 H), 2.25 (s, 3 H), 1.89 (s, 3 H).

2c[16]

White solid; yield: 1.106 g (65%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.82 (d, *J* = 7.2 Hz, 2 H), 7.52 (tt, *J* = 7.4, 1.2 Hz, 1 H), 7.41 (t, *J* = 7.5 Hz, 2 H), 7.13 (d, *J* = 8.7 Hz, 2 H), 6.77 (d, *J* = 8.7 Hz, 2 H), 4.28 (d, *J* = 11.1 Hz, 1 H), 4.17 (ddd, *J* = 11.1, 8.9, 4.2 Hz, 1 H), 3.73 (s, 3 H), 3.27 (dd, *J* = 16.2, 8.8 Hz, 1 H), 3.16 (dd, *J* = 16.2, 4.2 Hz, 1 H), 2.28 (s, 3 H), 1.89 (s, 3 H).

2d

White solid; yield: 0.708 g (40%); mp 220–221 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.84 (d, *J* = 7.1 Hz, 2 H), 7.52 (tt, *J* = 7.3, 1.3 Hz, 1 H), 7.40 (t, *J* = 7.5 Hz, 2 H), 7.06 (d, *J* = 8.8 Hz, 2 H), 6.59 (d, *J* = 8.8 Hz, 2 H), 4.28 (d, *J* = 11.1 Hz, 1 H), 4.12 (ddd, *J* = 11.1, 8.9, 4.3 Hz, 1 H), 3.26 (dd, *J* = 16.1, 8.9 Hz, 1 H), 3.14 (dd, *J* = 16.0, 4.3 Hz, 1 H), 2.90 (s, 6 H), 2.27 (s, 3 H), 1.89 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 204.0, 203.7, 198.3, 149.7, 137.0, 133.1, 128.9, 128.6, 128.3, 127.6, 112.8, 74.9, 43.6, 40.65, 40.56, 30.1, 30.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{26}NO_3$: 352.1913; found: 352.1910.

2e

White solid; yield: 1.338 g (76%); mp 141–142 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.84 (d, *J* = 7.1 Hz, 2 H), 7.54 (tt, *J* = 7.3, 1.3 Hz, 1 H), 7.42 (t, *J* = 7.5 Hz, 2 H), 6.72 (t, *J* = 1.1 Hz, 1 H), 6.61–6.69 (m, 2 H), 5.90 (q, *J* = 1.4 Hz, 2 H), 4.26 (d, *J* = 11.0 Hz, 1 H), 4.15 (ddd, *J* = 11.1, 8.9, 4.1 Hz, 1 H), 3.25 (dd, *J* = 16.3, 8.8 Hz, 1 H), 3.14 (dd, *J* = 16.2, 4.1 Hz, 1 H), 2.27 (s, 3 H), 1.94 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.5, 203.1, 197.8, 147.9, 146.7, 136.8, 134.0, 133.3, 128.7, 128.2, 121.5, 108.59, 108.55, 101.2, 74.7, 43.3, 41.0, 30.1, 30.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{21}O_5$: 353.1389; found: 353.1382.

2f[16]

White solid; yield: 1.471 g (86%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.82 (d, *J* = 7.1 Hz, 2 H), 7.54 (tt, *J* = 7.4, 1.2 Hz, 1 H), 7.42 (t, *J* = 7.5 Hz, 2 H), 7.23 (d, *J* = 8.8 Hz, 2 H), 7.18 (d, *J* = 8.7 Hz, 2 H), 4.29 (d, *J* = 10.9 Hz, 1 H), 4.21 (ddd, *J* = 11.0, 8.9, 4.1 Hz, 1 H), 3.30 (dd, *J* = 16.6, 8.5 Hz, 1 H), 3.18 (dd, *J* = 16.6, 3.9 Hz, 1 H), 2.27 (s, 3 H), 1.92 (s, 3 H).

2g[17]

White solid; yield: 1.536 g (87%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 8.12 (d, *J* = 8.9 Hz, 2 H), 7.82 (d, *J* = 7.1 Hz, 2 H), 7.55 (tt, *J* = 7.4, 1.3 Hz, 1 H), 7.46 (d, *J* = 8.8 Hz, 2 H), 7.43 (t, *J* = 7.5 Hz, 1 H), 4.30–4.42 (m, 2 H), 3.32–3.44 (m, 1 H), 3.22–3.32 (m, 1 H), 2.29 (s, 3 H), 1.97 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 202.5, 202.1, 196.9, 148.5, 147.1, 136.4, 133.7, 129.4, 128.9, 128.1, 124.0, 73.8, 42.3, 40.5, 30.2, 29.9.

2h

White solid; yield: 1.356 g (80%); mp 132–133 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.80 (d, *J* = 9.0 Hz, 2 H), 7.12–7.26 (m, 5 H), 6.87 (d, *J* = 9.0 Hz, 2 H), 4.33 (d, *J* = 11.1 Hz, 1 H), 4.20 (ddd, *J* = 11.1, 8.8, 4.2 Hz, 1 H), 3.84 (s, 3 H), 3.26 (dd, *J* = 15.9, 8.8 Hz, 1 H), 3.13 (dd, *J* = 16.0, 4.2 Hz, 1 H), 2.29 (s, 3 H), 1.88 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.6, 203.3, 196.4, 163.6, 140.5, 130.5, 129.9, 128.9, 128.2, 127.4, 113.8, 74.6, 55.6, 42.8, 41.5, 30.1, 30.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{23}O_4$: 339.1596; found: 339.1590.

2i

White solid; yield: 1.304 g (81%); mp 156–157 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.72 (d, *J* = 8.2 Hz, 2 H), 7.12–7.26 (m, 7 H), 4.32 (d, *J* = 11.0 Hz, 1 H), 4.21 (ddd, *J* = 11.1, 8.8, 4.1 Hz, 1 H), 3.29 (dd, *J* = 16.2, 8.7 Hz, 1 H), 3.15 (dd, *J* = 16.2, 4.1 Hz, 1 H), 2.38 (s, 3 H), 2.28 (s, 3 H), 1.88 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.5, 203.2, 197.5, 144.1, 140.5, 134.4, 129.3, 128.9, 128.3, 128.2, 127.3, 74.5, 43.0, 41.3, 30.0, 21.7.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{23}O_3$: 323.1647; found: 323.1639.

2j[16]

White solid; yield: 1.214 g (71%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.76 (d, *J* = 8.7 Hz, 2 H), 7.38 (d, *J* = 8.7 Hz, 2 H), 7.10–7.30 (m, 5 H), 4.31 (d, *J* = 10.9 Hz, 1 H), 4.18 (ddd, *J* = 11.0, 8.6, 4.5 Hz, 1 H), 3.26 (dd, *J* = 16.1, 8.5 Hz, 1 H), 3.18 (dd, *J* = 16.1, 4.6 Hz, 1 H), 2.28 (s, 3 H), 1.89 (s, 3 H).

3a[18]

White solid; from substrate **1a**, yield: 100.5 mg (82%); from substrate **24**, yield: 29.7 mg (24%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.61 (d, *J* = 7.2 Hz, 4 H), 7.45 (t, *J* = 7.3 Hz, 4 H), 7.39 (t, *J* = 1.5 Hz, 1 H), 7.36 (t, *J* = 7.3 Hz, 2 H), 7.04 (d, *J* = 1.5 Hz, 2 H), 5.11 (br s, 1 H).

3a′

Obtained from the preparation of **3a** as a by-product; yellow oil; yield: 16.7 mg (9%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.57–7.63 (m, 2 H), 7.32–7.50 (m, 8 H), 7.25 (d, *J* = 2.2 Hz, 1 H), 7.13 (d, *J* = 2.2 Hz, 1 H), 5.67 (s, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 155.5, 148.0, 144.3, 142.8, 139.6, 129.3, 129.0, 128.2, 128.1, 128.0, 127.1, 121.3, 112.1, 90.3.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{18}H_{14}IO$: 373.0089; found: 373.0090.

3b[10c]

Pale yellow solid; from substrate **1b**, yield: 100.1 mg (77%), from substrate **1i**, yield: 94.90 mg (73%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.61 (d, *J* = 6.9 Hz, 2 H), 7.51 (d, *J* = 8.1 Hz, 2 H), 7.44 (t, *J* = 7.3 Hz, 2 H), 7.32–7.39 (m, 2 H), 7.24 (d, *J* = 7.8 Hz, 2 H), 7.00–7.05 (m, 2 H), 5.30 (br s, 1 H), 2.40 (s, 3 H).

3c[18]

Yellow solid; from substrate **1c**, yield: 100.7 mg (73%), from substrate **1h**, yield: 103.5 mg (75%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.60 (d, *J* = 6.9 Hz, 2 H), 7.54 (d, *J* = 8.9 Hz, 2 H), 7.44 (t, *J* = 7.3 Hz, 2 H), 7.30–7.39 (m, 2 H), 7.00 (s, 1 H), 6.99 (s, 1 H), 6.97 (d, *J* = 8.9 Hz, 2 H), 5.27 (br s, 1 H), 3.85 (s, 3 H).

3d

Yellow solid; yield: 108.4 mg (75%); mp 116–117 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.61 (d, *J* = 7.0 Hz, 2 H), 7.51 (d, *J* = 8.9 Hz, 2 H), 7.43 (t, *J* = 7.3 Hz, 2 H), 7.31–7.38 (m, 2 H), 6.93–7.02 (m, 2 H), 6.81 (d, *J* = 8.9 Hz, 2 H), 5.44 (br s, 1 H), 2.99 (s, 6 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 156.5, 150.2, 143.3, 141.2, 129.4, 128.8, 127.9, 127.6, 127.3, 118.0, 113.4, 112.3, 112.2, 40.9.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{20}NO$: 290.1545; found: 290.1538.

3e[10c]

Yellow oil; yield: 120.4 mg (83%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.59 (d, *J* = 7.1 Hz, 2 H), 7.43 (t, *J* = 7.3 Hz, 2 H), 7.35 (tt, *J* = 7.2, 1.2 Hz, 1 H), 7.30 (t, *J* = 1.4 Hz, 1 H), 7.05–7.12 (m, 2 H), 7.00 (dd, *J* = 2.2, 1.5 Hz, 1 H), 6.96 (dd, *J* = 2.2, 1.6 Hz, 1 H), 6.87 (d, *J* = 8.6 Hz, 1 H), 5.99 (s, 2 H), 5.39 (br s, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 156.3, 148.2, 147.4, 143.5, 143.1, 140.9, 135.2, 128.9, 127.7, 127.3, 120.8, 118.7, 113.0, 112.9, 108.7, 107.8, 101.3.

3f[10c]

White solid; from substrate **1f**, yield: 112.4 mg (80%), from substrate **1j**, yield: 98.0 mg (70%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.59 (d, *J* = 6.9 Hz, 2 H), 7.52 (d, *J* = 8.7 Hz, 2 H), 7.45 (t, *J* = 7.2 Hz, 2 H), 7.34-7.41 (m, 3 H), 7.32 (t, *J* = 1.5 Hz, 1 H), 7.05 (dd, *J* = 2.4, 1.6 Hz, 1 H), 7.00 (dd, *J* = 2.3, 1.6 Hz, 1 H), 5.30 (br s, 1 H).

3g[8d]

Yellow solid; from substrate **1g**, yield: 110.4 mg (76%); from substrate **4p** + **5p**, yield: 82.7 mg (57%).

^{1}H NMR (300 MHz, DMSO-d_6): δ = 9.94 (s, 1 H), 8.31 (d, *J* = 8.8 Hz, 2 H), 8.00 (d, *J* = 8.9 Hz, 2 H), 7.73 (d, *J* = 7.1 Hz, 2 H), 7.49 (t, *J* = 7.4 Hz, 2 H), 7.45 (t, *J* = 1.5 Hz, 1 H), 7.40 (tt, *J* = 7.3, 1.2 Hz, 1 H), 7.143 (s, 1 H), 7.138 (s, 1 H).

Michael Addition Products 2k, 2l, 2m, and 2o and Phenols 3k, 3l, and 3m; General Procedure

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **1** (5 mmol), acetylacetone (750 mg, 7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (4 mL). The mixture was stirred at rt until the completion of reaction (TLC analysis). The mixture was diluted with EtOAc and then washed successively with 1 N dil HCl, sat. aq $NaHCO_3$, and brine. The organic phase was dried (anhyd Na_2SO_4), evaporated, and the residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding products of **2k**, **2l**, **2m**, and **2o**.

Step 2: The process for the subsequent I_2-mediated phenol formation was the same as Step 2 in the general procedure for the preparation of **3a**–**g**.

2k

Pale yellow solid; yield: 1.365 g (82%); mp 114–115 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.83 (d, *J* = 8.5 Hz, 2 H), 7.41 (d, *J* = 8.6 Hz, 2 H), 7.27 (d, *J* = 1.8 Hz, 1 H), 6.22 (dd, *J* = 3.2, 1.8 Hz, 1 H), 6.05 (d, *J* = 3.2 Hz, 1 H), 4.21–4.37 (m, 2 H), 3.30 (dd, *J* = 16.7, 7.4 Hz, 1 H), 3.19 (dd, *J* = 16.7, 3.6 Hz, 1 H), 2.24 (s, 3 H), 2.03 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.1, 202.9, 196.6, 153.2, 141.9, 139.8, 135.0, 129.7, 129.0, 110.7, 107.6, 70.9, 40.1, 34.6, 30.5, 29.6.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd for $C_{18}H_{17}ClO_4Na$: 355.0713; found: 355.0710.

2l

White solid; yield: 1.294 g (74%); mp 89–90 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.80 (d, *J* = 8.7 Hz, 2 H), 7.40 (d, *J* = 8.7 Hz, 2 H), 7.12 (dd, *J* = 4.5, 1.7 Hz, 1 H), 6.80–6.87 (m, 2 H), 4.53 (ddd, *J* = 10.3, 8.4, 4.3 Hz, 1 H), 4.35 (d, *J* = 10.3 Hz, 1 H), 3.31 (dd, *J* = 16.5, 8.4 Hz, 1 H), 3.22 (dd, *J* = 16.5, 4.3 Hz, 1 H), 2.26 (s, 3 H), 2.02 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.0, 202.8, 196.5, 143.5, 139.9, 135.1, 129.7, 129.1, 127.0, 126.2, 124.6, 74.4, 43.6, 36.5, 30.3, 30.1.

HRMS (ESI): *m*/*z* [M + K]$^+$ calcd for $C_{18}H_{17}ClO_3SK$: 387.0224; found: 387.0223.

2m[19]

White solid; yield: 1.107 g (90%).

^{1}H NMR (300 MHz, $CDCl_3$): d = 7.95 (d, *J* = 7.1 Hz, 2 H), 7.58 (tt, *J* = 7.3, 1.3 Hz, 1 H), 7.47 (t, *J* = 7.4 Hz, 2 H), 3.83 (d, *J* = 8.6 Hz, 1 H), 2.95–3.11 (m, 2 H), 2.84 (dd, *J* = 17.2, 9.3 Hz, 1 H), 2.24 (s, 3 H), 2.20 (s, 3 H), 1.00 (d, *J* = 6.8 Hz, 3 H).

2o

Colorless oil; yield: 1.305 g (90%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.93 (d, *J* = 7.1 Hz, 2 H), 7.58 (tt, *J* = 7.4, 1.3 Hz, 1 H), 7.46 (t, *J* = 7.5 Hz, 2 H), 4.41 (d, *J* = 7.5 Hz, 1 H), 3.86 (ddd, *J* = 7.4, 5.8, 5.1 Hz, 1 H), 3.65 (s, 3 H), 3.53 (dd, *J* = 18.4, 6.0 Hz, 1 H), 3.25 (dd, *J* = 18.4, 5.0 Hz, 1 H), 2.32 (s, 3 H), 2.26 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.1, 202.9, 197.6, 173.0, 136.1, 133.5, 128.6, 128.0, 67.4, 52.3, 39.4, 37.2, 30.4, 30.1.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{16}H_{19}O_5$: 291.1232; found: 291.1226.

3k

Pale yellow solid; yield: 93.1 mg (69%); mp 109–110 °C.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 9.81 (s, 1 H), 7.75–7.78 (m, 1 H), 7.70 (d, *J* = 8.7 Hz, 2 H), 7.52 (d, *J* = 8.5 Hz, 2 H), 7.42 (t, *J* = 1.4 Hz, 1 H), 7.12 (dd, *J* = 2.2, 1.4 Hz, 1 H), 7.02 (dd, *J* = 3.5, 0.6 Hz, 1 H), 6.95 (dd, *J* = 2.1, 1.5 Hz, 1 H), 6.61 (dd, *J* = 3.4, 1.8 Hz, 1 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 158.3, 152.9, 143.0, 140.9, 138.8, 132.5, 132.2, 128.9, 128.5, 112.9, 112.8, 112.1, 109.6, 106.4.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{16}H_{12}ClO_2$: 271.0526; found: 271.0527.

3l

Brown solid; yield: 114.4 mg (80%); mp 101–102 °C.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 9.83 (s, 1 H), 7.70 (d, *J* = 8.6 Hz, 2 H), 7.53–7.60 (m, 2 H), 7.51 (d, *J* = 8.6 Hz, 2 H), 7.35 (t, *J* = 1.4 Hz, 1 H), 7.14 (dd, *J* = 5.1, 3.6 Hz, 1 H), 7.06 (t, *J* = 1.8 Hz, 1 H), 6.97 (t, *J* = 1.8 Hz, 1 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 158.4, 143.3, 141.2, 138.8, 135.7, 132.6, 128.9, 128.6, 128.5, 125.7, 124.1, 114.8, 113.0, 111.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{16}H_{12}ClOS$: 287.0297; found: 287.0286.

3m[8d]

Yellow oil, from substrate **2n** [prepared by the $Cu(ClO_4)_2{\cdot}6H_2O$-catalyzed Michael reaction of **1n**, see below]; yield: 57.9 mg (63%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.54 (d, *J* = 7.0 Hz, 2 H), 7.40 (t, *J* = 7.3 Hz, 2 H), 7.33 (tt, *J* = 7.2, 1.4 Hz, 1 H), 6.98 (s, 1 H), 6.86 (s, 1 H), 6.64 (s, 1 H), 5.04 (br s, 1 H), 2.35 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 155.9, 142.9, 141.0, 140.2, 128.8, 127.5, 127.2, 120.8, 115.1, 111.4, 21.6.

Reaction of 1p with Acetylacetone and the Subsequent I_2-Mediated Phenol Formation

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **1p** (5 mmol), acetylacetone (750 mg, 7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (5 mL). The reaction mixture was stirred at rt until the completion of reaction (TLC analysis). The mixture was diluted with EtOAc and then washed successively with 1 N HCl, sat. aq $NaHCO_3$, and brine. The organic phase was dried (anhyd Na_2SO_4) and evaporated. The residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding products of **4p** and **5p** as a mixture (recrystallization twice from EtOH provided the pure enol form product **5p**).

Step 2: The process for the subsequent I_2-mediated phenol formation (a mixture of **4p** and **5p** was used) was the same as Step 2 in the general procedure for the preparation of **3a–g**.

4p/5p

Mixture of **4p**:**5p** (1:4.7); white solid; yield: 1.271 g (72%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 16.27 (s, 1 H), 8.18 (d, *J* = 9.0, Hz, 2 H), 7.64 (d, *J* = 9.0 Hz, 2 H), 7.30 (d, *J* = 7.5 Hz, 2 H), 7.16–7.26 (m, 3 H), 4.14 (dd, *J* = 10.5, 6.5 Hz, 1 H), 3.05 (dd, *J* = 18.3, 1.3 Hz, 1 H), 2.66 (dd, *J* = 18.3, 3.3 Hz, 1 H), 2.40 (s, 1 H), 2.36 (ddd, *J* = 14.0, 6.5, 3.3 Hz, 1 H), 1.98 (dd, *J* = 14.1, 10.7 Hz, 1 H), 1.75 (s, 3 H).

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{20}NO_5$: 354.1341; found: 354.1351.

Reaction 1q/1r with Acetylacetone and the Subsequent I_2-Mediated Phenol Formation

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **1q** or **1r** (5 mmol), acetylacetone (750 mg, 7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (5 mL). The mixture was stirred (for **1q**, at 40 °C; for **1r**, at rt) until the completion of reaction as determined by TLC and then dispersed in EtOH (10 mL) and H_2O (15 mL). The precipitate was filtered to give a mixture of **4q** (**4r**) and **5q** (**5r**) as white solid (recrystallization from EtOH the pure keto form product **4q** and **4r**).

Step 2: The process for the subsequent I_2-mediated phenol formation (a mixture of **4q/4r** and **5q/5r** was used) was the same as Step 2 in the general procedure for the preparation of **3a–g**.

4q/5q

Mixture of **4q**:**5q** (1:2); white solid; yield: 1.389 g (86%).

^{1}H NMR (500 MHz, $CDCl_3$): δ = 16.36 (s, 1 H, enol), 8.55 (d, *J* = 5.1 Hz, 1 H, ketone), 8.54 (d, *J* = 5.1 Hz, 1 H, enol), 7.76 (t, *J* = 7.7 Hz, 1 H, ketone), 7.70 (t, *J* = 7.7 Hz, 2 H, enol), 7.46 (d, *J* = 7.9 Hz, 1 H, ketone), 7.31 (d, *J* = 8.0 Hz, 1 H, enol), 7.26–7.28 (m, 1 H, ketone), 7.24 (dd, *J* = 7.3, 4.8 Hz, 1 H, enol), 7.17 (d, *J* = 8.0 Hz, 2 H, ketone), 7.08–7.14 (m, 6 H, ketone + enol), 5.39 (s, 1 H, enol), 4.99 (s, 1 H, ketone), 4.19 (dd, *J* = 10.6, 6.2 Hz, 1 H, enol), 4.06 (td, *J* = 12.5, 3.8 Hz, 1 H, ketone), 3.85 (d, *J* = 12.5 Hz, 1 H, ketone), 3.06 (d, *J* = 14.1 Hz, 1 H, ketone), 3.02 (d, *J* = 18.2 Hz, 1 H, enol), 2.61 (dd, *J* = 14.0, 2.4 Hz, 1 H, ketone), 2.55 (dd, *J* = 18.1, 3.0 Hz, 1 H, enol), 2.39 (t, *J* = 13.2 Hz, 1 H, ketone), 2.31 (s, 3 H, enol), 2.29 (s, 3 H, ketone), 2.17 (ddd, *J* = 13.6, 6.3, 3.1 Hz, 1 H, enol), 2.07–2.13 (m, 4 H, ketone), 1.91 (dd, *J* = 13.4, 11.0 Hz, 1 H, enol), 1.75 (s, 3 H, enol).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 205.9, 205.6, 200.6, 180.4, 162.6, 162.2, 148.2, 147.8, 143.8, 138.5, 137.54, 137.46, 136.9, 136.0, 129.8, 129.7, 127.2, 127.1, 122.8, 122.7, 118.9, 118.7, 110.4, 76.1, 71.8, 69.1, 53.6, 46.8, 46.0, 45.0, 42.1, 39.5, 30.1, 27.2, 21.1.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{22}NO_3$: 324.1600; found: 324.1596.

4r/5r

Mixture of **4r**:**5r** (1.25:1); white solid; yield: 0.950 g (50%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 16.28 (s, 1 H, enol), 7.14–7.52 (m, 20 H, ketone + enol), 4.51 (d, *J* = 2.8 Hz, 1 H, ketone), 4.29 (d, *J* = 10.6 Hz, 1 H, enol), 4.19 (t, *J* = 12.1 Hz, 1 H, ketone), 4.14 (d, *J* = 2.5 Hz, 1 H, enol), 3.95 (d, *J* = 12.4 Hz, 1 H, ketone), 3.56–3.75 (m, 2 H, enol), 3.60 (d, *J* = 12.0 Hz, 1 H, ketone), 3.45–3.56 (m, 2 H, ketone), 3.09 (d, *J* = 10.6 Hz, 1 H, enol), 2.87–2.98 (m, 1 H, enol), 2.86 (dd, *J* = 14.7, 2.8 Hz, 1 H, ketone), 2.76 (d, *J* = 14.6 Hz, 1 H, ketone), 2.69 (d, *J* = 18.6 Hz, 1 H, enol), 2.10 (s, 3 H, ketone), 1.69 (s, 3 H, enol), 0.63 (t, *J* = 7.1 Hz, 3 H, enol), 0.51 (t, *J* = 7.1 Hz, 3 H, ketone).

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{23}H_{25}O_5$: 381.1702; found: 381.1698.

3q

White solid; yield: 114.8 mg (88%); mp 98–99 °C.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 9.72 (s, 1 H), 8.67 (ddd, *J* = 4.7, 1.7, 0.8 Hz, 1 H), 7.99 (d, *J* = 8.0 Hz, 1 H), 7.87 (td, *J* = 7.7, 1.8 Hz, 1 H), 7.74 (t, *J* = 1.5 Hz, 1 H), 7.59 (d, *J* = 8.1 Hz, 2 H), 7.50 (dd, *J* = 2.2, 1.6 Hz, 1 H), 7.35 (ddd, *J* = 7.4, 4.8, 1.0 Hz, 1 H), 7.28 (d, *J* = 7.9 Hz, 2 H), 7.08 (dd, *J* = 2.2, 1.7 Hz, 1 H), 2.35 (s, 3 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 158.3, 156.0, 149.5, 142.0, 140.6, 137.4, 137.2, 136.9, 129.5, 126.6, 122.7, 120.5, 115.8, 114.1, 112.4, 20.7.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{18}H_{16}NO$: 262.1232; found: 262.1235.

3r[10c]

White solid; yield: 147.9 mg (93%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.32–7.40 (m, 10 H), 6.80 (s, 2 H), 5.28 (br s, 1 H), 3.82 (q, *J* = 7.1 Hz, 2 H), 0.77 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.2, 156.3, 142.8, 140.5, 128.4, 128.3, 127.7, 125.5, 115.9, 61.2, 13.5.

$Cu(ClO_4)_2·6H_2O$-Catalyzed Michael Reaction of 1n/1s with Acetylacetone for the Preparation of 2n, 2s, and 2s′ and the Subsequent I_2-Mediated Phenol Formation

Step 1: A big tube (⌀ 18 × 150 mm) tube was charged with enone **1n/1s** (5 mmol), acetylacetone (750 mg, 7.5 mmol), $Cu(ClO_4)_2·6H_2O$ (740 mg, 2 mmol), and THF (4 mL). The mixture was stirred (for **1n**, at rt; for **1s**, at 80 °C) until the completion of reaction as determined by TLC. H_2O (10 mL) was added and the mixture was extracted with EtOAc (3 × 25 mL). The combined organic phases were dried (anhyd Na_2SO_4) and evaporated. The residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding products of **2n**, **2s**, and **2s′**.

Step 2: The process for the subsequent I_2-mediated phenol formation was the same as Step 2 in the general procedure for the preparation of **3a–g**.

2n[16]

White solid; yield: 1.070 g (87%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.27–7.32 (m, 1 H), 7.16–7.27 (m, 4 H), 4.19 (d, *J* = 11.1 Hz, 1 H), 4.01 (ddd, *J* = 13.3, 8.8, 4.5 Hz, 1 H), 2.78 (dd, *J* = 16.3, 8.8 Hz, 1 H), 2.65 (dd, *J* = 16.3, 4.4 Hz, 1 H), 2.24 (s, 3 H), 1.97 (s, 3 H), 1.86 (s, 3 H).

2s

White solid; yield: 0.655 g (39%); mp 110–111 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.80 (d, *J* = 7.2 Hz, 2 H), 7.55 (tt, *J* = 7.3, 1.2 Hz, 1 H), 7.44 (t, *J* = 7.5 Hz, 2 H), 7.10 (d, *J* = 8.2 Hz, 2 H), 7.05 (d, *J* = 8.1 Hz, 2 H), 4.43 (d, *J* = 11.1 Hz, 1 H), 4.06 (dd, *J* = 11.1, 6.0 Hz, 1 H), 3.86 (quint, *J* = 6.7 Hz, 1 H), 2.26 (s, 3 H), 2.19 (s, 3 H), 1.74 (s, 3 H), 1.11 (d, *J* = 7.0 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 203.3, 203.2, 203.1, 137.2, 137.0, 136.6, 133.1, 129.4, 129.1, 128.8, 128.2, 72.3, 46.4, 45.2, 30.6, 28.0, 21.1, 14.7.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{25}O_3$: 337.1804; found: 337.1810.

2s′

Yellow oil; yield: 0.445 g (28%).

^{1}H NMR (500 MHz, $CDCl_3$): δ = 16.39 (s, 1 H), 7.26–7.36 (m, 5 H), 7.11 (d, *J* = 8.0 Hz, 2 H), 7.05 (d, *J* = 7.9 Hz, 2 H), 6.42 (s, 1 H), 3.81 (s, 1 H), 3.17 (q, *J* = 7.0 Hz, 1 H), 2.27 (s, 3 H), 2.01 (s, 3 H), 1.30 (d, *J* = 7.1 Hz, 3 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 193.5, 179.4, 157.3, 140.5, 137.9, 136.4, 129.6, 129.4, 128.8, 127.1, 126.4, 120.6, 104.9, 46.2, 41.3, 23.1, 21.5, 21.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{23}O_2$: 319.1698; found: 319.1692.

3s

Yellow oil; yield: 75.1 mg (55%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.28–7.44 (m, 5 H), 7.17–7.27 (m, 4 H), 6.72 (s, 2 H), 4.94 (br s, 1 H), 2.39 (s, 3 H), 2.01 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 152.7, 144.2, 142.3, 139.3, 136.7, 129.3, 129.2, 128.9, 128.2, 127.0, 125.4, 116.1, 115.9, 21.3, 18.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{19}O$: 275.1436; found: 275.1440.

Reaction of 1,5-Diarylpenta-1,4-dien-3-ones 6 with Acetylacetone and the Subsequent I_2-Mediated Preparation of Hydroxylated Stilbene Derivatives 10

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **6** (5 mmol), acetylacetone (750 mg, 7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (4–15 mL). Upon completion of the reaction as determined by TLC, the reaction mixture was diluted with EtOAc and then successively washed with 1 N HCl, sat. aq $NaHCO_3$, and brine. The organic phase was dried (anhyd Na_2SO_4) and evaporated. The residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding products **7**, **8**, and **9** as a mixture (**7c**, the second fraction; **8c** the first fraction; **9c**, the third fraction; **8c** and **9c** were hard to separate on silica gel column due to the tautomerization. Recrystallization of the fraction **8c** or **9c** from EtOH 2–3 times gave the single pure product).

Step 2: The process for the subsequent I_2-mediated phenol formation of **10** (a mixture of **7**, **8**, and **9** was used) was the same as Step 2 in the general procedure for the preparation of **3a–g**.

7c

White solid; yield: 0.833 g (46%); mp 128–129 °C.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.38 (d, *J* = 16.2 Hz, 1 H), 7.36 (d, *J* = 8.1 Hz, 2 H), 7.17 (d, *J* = 8.0 Hz, 2 H), 7.11 (d, *J* = 8.1 Hz, 2 H), 7.06 (d, *J* = 8.0 Hz, 2 H), 6.50 (d, *J* = 16.2 Hz, 1 H), 4.27 (d, *J* = 11.1 Hz, 1 H), 4.09 (ddd, *J* = 11.1, 9.3, 4.1 Hz, 1 H), 2.94 (dd, *J* = 15.5, 9.2 Hz, 1 H), 2.85 (dd, *J* = 15.4, 4.2 Hz, 1 H), 2.36 (s, 3 H), 2.29 (s, 3 H), 2.25 (s, 3 H), 1.89 (s, 3 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 203.6, 203.3, 197.9, 143.4, 141.2, 137.2, 137.0, 131.7, 129.8, 129.6, 128.5, 128.1, 125.2, 74.5, 45.4, 41.2, 30.1, 29.9, 21.6, 21.1.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{24}H_{27}O_3$: 363.1960; found: 363.1952.

8c/9c

Mixture of **8c**:**9c** (1:2.3); white solid; yield: 0.760 g (42%).

^{1}H NMR (500 MHz, $CDCl_3$): δ = 16.31 (s, 1 H, enol), 7.25 (d, *J* = 8.0 Hz, 2 H, ketone), 7.21 (d, *J* = 8.1 Hz, 2 H, enol), 7.04–7.17 (m, 12 H, ketone + enol), 6.60 (d, *J* = 16.1 Hz, 1 H, ketone), 6.59 (d, *J* = 16.1 Hz, 1 H, enol), 6.26 (d, *J* = 16.1 Hz, 1 H, ketone), 6.17 (d, *J* = 16.1 Hz, 1 H, enol), 4.04 (dd, *J* = 10.3, 6.7 Hz, 1 H, enol), 3.91 (td, *J* = 11.9, 5.0 Hz, 1 H, ketone), 3.76 (d, *J* = 12.4 Hz, 1 H, ketone), 2.83 (d, *J* = 18.3 Hz, 1 H, enol), 2.80 (d, *J* = 14.2 Hz, 1 H, ketone), 2.63 (dd, *J* = 14.2, 1.9 Hz, 1 H, ketone), 2.55 (dd, *J* = 18.3, 2.9 Hz, 1 H, enol), 2.33 (s, 3 H, ketone), 2.322 (s, 3 H, enol), 2.317 (s, 3 H, enol), 2.33 (s, 3 H, ketone), 2.30 (s, 3 H, ketone), 2.23–2.37 (m, 2 H, ketone + enol), 2.06 (s, 3 H, ketone), 1.82 (br, 1 H, enol), 1.74 (s, 3 H, enol), 1.65–1.73 (m, 2 H, ketone + enol).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 205.8 (ketone), 205.4 (ketone), 200.8 (enol), 179.8 (enol), 143.5, 138.4, 138.2, 137.9, 137.0, 136.1, 133.5, 133.2, 129.8, 129.8, 129.6, 129.5, 129.4, 128.6, 128.4, 127.2, 126.6, 126.5, 110.0, 75.2, 70.9, 68.9, 53.0, 45.9, 45.1, 44.0, 41.7, 39.0, 30.4, 29.8, 27.1, 21.31, 21.29, 21.11, 21.09.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{24}H_{27}O_3$: 363.1960; found: 363.1956.

10a

Yellow oil; yield: 96.6 mg (71%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.59 (d, *J* = 7.0 Hz, 2 H), 7.51 (d, *J* = 7.2 Hz, 2 H), 7.43 (t, *J* = 7.3 Hz, 2 H), 7.32–7.39 (m, 3 H), 7.30 (t, *J* = 1.5 Hz, 1 H), 7.26 (t, *J* = 7.2 Hz, 1 H), 7.13 (d, *J* = 16.4 Hz, 1 H), 7.07 (d, *J* = 16.3 Hz, 1 H), 6.94–6.99 (m, 2 H), 5.20 (br s, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 156.2, 143.4, 140.8, 139.5, 137.2, 129.6, 128.9, 128.8, 128.3, 127.9, 127.7, 127.3, 126.7, 118.7, 113.7, 112.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{17}O$: 273.1279; found: 273.1273.

10b

Brown solid; yield: 131.1 mg (79%); mp 100–101 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.49 (d, *J* = 8.8 Hz, 2 H), 7.40 (d, *J* = 8.7 Hz, 2 H), 7.21 (t, *J* = 1.3 Hz, 1 H), 7.03 (d, *J* = 16.3 Hz, 1 H), 6.83–6.97 (m, 7 H), 5.85 (br s, 1 H), 3.81 (s, 3 H), 3.79 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 159.3, 159.2, 156.2, 142.7, 139.7, 133.3, 130.1, 128.9, 128.2, 127.9, 126.3, 117.9, 114.3, 114.2, 112.9, 111.2, 55.44, 55.42.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{21}O_3$: 333.1491; found: 333.1497.

10c

Pale pink solid; yield: 112.5 mg (75%); mp 121–122 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.50 (d, *J* = 8.1 Hz, 2 H), 7.42 (d, *J* = 8.1 Hz, 2 H), 7.28 (t, *J* = 1.5 Hz, 1 H), 7.25 (d, *J* = 8.1 Hz, 2 H), 7.18 (d, *J* = 8.0 Hz, 2 H), 7.12 (d, *J* = 16.4 Hz, 1 H), 7.07 (d, *J* = 16.4 Hz, 1 H), 6.92–6.97 (m, 2 H), 4.99 (br s, 1 H), 2.40 (s, 3 H), 2.37 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 156.1, 143.2, 139.6, 137.82, 137.76, 137.5, 134.4, 129.52, 129.47, 129.4, 127.3, 127.0, 126.6, 118.4, 113.2, 111.5, 21.3, 21.2.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{21}O$: 301.1592; found: 301.1590.

10d

Yellow solid; yield: 124.1 mg (73%); mp 128–129 °C.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 9.69 (s, 1 H), 7.68 (d, *J* = 8.6 Hz, 2 H), 7.65 (d, *J* = 8.6 Hz, 2 H), 7.52 (d, *J* = 8.6 Hz, 2 H), 7.44 (d, *J* = 8.6 Hz, 2 H), 7.35 (t, *J* = 1.5 Hz, 1 H), 7.28 (s, 2 H), 7.00 (t, *J* = 1.6 Hz, 1 H), 6.95 (t, *J* = 1.6 Hz, 1 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 158.2, 140.6, 139.0, 138.8, 136.0, 132.4, 132.0, 129.3, 128.9, 128.7, 128.5, 128.2, 127.5, 116.2, 113.3, 112.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{15}Cl_2O$: 341.0500; found: 341.0497.

Reaction of 1,5-Diarylpenta-2,4-dien-1-ones 11 with Acetylacetone and the Subsequent I_2-Mediated Preparation of Hydroxylated Stilbene Derivatives 15

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **11** (5 mmol), acetylacetone (750 mg, 7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (4–15 mL). The reaction mixture was diluted with EtOAc and then washed successively with 1 N HCl, sat. aq $NaHCO_3$, and brine. The organic phase was dried (anhyd Na_2SO_4) and evaporated. The residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding products **12**, **13**, and **14** as a mixture (**12a**, the second fraction; **13a** the first fraction; **14a**, the third fraction).

Step 2: The process for the subsequent I_2-mediated phenol formation of **15** (a mixture of **12**, **13**, and **14** was used) was the same as Step 2 in the general procedure for the preparation of **3a–g**.

12a

White solid; yield: 0.515 g (31%); mp 133–134 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.93 (d, *J* = 7.2 Hz, 2 H), 7.56 (tt, *J* = 7.4, 1.2 Hz, 1 H), 7.46 (t, *J* = 7.5 Hz, 2 H), 7.10–7.32 (m, 5 H), 6.44 (d, *J* = 16.0 Hz, 1 H), 6.14 (dd, *J* = 15.9, 9.3 Hz, 1 H), 4.16 (d, *J* = 9.0 Hz, 1 H), 3.60–3.80 (m, 1 H), 3.07–3.25 (m, 2 H), 2.26 (s, 3 H), 2.17 (s, 3 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 203.7, 198.3, 136.9, 136.6, 133.4, 132.9, 128.8, 128.6, 128.4, 128.2, 127.8, 126.5, 71.9, 41.5, 39.0, 30.5, 30.2.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{23}O_3$: 335.1647; found: 335.1641.

13a + 14a

Mixture of **13a**:**14a** (1.08:1); white solid; yield: 0.668 g (40%).

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{23}O_3$: 335.1647; found: 335.1650.

15b

Yellow solid; yield: 35.7 mg (25%); mp 110–111 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.46–7.55 (m, 4 H), 7.36 (t, *J* = 7.4 Hz, 2 H), 7.21–7.31 (m, 4 H), 7.14 (d, *J* = 16.4 Hz, 1 H), 7.08 (d, *J* = 16.4 Hz, 1 H), 6.93–6.99 (m, 2 H), 5.15 (s, 1 H), 2.40 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 156.3, 143.3, 139.4, 137.9, 137.6, 137.3, 129.6, 129.5, 128.8, 128.4, 127.9, 127.1, 126.7, 118.5, 113.5, 111.7, 21.3.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{19}O$: 287.1436; found: 287.1428.

15c

Yellow oil; yield: 48.2 mg (32%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.47–7.55 (m, 4 H), 7.35 (t, *J* = 7.3 Hz, 2 H), 7.22–7.29 (m, 2 H), 7.10 (d, *J* = 1.7 Hz, 2 H), 6.90–7.00 (m, 4 H), 5.63 (br s, 1 H), 3.83 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 159.4, 156.4, 142.9, 139.4, 137.3, 133.3, 129.4, 128.8, 128.5, 128.3, 127.9, 126.7, 118.2, 114.3, 113.4, 111.4, 55.5.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{19}O_2$: 303.1385; found: 303.1380.

15d

White solid; yield: 84.4 mg (55%); mp 136–137 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.51 (d, *J* = 8.5 Hz, 4 H), 7.32–7.43 (m, 4 H), 7.21–7.32 (m, 2 H), 7.11 (d, *J* = 16.4 Hz, 1 H), 7.10 (d, *J* = 16.4 Hz, 1 H), 6.95 (dt, *J* = 21.9, 1.9 Hz, 2 H), 5.11 (s, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 156.3, 142.1, 139.7, 139.2, 137.1, 133.8, 129.8, 129.0, 128.9, 128.5, 128.1, 128.0, 126.7, 118.5, 113.5, 112.2.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{16}ClO$: 307.0890; found: 307.0879.

15e

Yellow solid; yield: 99.9 mg (63%); mp 156–157 °C.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 9.84 (s, 1 H), 8.32 (d, *J* = 9.0 Hz, 2 H), 7.96 (d, *J* = 9.0 Hz, 2 H), 7.64 (d, *J* = 7.2 Hz, 2 H), 7.48 (s, 1 H), 7.40 (t, *J* = 7.5 Hz, 2 H), 7.23–7.34 (m, 3 H), 7.09 (dt, *J* = 14.4, 1.7 Hz, 2 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 158.3, 146.7, 139.6, 139.3, 136.9, 129.2, 128.8, 128.1, 127.9, 127.8, 126.6, 124.1, 116.6, 113.8, 113.5.

HRMS (ESI): *m*/*z* [M + K]$^+$ calcd for $C_{20}H_{15}NO_3K$: 356.0689; found: 356.0693.

15f

Yellow solid; yield: 93.0 mg (53%); mp 85–86 °C.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.58 (d, *J* = 7.1 Hz, 2 H), 7.41–7.48 (m, 4 H), 7.31–7.40 (m, 3 H), 7.28 (t, *J* = 1.3 Hz, 1 H), 7.05 (d, *J* = 16.4 Hz, 1 H), 7.04 (d, *J* = 16.3 Hz, 1 H), 6.96 (dt, *J* = 7.9, 2.2 Hz, 2 H), 5.26 (s, 1 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 156.3, 143.5, 140.7, 139.1, 136.1, 131.9, 129.0, 128.9, 128.3, 128.2, 127.8, 127.2, 121.6, 118.7, 114.0, 112.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{16}BrO$: 351.0385; found: 351.0378.

15g

Yellow oil; yield: 61.9 mg (41%).

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.59 (d, *J* = 7.1 Hz, 2 H), 7.41–7.46 (m, 4 H), 7.35 (tt, *J* = 7.3, 1.1 Hz, 1 H), 7.26–7.29 (m, 1 H), 7.08 (d, *J* = 16.2 Hz, 1 H), 6.92–6.98 (m, 3 H), 6.90 (d, *J* = 8.8 Hz, 2 H), 5.22 (br s, 1 H), 3.82 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 159.5, 156.3, 143.4, 140.9, 139.9, 130.1, 129.1, 128.9, 128.0, 127.7, 127.3, 126.3, 118.5, 114.3, 113.3, 111.7, 55.5.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{19}O_2$: 303.1385; found: 303.1381.

Reaction of 16, 19, 21, and 23 with Acetylacetone and the Subsequent I_2-Mediated Preparation of Phenols

Step 1: A big tube (⌀ 18 × 150 mm) was charged with enone **1a** (1.04 g, 5 mmol), **16**/**19**/**21**/**23** (7.5 mmol), DBU (114 mg, 0.75 mmol), and DMSO (5 mL). The mixture was stirred at rt (for **23**, at 5 °C) until the completion of reaction (TLC analysis). The reaction mixture was diluted with EtOAc and then washed successively with 1 N HCl, sat. aq $NaHCO_3$, and brine. The organic phase was dried (anhyd Na_2SO_4) and evaporated. The residue was purified by column chromatography on silica gel eluting with EtOAc/PE to provide the corresponding product **17**, **20**, **22**, and **24** (compound **20**, **22**, or **24** was a mixture of two diastereoisomers).

Step 2: The process for the subsequent I_2-mediated phenol formation of **10** was the same as Step 2 in the general procedure for the preparation of **3a**–**g**.

17

White solid; yield: 0.840 g (50%); mp 107–108 °C.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 7.51 (d, *J* = 7.4 Hz, 2 H), 7.31–7.39 (m, 4 H), 7.28 (t, *J* = 7.5 Hz, 2 H), 7.22 (t, *J* = 7.1 Hz, 1 H), 7.17 (t, *J* = 7.1 Hz, 1 H), 5.47 (d, *J* = 0.8 Hz, 1 H), 4.46 (d, *J* = 12.4 Hz, 1 H), 3.82 (td, *J* = 12.4, 3.8 Hz, 1 H), 3.33 (q, *J* = 6.6 Hz, 1 H), 2.59 (t, *J* = 13.1 Hz, 1 H), 2.36 (dq, *J* = 17.9, 7.2 Hz, 1 H), 2.19 (dq, *J* = 17.9, 7.2 Hz, 1 H), 1.86 (dd, *J* = 13.7, 3.9 Hz, 1 H), 0.77 (t, *J* = 7.3 Hz, 3 H), 0.63 (d, *J* = 6.7 Hz, 3 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 208.7, 208.0, 146.8, 143.1, 128.5, 128.0, 127.3, 126.5, 126.4, 124.8, 78.6, 66.1, 52.7, 47.5, 41.5, 36.5, 7.9, 7.2.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{25}O_3$: 337.1804; found: 337.1800.

20

Mixture of two diastereoisomers, dr = 2:1; colorless oil; yield: 1.075 g (58%).

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{25}H_{23}O_3$: 371.1647; found: 371.1641.

22

Mixture of two diastereoisomers, dr = 1.35:1; colorless oil; yield: 1.116 g (60%).

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{25}H_{25}O_3$: 373.1804; found: 373.1811.

24[10b]

Mixture of two diastereoisomers, dr = 1.25:1; white solid; yield: 1.437 g (85%).

18[8d]

White solid; yield: 110.5 mg (85%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.58 (d, *J* = 7.1 Hz, 2 H), 7.29–7.46 (m, 8 H), 7.08 (dd, *J* = 20.6, 1.7 Hz, 2 H), 4.89 (s, 1 H), 2.19 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 154.4, 144.2, 141.7, 140.6, 139.6, 129.4, 128.9, 128.2, 127.4, 127.13, 127.07, 121.5, 120.9, 112.6, 13.0.

25

Colorless oil; yield: 47.4 mg (28%).

^{1}H NMR (300 MHz, $CDCl_3$): δ = 8.09 (d, *J* = 7.1 Hz, 2 H), 7.62 (tt, *J* = 7.4, 1.3 Hz, 1 H), 7.51 (t, *J* = 7.5 Hz, 2 H), 7.31–7.46 (m, 3 H), 7.31 (s, 1 H), 7.27–7.30 (m, 1 H), 4.19 (d, *J* = 7.7 Hz, 1 H), 4.00 (q, *J* = 7.1 Hz, 2 H), 3.89 (d, *J* = 7.7 Hz, 1 H), 2.33 (s, 3 H), 0.98 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 198.6, 193.9, 166.6, 136.7, 133.9, 133.7, 129.0, 128.7, 128.5, 127.8, 62.2, 52.2, 37.1, 36.5, 29.9, 13.9.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{21}H_{21}O_4$: 337.1440; found: 337.1436.

Compound 35

Compound **35** was prepared according to the reported procedure.[7]

Compound 36

A mixture of chalcone **1a** (1.04 g, 5 mmol), acetylacetone (0.55 g, 5.5 mmol), and NaOH (40 mg, 1 mmol) in a mixed solvent of EtOH and H_2O (20 mL, EtOH/H_2O = 4:1) was heated at 80 °C for 24 h. Upon cooling to 10 °C, a yellow solid precipitated out. After filtering, washing with the mixed solvent of EtOH and H_2O (EtOH/H_2O = 7:3), and drying, compound **36** was obtained as yellow solid; yield: 0.725 g (50%); mp 127–128 °C.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 16.42 (s, 1 H), 7.28–7.46 (m, 6 H), 7.22–7.28 (m, 3 H), 7.14–7.22 (m, 1 H), 6.50 (d, *J* = 2.8 Hz, 1 H), 4.14 (dd, *J* = 8.3, 1.6 Hz, 1 H), 3.31 (ddd, *J* = 17.2, 8.3, 2.8 Hz, 1 H), 3.03 (dd, *J* = 17.2, 1.7 Hz, 1 H), 2.00 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 192.7, 180.1, 151.0, 143.7, 138.8, 129.7, 128.8, 128.7, 127.3, 126.9, 126.1, 122.1, 106.3, 38.4, 36.1, 23.2.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{20}H_{19}O_2$: 291.1385; found: 291.1376.

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Supporting Information

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