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C–H Arylation

Rhodium-Catalyzed Directing-Group-Assisted Aldehydic C–H Arylations with Aryl Halides

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Abstract: A rhodium-catalyzed general protocol for the directing-group-assisted arylation of aromatic aldehydic C–H bonds was developed. This method involves either hydroxy- or amino-group-directed aldehyde C–H arylation with various aryl halides. A broad synthetic scope for the preparation of 2-hydroxybenzophenones was established with electronically variant salicylaldehydes and aryl halides with chemo- and regioselective possibilities. The developed protocol was also applied in the synthesis of medicinally important 3-salicyloylpyridines in high yields.

Introduction

Molecular scaffolds such as 2-hydroxybenzophenones present in natural products[1,2] are associated with immense biological properties.[3,4] Some of these skeletons are shown in Figure 1, of which hydroxyphenstatin (**1**) exhibits potent cytotoxicity and inhibits tubulin polymerization.[4b] Similarly, 1,5-dimethoxyajacareubin (**2**) extracted from the stem bark of *Garcinia buchananii* has strong antioxidative, oxygen-radical absorbance capacity.[1b] Further, calanone (**3**) isolated from the bark of *Calophyllum teysmannii var. inophylloide* shows cytotoxicity against a human monocytic leukemia cancer cell line.[2a] The alkoxybenzophenone **4** is known as antispasmodic agent.[4a] Additionally, morintrifolin A (**5**) isolated from the roots of *M. citrifolia* (noni) has been used in the treatment of asthma, bone fractures, cancer and other ailments.[2b] Some 2-hydroxybenzophenones such as **6**–**9** have been used as UV absorbers in sunscreens.[5]

Synthetic efforts to access some of these scaffolds are known to involve metal-catalyzed couplings of aryl halides[6] or aryl organometallic reagents[8–11] with arenecarbaldehydes (Scheme 1). Importantly, Miura reported the cross-coupling of salicylaldehydes with aryl iodides under palladium-catalyzed[6a] conditions for the synthesis of 2-hydroxybenzophenones, and this reaction was also reported under aqueous conditions.[6b,6c] Further, Nowrouzi reported a similar protocol under nickel-catalyzed conditions.[7] However, some of these studies suffer from the lack of a broad substrate scope and require the use of additives. Other variations with organometallic diaryliodonium salts[8] and arylboronic acids in lieu of aryl halides were studied under palladium- and/or rhodium-catalyzed conditions.[9,10] Furthermore, rhodium-catalyzed directed C–H arylations using diaryliodonium salts and 2-(sulfonylamino)benzaldehyde have been reported.[11] In addition, a few methods have been reported for the synthesis of 2-hydroxybenzophenones.[12,13] A

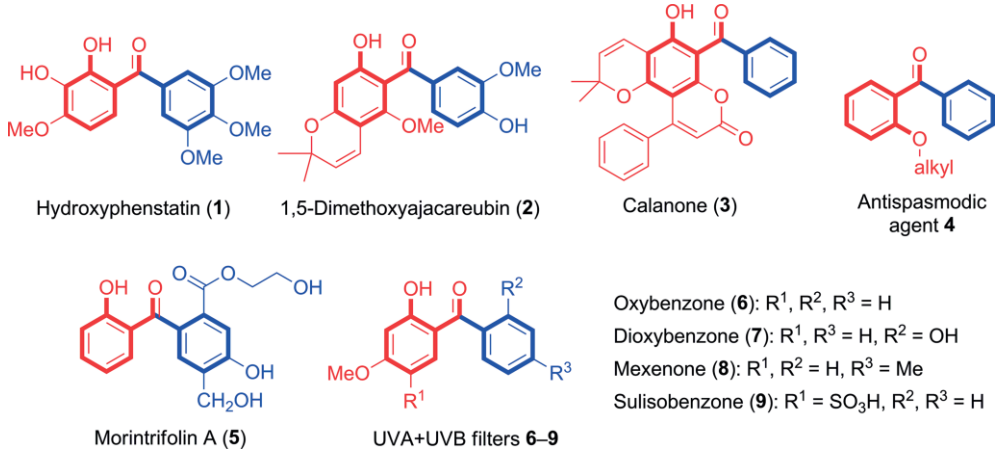

Figure 1. Some biologically active molecules.

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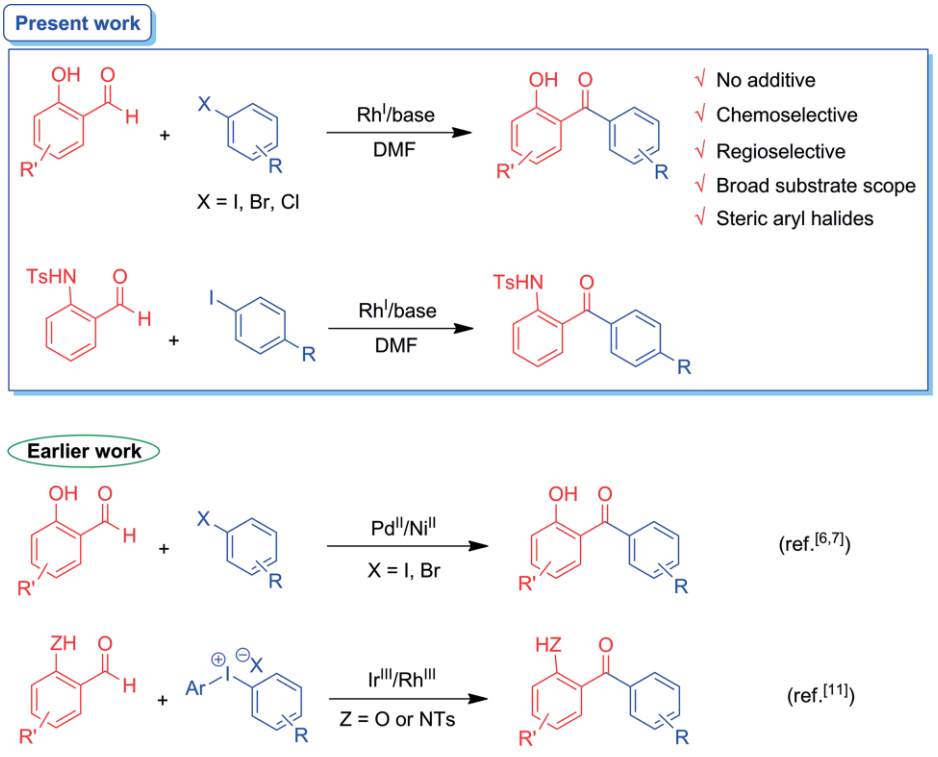


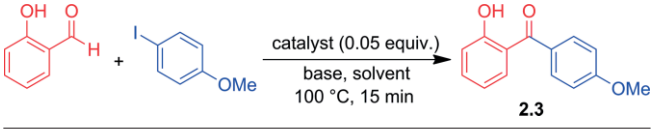
Scheme 1. Metal-catalyzed directed aldehyde C–H arylation.

quick look into some of these methods revealed that rhodium-catalyzed conditions provide an expanded scope in terms of synthetic utility and substrate reactivity. Despite this, rhodium catalysis was not applied in C–H arylation of arenecarbaldehydes with aryl halides; although, similar studies employing arylboronic acids and diaryliodonium salts were performed under rhodium catalysis. Keeping in view the synthetic advantages associated with aryl halides in comparison to the use of organometallic reagents, it was of interest to explore this reactivity. This was in continuation of our recent studies on the rhodium-catalyzed reactivity of functionalized salicylaldehydes in the synthesis of 2,2′-dihydroxybenzophenones and xanthones.[14] The present study aimed to explore the new reactivity potential of directing-group-assisted C–H arylation of arenecarbaldehydes with aryl halides under rhodium catalysis with a broader synthetic applicability.

Results and Discussion

Our efforts to develop a viable rhodium-catalyzed protocol for the arylation of aldehyde C–H bonds in salicylaldehydes are summarized in Table 1. This screening started with the reaction of salicylaldehyde with 1-iodo-4-methoxybenzene using catalytic conditions with $RhCl_3/PPh_3$ at 100 °C in DMF, and this protocol gave 2-hydroxybenzophenone **2.3** in 30 % yield (Entry 1). To improve the efficiency, further screening was carried out under different rhodium-catalyzed conditions (Entries 2–4). Delightfully, the cross-coupling efficiency was increased to a great extent with the $Rh(CO)_2(acac)$ catalytic system and gave **2.3** in 95 % yield (Entry 4). Further tests using an NMP or DMSO solvent system lowered the arylation product yield (Entries 5 and 6). The desired coupling was not observed in nonpolar chlorobenzene as a solvent (Entry 7).

Table 1. Screening conditions.[a]



Entry	Catalyst	Base	Solvent	Yield of **2.3** [%][b]
1	$RhCl_3/PPh_3$	$NaHCO_3$	DMF	30
2	$RhCl(PPh_3)_3$	$NaHCO_3$	DMF	54
3	$RhCl(CO)(PPh_3)_2$	$NaHCO_3$	DMF	66
4	$Rh(CO)_2(acac)$	$NaHCO_3$	DMF	95
5	$Rh(CO)_2(acac)$	$NaHCO_3$	NMP	90
6	$Rh(CO)_2(acac)$	$NaHCO_3$	DMSO	70
7	$Rh(CO)_2(acac)$	$NaHCO_3$	PhCl	–
8	$Rh(CO)_2(acac)$	Na_2CO_3	DMF	75
9	$Rh(CO)_2(acac)$	K_2CO_3	DMF	92
10	$Rh(CO)_2(acac)$	$NaHCO_3$	DMF	34[c]
11	$Rh(CO)_2(acac)$	$NaHCO_3$	DMF	78[d]
12	$Rh(CO)_2(acac)$	–	DMF	–
13	–	$NaHCO_3$	DMF	–

[a] Conditions: salicylaldehyde (0.5 mmol, 1 equiv.), 1-iodo-4-methoxybenzene (0.5 mmol, 1 equiv.), catalyst (0.025 mmol, 0.05 equiv.), base (0.5 mmol, 1 equiv.), solvent (2 mL), 100 °C, 15 min. [b] Isolated yields. [c] 60 °C. [d] 90 °C.

Further examination with different bases such as Na_2CO_3 and K_2CO_3 did not improve the yield (Entries 8 and 9). The arylations carried out at 60 and 90 °C afforded yields of 34 and 78 %, respectively (Entries 10 and 11). Two control reactions per-

formed in the absence of either base or catalyst were ineffective (Entries 12 and 13). This screening thus proved that the protocol with $Rh(CO)_2(acac)$ (0.05 equiv.) and $NaHCO_3$ (1 equiv.) at 100 °C is very effective for C–H arylation of salicylaldehyde with aryl iodide to deliver the corresponding 2-hydroxybenzophenone in high yield, and it proved to be a very efficient process. In turn, this study also revealed that the present rhodium protocol is more viable with short reaction times and without the use of additives in comparison with literature procedures.[6,7]

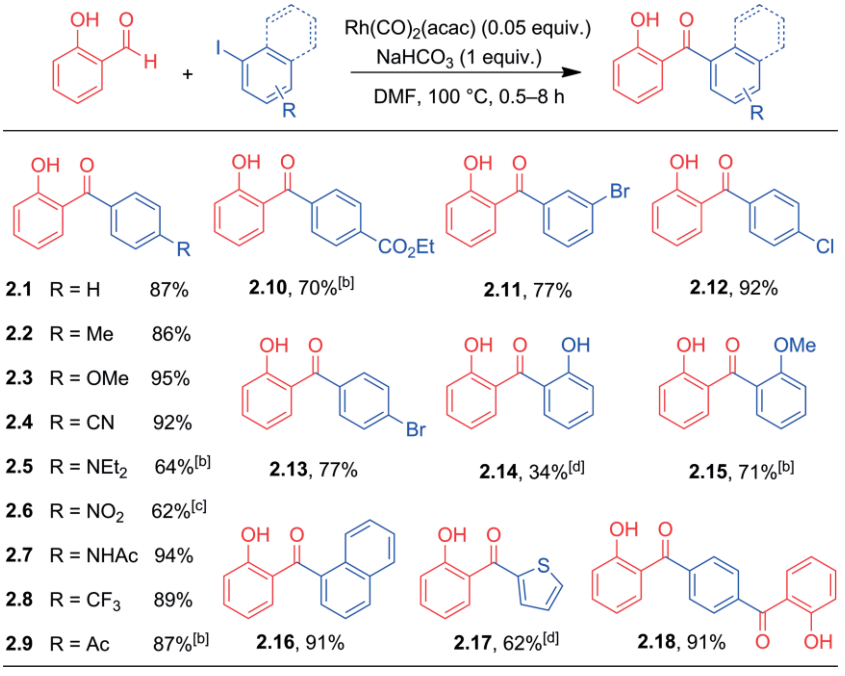
At this stage, it was decided to check the general reactivity with differently functionalized salicylaldehydes and aryl iodides. Different aryl iodides were initially tested against salicylaldehyde as a model substrate, and the corresponding results are given in Table 2. The desired arylations using electronically different aryl iodides were very efficient, and the corresponding functionalized 2-hydroxybenzophenones **2.1**–**2.10** were obtained in excellent yields. Interestingly, reactions of aryl iodides functionalized with chloro and bromo substituents were chemoselective and delivered the corresponding bromo- and chloro-functionalized 2-hydroxybenzophenones **2.11**–**2.13** in 77–92 % yield.

Further, the steric effect was studied with *ortho*-substituted aryl iodides. These studies, performed with 2-iodophenol and 1-iodo-2-methoxybenzene, gave the corresponding 2-hydroxybenzopenones **2.14** and **2.15** in 34 and 71 % yield, respectively. In fact, this reactivity with sterically bulky aryl iodides was not reported with the literature method.[7] Further reactions with substrates such as 1-iodonaphthalene and 2-iodothiophene gave products **2.16** and **2.17** in 62–91 % yield. Encouragingly, the present method was effective even in a bis(coupling) reaction to give bis(phenolic) product **2.18** in 91 % yield.

Elaboration of the scope was further extended to different salicylaldehydes and aryl iodides (Table 3). These couplings using salicylaldehydes functionalized with 4-methoxy and 5-nitro groups performed very well with different aryl iodides equipped with methoxy, cyano, trifluoromethyl and bromo groups. These arylations gave the corresponding 2-hydroxybenzophenones **3.1**–**3.8** in 68–88 % yield. In addition, we have extended this study to competitive couplings using 4-hydroxyisophthalaldehyde to explore the differential reactivity of formyl groups in two different chemical environments. In this case, the formyl group adjacent to the hydroxy group selectively reacted with aryl iodides, while the formyl group at the C-5 position was unaffected leading to products **3.9** and **3.10** in good yields.

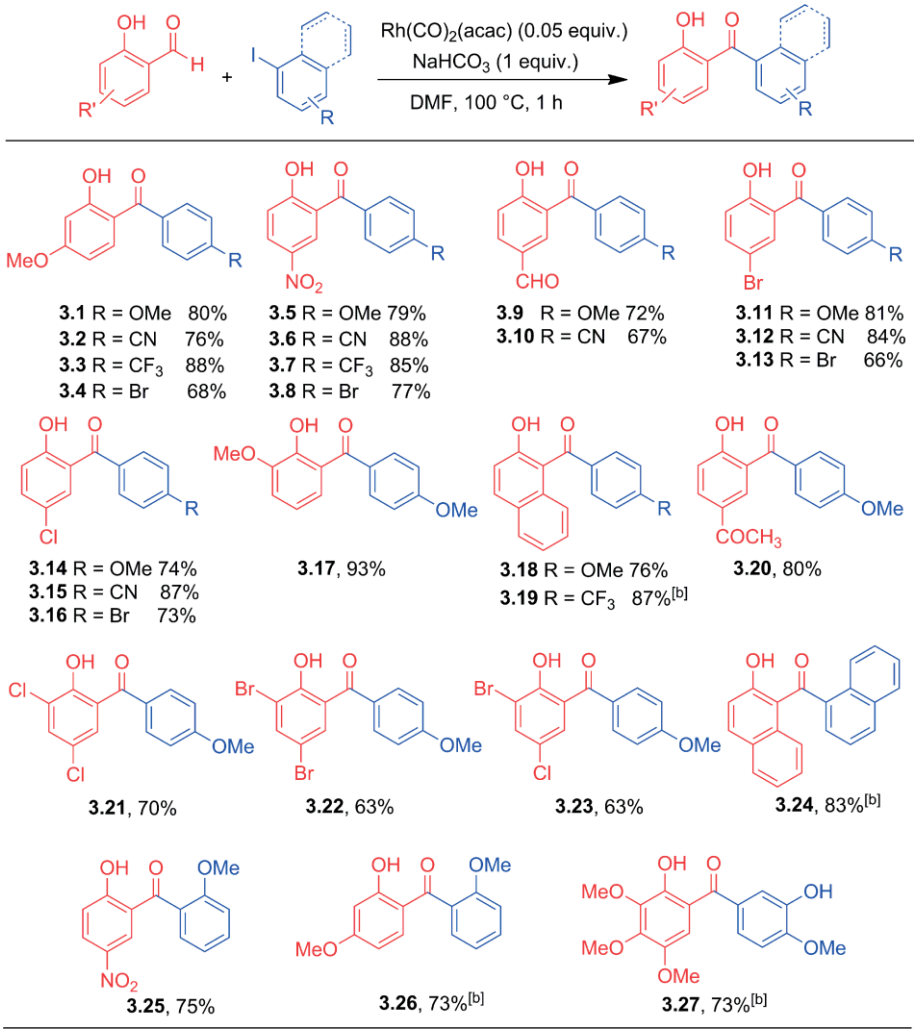
Moreover, chemoselective reactivity studies conducted with halogenated salicylaldehydes containing 5-Br, 5-Cl and 3,5-dihalo groups delivered the corresponding halogen-substituted 2-hydroxybenzophenones **3.11**–**3.16** and **3.21**–**3.23** in high yields. Notably, other functionalized salicylaldehydes and sterically hindered 2-hydroxy-1-naphthaldehyde also reacted well to provide **3.17**–**3.20** and **3.24** in good yields. Additionally, *ortho*-substituted aryl iodides also demonstrated viable reactivity (products **3.24**–**3.26**). To test the applicability of our protocol in the preparation of medicinally important skeletons, the coupling of 3,4,5-trimethoxysalicylaldehyde was carried out with 5-iodo-2-methoxyphenol. This reaction afforded product **3.27** in 73 % yield. Importantly, this compound was studied for antiproliferative activity against parental KB cells with an IC_{50} value of 11.1 nM and identified as vascular disrupting agent with concentration-dependent suppression activity.[15] Our protocol thus proved to be useful to synthesize medicinally important polysubstituted 2-hydroxybenzophenone **3.27** in high yield. Overall,

Table 2. Couplings of salicylaldehyde with aryl/heteroaryl iodides.[a]



[a] Conditions: salicylaldehyde (0.5 mmol, 1 equiv.), aryl iodide (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (0.5 mmol, 1 equiv.), DMF (2 mL), 100 °C, 0.5 h. [b] 1 h. [c] 8 h. [d] 2 h.

Table 3. Couplings of functionalized salicylaldehydes with aryl iodides.[a]



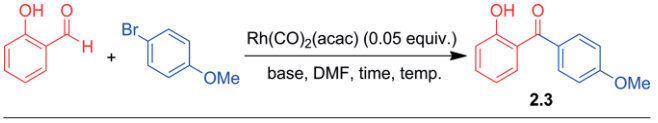
[a] Conditions: functionalized salicylaldehyde (0.5 mmol, 1 equiv.), aryl iodide (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (0.5 mmol, 1 equiv.), DMF (2 mL), 100 °C, 1 h. [b] 2 h.

our efforts thus far established the broad reactivity of aldehyde C–H arylation of salicylaldehydes with electronically different aryl iodides in a chemo- and regioselective manner.

This prompted us to extend this study to aryl bromides with pertinent reactivity (Table 4). Initially, a reaction of 1-bromo-4-methoxybenzene and salicylaldehyde was examined using the above established conditions (Entry 1). Surprisingly, this reaction gave only 13 % product yield of **2.3** after 1 h.

To find the right conditions, a further investigation was carried out with other bases (Entries 2–5). This led to mixed results with yields of 42–54 % using K_2CO_3, NaOAc and KOAc (Entries 2–4). However, better reactivity was observed with $NaHCO_3$, and in this case **2.3** was obtained in 72 % yield (Entry 5). Additional screening was performed with 2 and 3 equiv. of base (Entries 6 and 7) and delivered the products in 83 and 91 % yield, respectively. From this, it was realized that the protocol involving $Rh(CO)_2(acac)$ (0.05 equiv.), salicylaldehyde (2 equiv.), aryl bromide (1 equiv.) and $NaHCO_3$ (3 equiv.) in DMF at 120 °C was an effective combination (Entry 7) to obtain high product yields in aryl bromide couplings.

Table 4. Screening conditions.[a]

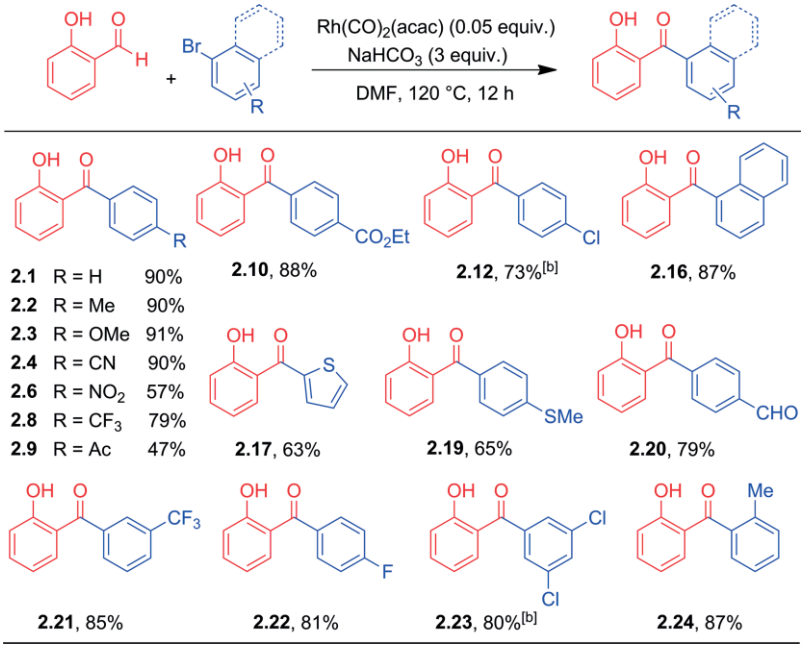


Entry	Base (equiv.)	Temp. [°C]	Time [h]	Yield of **2.3** [%]
1	Na_2CO_3 (1)	100	1	13
2	K_2CO_3 (1)	100	12	54
3	NaOAc (1)	100	12	42
4	KOAc (1)	100	12	51
5	$NaHCO_3$ (1)	100	12	72
6	$NaHCO_3$ (2)	120	12	83[b]
7	$NaHCO_3$ (3)	120	12	91[b]

[a] Conditions: salicylaldehyde (0.5 mmol, 1 equiv.), 1-bromo-4-methoxybenzene (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), base, DMF (2 mL), temp., time. [b] Salicylaldehyde (1 mmol, 2 equiv.).

With this protocol in hand, we investigated the process further with divergent aryl bromides (Table 5) enriched with both electron-rich and -deficient functional groups. Noteworthy is

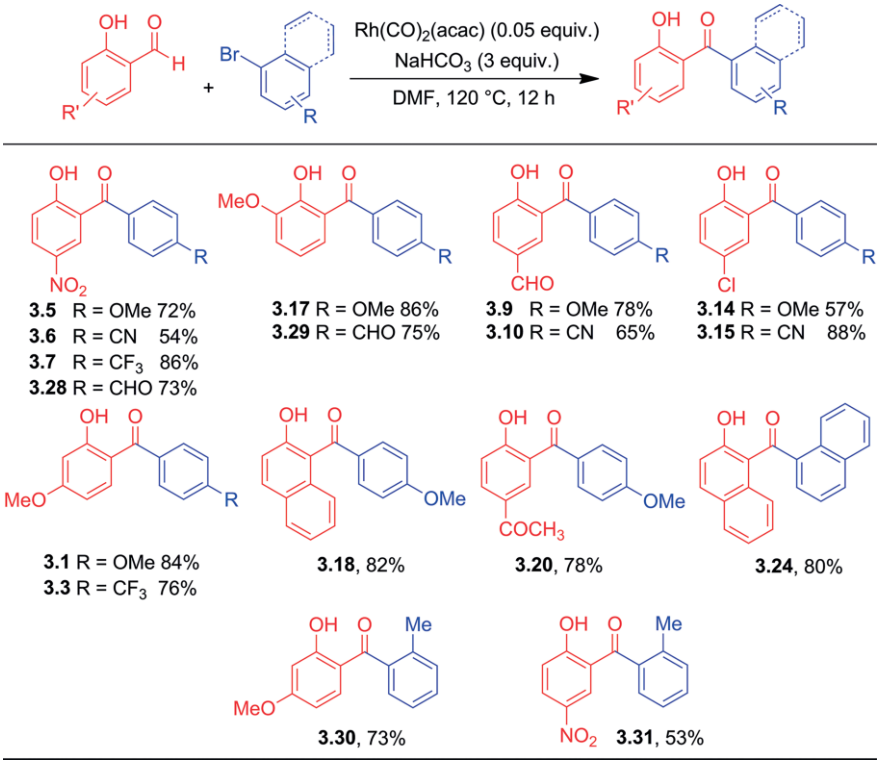
Table 5. Couplings of salicylaldehyde with functionalized aryl bromides.[a]



[a] Conditions: salicylaldehyde (1 mmol, 2 equiv.), aryl bromide (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (1.5 mmol, 3 equiv.), DMF (2 mL), 120 °C, 12 h. [b] 100 °C.

that these arylations proceeded very smoothly delivering good to high yields and tolerated aldehyde, ester, cyano, thiomethyl, trifluoromethyl and nitro functionalities under the established conditions. From this, the corresponding 2-hydroxybenzophenone products **2.1**–**2.10** and **2.19**–**2.21** were obtained in 47–91 % yield. Some of the couplings carried out with chloro-

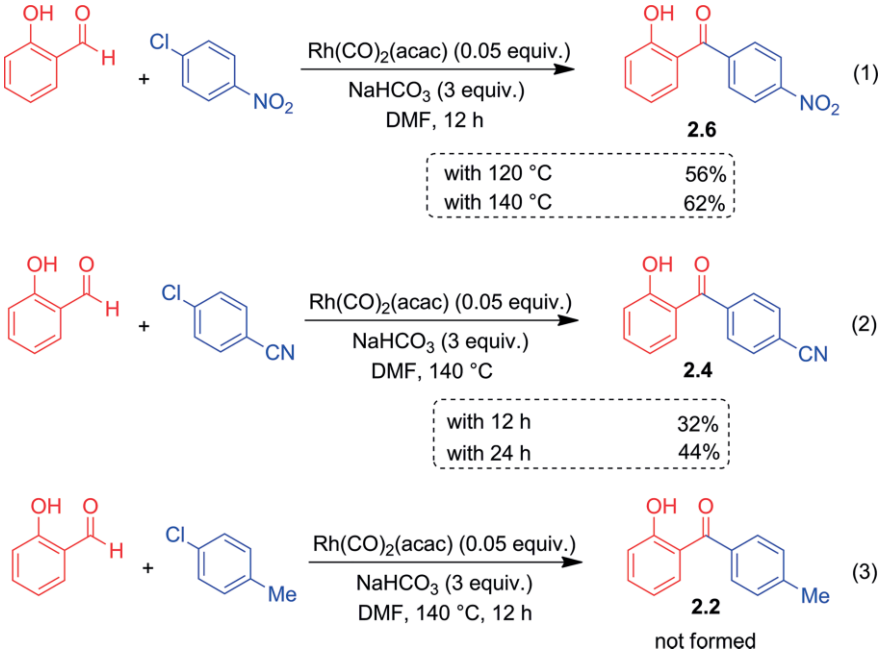
Table 6. Couplings of functionalized salicylaldehydes with aryl bromides.[a]



[a] Conditions: functionalized salicylaldehyde (1 mmol, 2 equiv.), aryl bromide (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (1.5 mmol, 3 equiv.), DMF (2 mL), 120 °C, 12 h.

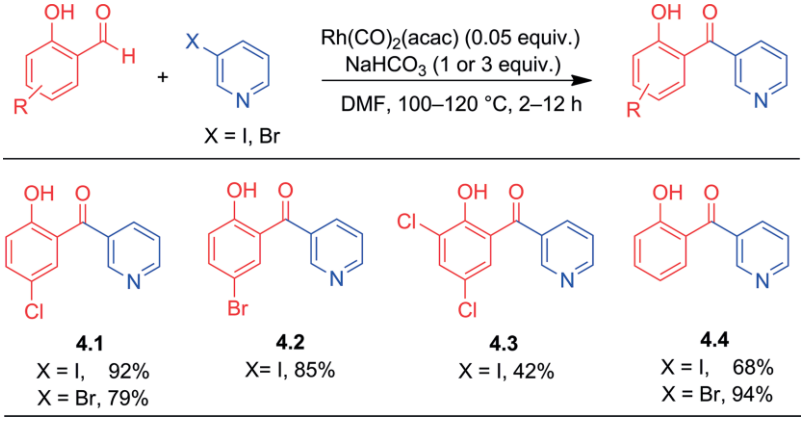
and fluoro-substituted phenyl bromides also gave products **2.12**, **2.22** and **2.23** in 73–81 % yield. Similarly, an efficient coupling was obtained with 1-bromonaphthalene providing product **2.16** in 87 % yield. Even the coupling of heteroaryl 2-bromothiophene proved to be facile and gave **2.17** in high yield. Furthermore, an *ortho*-substituted aryl bromide reacted well leading to **2.24** in 87 % yield, and this promising reactivity was not realized earlier.[7]

A further scope was established with functionalized salicylaldehydes and aryl bromides (Table 6). For example, the reaction of 5-nitrosalicylaldehyde with phenyl bromides functionalized with 4-OMe, 4-CN, 4-CF_3, 4-CHO groups proceeded efficiently to give the corresponding 2-hydroxybenzophenones **3.5**–**3.7** and **3.28** in 54–86 % yield. This arylation examined with other functionalized salicylaldehydes containing 3-OMe, 4-OMe, 5-Cl and 5-COMe groups was broadly applicable (products **3.1**, **3.3**, **3.14**, **3.15**, **3.17**, **3.20** and **3.29**) with high yields. As observed before, selective C–H arylation of an aldehyde with an *ortho*-hydroxy group was performed with 4-hydroxyisophthalaldehyde to afford **3.9** and **3.10** in 65–78 % yield. Arylations of 4-methoxy- and 5-nitrosalicylaldehyde with *o*-tolyl bromide proceeded smoothly to afford moderate to good yields of **3.30** and **3.31**.[7] Further couplings of different aryl bromides with 2-hydroxy-1-naphthaldehyde were facile and afforded **3.18** and **3.24** in high yields. This elaborative study with various functionalized salicylaldehydes established the reliability of the developed protocol for successful C–H arylations of salicylaldehydes with aryl bromides.



Scheme 2. Reactivity study with aryl chlorides.

Table 7. Synthesis of bioactive 2-hydroxybenzophenones.[a,b]



[a] Conditions for ArI: salicylaldehyde (0.5 mmol, 1 equiv.), ArI (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (0.5 mmol, 1 equiv.), DMF (2 mL), 100 °C, 2 h. [b] Conditions for ArBr: salicylaldehyde (1 mmol, 2 equiv.), ArBr (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (1.5 mmol, 3 equiv.), DMF (2 mL), 120 °C, 12 h.

Having successfully established the new reactivity of aryl iodides and bromides in C–H arylation, a brief investigation was then carried out to explore the corresponding reactivity with aryl chlorides. Initially, the arylation of salicylaldehyde with 1-chloro-4-nitrobenzene was explored by using the above established conditions [Scheme 2, Equation (1)]. This reaction carried out at 120 °C gave 56 % yield, and the yield was raised to 62 % with heating to 140 °C. A similar study with 4-chlorobenzonitrile afforded the corresponding products in 32–44 % yield with 12 and 24 h reaction time [Scheme 2, Equation (2)]. Further examination with 4-chlorotoluene did not afford any arylation product [Scheme 2, Equation (3)]. This brief study with electronically different aryl chlorides delivered mixed results. Further investigations are required to establish the general coupling reactivity for electronically variant aryl chlorides.

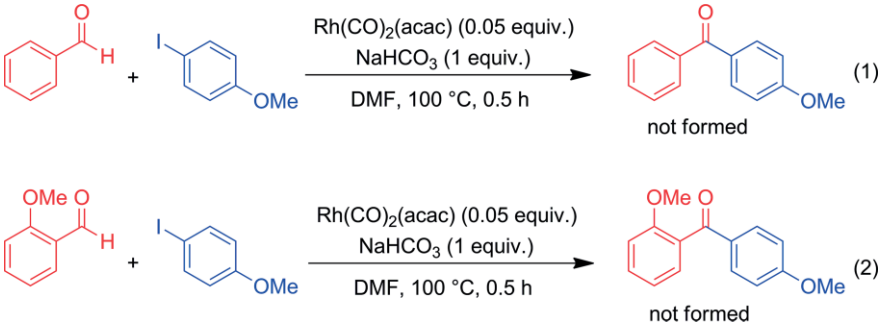
To highlight the applicability, our protocol was tested in the synthesis of a series of bioactive 3-salicyloylpyridines (Table 7). These compounds were earlier studied as cytotoxic mitochondrial apoptosis inducers and demonstrated cytotoxic potential against various human cancer cell lines.[16] Hence, it was of interest to apply our protocol to prepare these molecular scaffolds. This was done with a variety of salicylaldehydes in combination with either 3-iodopyridine or 3-bromopyridine substrates and allowed the successful preparation of various 3-salicyloylpyridines **4.1**–**4.4** in high yields. It also established the viability of our rhodium-catalyzed protocol in synthetic applications.

Later on, amino-directed C–H arylation was studied with different aryl iodides, and the results are summarized in Table 8. These reactions involved aryl iodides with methoxy, methyl and trifluoromethyl substituents and led to the corresponding 2-(sulfonylamino)benzophenones **5.1**–**5.4** in high yields. These reactions show the broad applicability of the developed protocol towards the directed arylation of aldehyde C–H bonds.

To understand the mechanistic pathway of these C–H arylations, a few control reactions were investigated by using 1-iodo-4-methoxybenzene in combination with benzaldehyde and 2-methoxybenzaldehyde. In these cases, the desired C–H arylations were not realized. These results, in comparison with our established protocols strongly suggest that the presence of a free *ortho*-phenolic group is essential for C–H arylation of the –CHO group in salicylaldehydes [Scheme 3, Equations (1) and (2)].

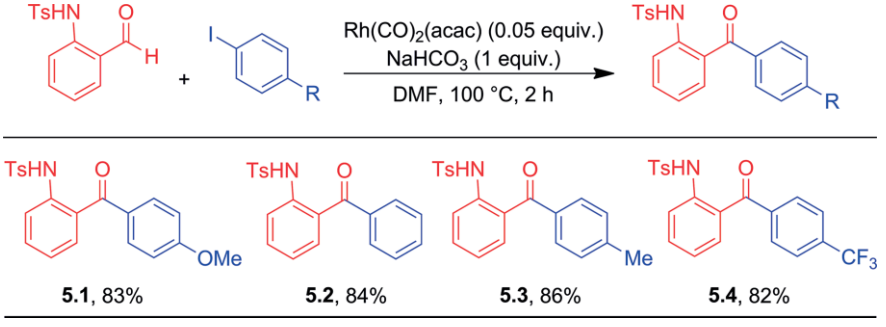
On the basis of these results, the following mechanistic pathway was proposed for the formation of benzophenones (Scheme 4): The probable oxidative addition of aryl halide with Rh^{I} forms reactive intermediate **A**[17] which in turn reacts with arenecarbaldehyde mediated by base to generate intermediate **B**.[6a,8] The latter is expected to undergo intramolecular C–H activation of the formyl group[9,14] to form intermediate **C**.

This intermediate upon reductive elimination delivers the benzophenone product. During the control experiments (Scheme 3), formation of intermediate **B** was not possible as a

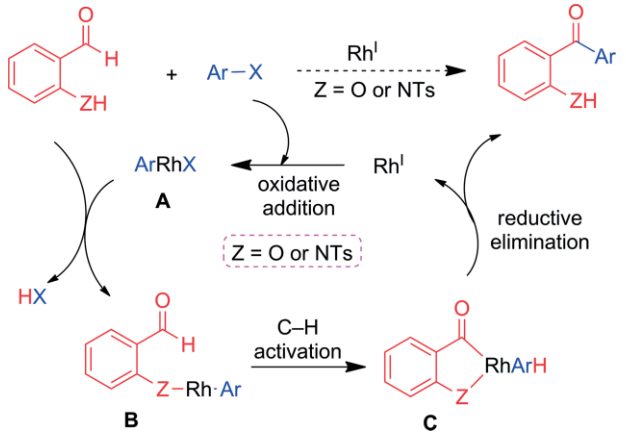


Scheme 3. Control experiments.

Table 8. Couplings of 2-(sulfonylamino)benzaldehyde with functionalized aryl iodides.[a]



[a] Conditions: 2-(sulfonylamino)benzaldehyde (0.5 mmol, 1 equiv.), ArI (0.5 mmol, 1 equiv.), $Rh(CO)_2(acac)$ (0.025 mmol, 0.05 equiv.), $NaHCO_3$ (0.5 mmol, 1 equiv.), DMF (2 mL), 100 °C, 2 h.



Scheme 4. Proposed catalytic cycle.

hydroxy group is absent either in benzaldehyde or 2-methoxybenzaldehyde, and hence the arylation did not occur in these cases.

Conclusions

An efficient rhodium-catalyzed general protocol for the synthesis of medicinally valuable 2-hydroxybenzophenone molecular scaffolds was developed from salicylaldehyde and aryl halides. Further, a broad synthetic scope was established with aryl iodides and bromides with chemo- and regioselective possibilities. These reactions tolerate many functional groups and sterically bulky aryl halides giving high yields. A brief study of aryl chlorides with salicylaldehydes demonstrated an initial promising reactivity. Synthetic application of this protocol was demonstrated in the target-specific synthesis of a series of medicinally important 3-salicyloylpyridines in high yields. A brief study of amino-group-directed aldehyde C–H arylation was demonstrated with aryl iodides.

Experimental Section

General: The arylation reactions were performed in dry Schlenk tubes under nitrogen. Various functionalized aryl aldehydes were prepared according to literature procedures.[18–20] Standard methods were applied to dry various solvents used in the coupling reactions.

Representative Coupling Procedure for Tables 2 and 3: The arylation reaction was performed by charging a dry Schlenk tube with salicylaldehyde (61 mg, 0.5 mmol), 1-iodo-4-methoxybenzene (117 mg, 0.5 mmol), $Rh(CO)_2(acac)$ (6.4 mg, 0.025 mmol), $NaHCO_3$ (42 mg, 0.5 mmol) and DMF (2 mL). This mixture was stirred at 100 °C in an oil bath for 0.5 h. Finally, the contents were brought to room temperature, the reaction quenched with diluted HCl, and the mixture extracted with ethyl acetate (30 mL). The organic extract was washed with water (15 mL) and brine (15 mL) and dried with anhydrous $MgSO_4$ and concentrated. The crude product was purified by silica gel column chromatography by using ethyl acetate/hexane as the eluent. Product **2.3** was obtained as a yellow liquid (108 mg, 95 %).

Representative Coupling Procedure for Tables 5 and 6: The representative coupling procedure given for Table 2 was applied but with use of salicylaldehyde (122 mg, 1 mmol), 1-bromo-4-methoxybenzene (94 mg, 0.5 mmol), $Rh(CO)_2(acac)$ (6.4 mg, 0.025 mmol), $NaHCO_3$ (126 mg, 1.5 mmol) and DMF (2 mL) at 120 °C for 12 h. The desired product **2.3** was obtained as a yellow liquid (104 mg, 91 %).

Representative Procedure for Scheme 2: The representative coupling procedure given for Table 2 was applied but with use of salicylaldehyde (122 mg, 1 mmol), 1-chloro-4-nitrobenzene (79 mg, 0.5 mmol), $Rh(CO)_2(acac)$ (6.4 mg, 0.025 mmol), $NaHCO_3$ (126 mg, 1.5 mmol) and DMF (2 mL) at 140 °C for 12 h. Product **2.6** was obtained as a yellow solid (76 mg, 62 %).

Representative Procedure for Table 7: The representative coupling procedure given for Table 2 was applied but with use of salicylaldehyde (61 mg, 0.5 mmol), 3-iodopyridine (102 mg, 0.5 mmol), $Rh(CO)_2(acac)$ (6.4 mg, 0.025 mmol), $NaHCO_3$ (42 mg, 0.5 mmol) and DMF (2 mL) at 100 °C for 2 h. Product **4.4** was obtained as a yellow solid (68 mg, 68 %).

Representative Procedure for Table 8: The representative coupling procedure given for Table 2 was applied but with use of 2-(sulfonylamino)benzaldehyde (137 mg, 0.5 mmol), 1-iodo-4-methoxybenzene (117 mg, 0.5 mmol), $Rh(CO)_2(acac)$ (6.4 mg, 0.025 mmol), $NaHCO_3$ (42 mg, 0.5 mmol) and DMF (2 mL) at 100 °C for 2 h. Product **5.1** was obtained as a colourless solid (158 mg, 83 %).

The characterization data of the products are given below.

(2-Hydroxyphenyl)(phenyl)methanone (2.1):[10] Yellow liquid (89 mg, 90 %). R_f (3 % ethyl acetate in hexane) = 0.48. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.03 (s, 1 H, Ar-OH), 7.70–7.67 (m, 2 H, Ar-H), 7.62–7.58 (m, 2 H, Ar-H), 7.53–7.49 (m, 3 H, Ar-H), 7.09–7.07 (m, 1 H, Ar-H), 6.90–6.86 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 201.64, 163.2, 137.87, 136.32, 133.60, 131.91, 129.15, 128.33, 119.10, 118.64, 118.39 ppm. IR (neat): $\tilde{\nu}$ = 3060, 2925, 1627, 1605, 1577, 1483, 1446, 1332, 1308, 1245, 1147, 942, 927, 826, 756, 699, 646 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_9O_2$ $[M - H]^+$ 197.0603; found 197.0608.

(2-Hydroxyphenyl)(*p*-tolyl)methanone (2.2):[10] Yellow liquid (95 mg, 90 %). R_f (3 % ethyl acetate in hexane) = 0.48. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.05 (s, 1 H, Ar-OH), 7.63–7.59 (m, 3 H, Ar-H), 7.52–7.48 (m, 1 H, Ar-H), 7.31 (d, J = 7.8 Hz, 2 H, Ar-H), 7.08–7.06 (m, 1 H, Ar-H), 6.89–6.85 (m, 1 H, Ar-H), 2.46 (s, 3 H, CH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 201.31, 163.09, 142.72, 136.06, 135.15, 133.50, 129.44, 128.99, 119.25, 118.52, 118.32, 21.59 ppm. IR (neat): $\tilde{\nu}$ = 3034, 2923, 1626, 1603, 1484, 1445, 1333, 1305, 1245, 1166, 936, 837, 759 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{12}O_2$ $[M]^+$ 212.0837; found 212.0839.

(2-Hydroxyphenyl)(4-methoxyphenyl)methanone (2.3):[10] Yellow liquid (104 mg, 91 %). R_f (3 % ethyl acetate in hexane) = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.97 (s, 1 H, Ar-OH), 7.72 (dd, J = 9.2, 2.3 Hz, 2 H, Ar-H), 7.63 (dd, J = 8.2, 1.8 Hz, 1 H, Ar-H), 7.49 (dt, J = 7.8, 1.8 Hz, 1 H, Ar-H), 7.06 (d, J = 7.3 Hz, 1 H, Ar-H), 7.00 (dd, J = 8.7, 1.8 Hz, 2 H, Ar-H), 6.88 (dt, J = 7.3, 1.4 Hz, 1 H, Ar-H), 3.9 (s, 3 H, OCH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 199.99, 162.91, 135.77, 133.24, 131.80, 130.35, 119.39, 118.46, 118.30, 113.65, 55.48 ppm. IR (neat): $\tilde{\nu}$ = 3008, 2840, 1624, 1597, 1484, 1444, 1334, 1307, 1259, 1163, 1030, 935, 845, 760, 614 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{12}O_3$ $[M]^+$ 228.0786; found 228.0788.

4-(2-Hydroxybenzoyl)benzonitrile (2.4):[21] Yellow solid (100 mg, 90 %), m.p. 116–118 °C. R_f (3 % ethyl acetate in hexane) = 0.50. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.78 (s, 1 H, Ar-OH), 7.82 (d, J = 8.7 Hz, 2 H, Ar-H), 7.76 (d, J = 8.7 Hz, 2 H, Ar-H), 7.58–7.53 (m, 1 H, Ar-H),

7.46–7.43 (m, 1 H, Ar-H), 7.10 (d, J = 8.7 Hz, 1 H, Ar-H), 6.92–6.88 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.74, 163.41, 141.55, 137.22, 133.03, 132.20, 129.42, 119.06, 118.79, 118.48, 117.85, 115.32 ppm. IR (KBr): $\tilde{\nu}$ = 3063, 2234, 1627, 1597, 1482, 1441, 1344, 1246, 1144, 939, 860, 768, 691 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_8NO_2$ [M – H]$^+$ 222.0555; found 222.0558.

[4-(Diethylamino)phenyl](2-hydroxyphenyl)methanone (2.5): Yellow liquid (86 mg, 64 %). R_f (3 % ethyl acetate in hexane) = 0.23. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.02 (s, 1 H, Ar-OH), 7.72–7.69 (m, 3 H, Ar-H), 7.44 (dt, J = 7.8, 1.8 Hz, 1 H, Ar-H), 7.04 (d, J = 8.2 Hz, 1 H, Ar-H), 6.89–6.86 (m, 1 H, Ar-H), 6.68 (d, J = 9.2 Hz, 2 H, Ar-H), 3.45 (q, J = 7.3 Hz, 4 H, NCH_2CH_3), 1.23 (t, J = 7.3 Hz, 6 H, NCH_2CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.45, 162.42, 150.99, 134.75, 132.93, 132.71, 124.02, 120.02, 118.14, 117.99, 110.14, 44.54, 12.50 ppm. IR (neat): $\tilde{\nu}$ = 2973, 2930, 1620, 1585, 1527, 1484, 1334, 1248, 1197, 1155, 1078, 934, 830, 760, 673 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{17}H_{19}NO_2$ [M]$^+$ 269.1416; found 269.1410.

(2-Hydroxyphenyl)(4-nitrophenyl)methanone (2.6):[21] Yellow solid (75 mg, 62 %), m.p. 94–96 °C. R_f (10 % ethyl acetate in hexane) = 0.50. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 10.34 (s, 1 H, Ar-OH), 8.26 (d, J = 9.2 Hz, 2 H, Ar-H), 8.00 (d, J = 8.2 Hz, 1 H, Ar-H), 7.68–7.64 (m, 1 H, Ar-H), 7.38 (t, J = 7.8 Hz, 1 H, Ar-H), 7.11–7.07 (m, 3 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 188.27, 162.48, 157.0, 143.43, 136.15, 129.56, 127.96, 126.18, 125.72, 120.77, 117.72 ppm. IR (KBr): $\tilde{\nu}$ = 3081, 2852, 1683, 1595, 1577, 1518, 1491, 1478, 1456, 1403, 1344, 1239, 1202, 1161, 1101, 865, 820, 763, 750 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_9NO_4$ [M]$^+$ 243.0532; found 243.0533.

***N*-[4-(2-Hydroxybenzoyl)phenyl]acetamide (2.7):** Yellow solid (120 mg, 94 %), m.p. 158–160 °C. R_f (20 % ethyl acetate in hexane) = 0.30. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.97 (s, 1 H, Ar-OH), 7.70–7.65 (m, 5 H, Ar-H), 7.60 (dd, J = 8.0, 1.6 Hz, 1 H, Ar-H), 7.50 (dt, J = 7.7, 1.6 Hz, 1 H, Ar-H), 7.06 (d, J = 8.5 Hz, 1 H, Ar-H), 6.88 (dt, J = 7.7, 1.2 Hz, 1 H, Ar-H), 2.23 (s, 3 H, COMe) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.15, 168.68, 162.97, 141.46, 136.18, 133.33, 130.79, 119.13, 118.85, 118.67, 118.34, 24.75 ppm. IR (KBr): $\tilde{\nu}$ = 3259, 3186, 3113, 1668, 1622, 1595, 1535, 1486, 1323, 1246, 1225, 1179, 937, 846, 756, 661 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{13}NO_3$ [M]$^+$ 255.0895; found 255.0890.

(2-Hydroxyphenyl)[4-(trifluoromethyl)phenyl]methanone (2.8):[10] White solid (105 mg, 79 %), m.p. 54–56 °C. R_f (3 % ethyl acetate in hexane) = 0.50. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.87 (s, 1 H, Ar-OH), 7.78 (s, 4 H, Ar-H), 7.57–7.49 (m, 2 H, Ar-H), 7.10 (d, J = 8.2 Hz, 1 H, Ar-H), 6.89 (t, J = 7.5 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.39, 163.38, 141.00, 136.97, 133.54, 133.26, 129.27, 125.45, 125.41, 123.56 (q, $J_{C,F}$ = 274 Hz), 118.80 (d, $J_{C,F}$ = 27.8 Hz), 118.72 ppm. IR (KBr): $\tilde{\nu}$ = 3075, 1614, 1579, 1483, 1326, 1139, 1064, 1017, 937, 847, 760, 656 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_9F_3O_2$ [M]$^+$ 266.0555; found 266.0540.

1-[4-(2-Hydroxybenzoyl)phenyl]ethanone (2.9): Yellow solid (105 mg, 87 %), m.p. 86–88 °C. R_f (3 % ethyl acetate in hexane) = 0.07. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.92 (s, 1 H, Ar-OH), 8.08 (d, J = 8.2 Hz, 2 H, Ar-H), 7.75 (d, J = 8.2 Hz, 2 H, Ar-H), 7.56–7.49 (m, 2 H, Ar-H), 7.09 (d, J = 8.7 Hz, 1 H, Ar-H), 6.90–6.86 (m, 1 H, Ar-H), 2.67 (s, 3 H, $COCH_3$) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.82, 197.33, 163.32, 141.64, 139.18, 136.86, 133.30, 129.16, 128.20, 118.88, 118.84, 118.59, 26.84 ppm. IR (KBr): $\tilde{\nu}$ = 3043, 1689, 1625, 1483, 1446, 1402, 1335, 1263, 1243, 1219, 1147, 936, 849, 757, 676 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{12}O_3$ [M]$^+$ 240.0786; found 240.0785.

Ethyl 4-(2-Hydroxybenzoyl)benzoate (2.10):[10] Yellow solid (119 mg, 88 %), m.p. 51–52 °C. R_f (3 % ethyl acetate in hexane) = 0.18. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.93 (s, 1 H, Ar-OH), 8.18 (d, J = 8.2 Hz, 2 H, Ar-H), 7.72 (d, J = 8.2 Hz, 2 H, Ar-H), 7.55–7.50 (m, 2 H, Ar-H), 7.09 (d, J = 8.2 Hz, 1 H, Ar-H), 6.90–6.86 (m, 1 H, Ar-H), 4.43 (q, J = 7.3 Hz, 2 H, OCH_2CH_3), 1.43 (t, J = 7.3 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.97, 165.69, 163.33, 141.51, 136.81, 133.37, 133.23, 129.51, 128.87, 118.86, 118.58, 61.47, 14.29 ppm. IR (KBr): $\tilde{\nu}$ = 2982, 1721, 1627, 1606, 1484, 1446, 1333, 1276, 1244, 1147, 1104, 1021, 938, 759, 709 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{16}H_{14}O_4$ [M]$^+$ 270.0892; found 270.0899.

(3-Bromophenyl)(2-hydroxyphenyl)methanone (2.11):[12] Yellow liquid (107 mg, 77 %). R_f (3 % ethyl acetate in hexane) = 0.48. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.85 (s, 1 H, Ar-OH), 7.81 (t, J = 1.8 Hz, 1 H, Ar-H), 7.74–7.71 (m, 1 H, Ar-H), 7.61–7.58 (m, 1 H, Ar-H), 7.55–7.51 (m, 2 H, Ar-H), 7.41–7.37 (m, 1 H, Ar-H), 7.10–7.07 (m, 1 H, Ar-H), 6.92–6.88 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.87, 163.27, 139.65, 136.77, 134.79, 133.28, 131.87, 129.91, 127.63, 122.57, 118.89, 118.75, 118.57 ppm. IR (neat): $\tilde{\nu}$ = 3063, 2920, 1628, 1608, 1484, 1331, 1307, 1244, 1220, 948, 759, 707, 669 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_9BrO_2$ [M]$^+$ 275.9786; found 275.9782.

(4-Chlorophenyl)(2-hydroxyphenyl)methanone (2.12):[10] Yellow liquid (107 mg, 92 %). R_f (3 % ethyl acetate in hexane) = 0.50. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.88 (s, 1 H, Ar-OH), 7.64 (d, J = 8.7 Hz, 2 H, Ar-H), 7.55–7.52 (m, 2 H, Ar-H), 7.49 (d, J = 8.7 Hz, 2 H, Ar-H), 7.08 (d, J = 8.2 Hz, 1 H, Ar-H), 6.91–6.87 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.22, 163.18, 138.40, 136.57, 136.14, 133.21, 130.63, 128.70, 118.89, 118.78, 118.55 ppm. IR (neat): $\tilde{\nu}$ = 3061, 1627, 1605, 1589, 1484, 1334, 1310, 1244, 1223, 1147, 1090, 1015, 935, 760, 719 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_9ClO_2$ [M]$^+$ 232.0291; found 232.0292.

(4-Bromophenyl)(2-hydroxyphenyl)methanone (2.13):[12] Yellow liquid (107 mg, 77 %). R_f (3 % ethyl acetate in hexane) = 0.52. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.88 (s, 1 H, Ar-OH), 7.67–7.65 (m, 2 H, Ar-H), 7.57–7.50 (m, 4 H, Ar-H), 7.08 (d, J = 8.2 Hz, 1 H, Ar-H), 6.91–6.86 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.35, 163.20, 136.60, 133.20, 131.66, 130.72, 126.88, 118.86, 118.79, 118.56 ppm. IR (neat): $\tilde{\nu}$ = 3055, 1626, 1606, 1587, 1482, 1446, 1334, 1310, 1245, 1146, 1070, 934, 843, 759 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_9BrO_2$ [M]$^+$ 275.9786; found 275.9786.

Bis(2-hydroxyphenyl)methanone (2.14):[22a] Yellow liquid (37 mg, 34 %). R_f (3 % ethyl acetate in hexane) = 0.30. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 10.60 (s, 2 H, Ar-OH), 7.66–7.61 (m, 2 H, Ar-H), 7.54–7.50 (m, 2 H, Ar-H), 7.13–7.08 (m, 2 H, Ar-H), 6.96–6.92 (m, 2 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 202.37, 161.72, 135.91, 133.04, 119.81, 118.85, 118.58 ppm. IR (neat): $\tilde{\nu}$ = 3307, 1615, 1574, 1481, 1342, 1231, 1151, 938, 761, 703, 521 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_{10}O_3$ [M]$^+$ 214.0630; found 214.0644.

(2-Hydroxyphenyl)(2-methoxyphenyl)methanone (2.15):[22b] White solid (81 mg, 71 %), m.p. 68–70 °C. R_f (3 % ethyl acetate in hexane) = 0.30. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.18 (s, 1 H, Ar-OH), 7.50–7.45 (m, 2 H, Ar-H), 7.33 (dd, J = 8.0, 1.6 Hz, 1 H, Ar-H), 7.29 (dd, J = 7.5, 1.6 Hz, 1 H, Ar-H), 7.08–7.01 (m, 3 H, Ar-H), 6.82–6.78 (m, 1 H, Ar-H), 3.78 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 202.10, 162.88, 156.53, 136.45, 133.74, 131.82, 128.80, 127.78, 120.49, 120.19, 118.66, 118.04, 111.41, 55.64 ppm. IR (KBr): $\tilde{\nu}$ = 3009, 2943, 2839, 1627, 1601, 1487, 1462, 1332, 1309, 1244, 1220, 1147, 1023, 933, 827, 753, 642 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{12}O_3$ [M]$^+$ 228.0786; found 228.0782.

(2-Hydroxyphenyl)(naphthalen-1-yl)methanone (2.16): Yellow liquid (113 mg, 91 %). R_f (3 % ethyl acetate in hexane) = 0.46. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.35 (s, 1 H, Ar-OH), 8.02 (dd, J = 6.9,

2.3 Hz, 1 H, Ar-H), 7.95–7.90 (m, 2 H, Ar-H), 7.58–7.49 (m, 5 H, Ar-H), 7.33 (d, J = 7.3 Hz, 1 H, Ar-H), 7.11 (d, J = 8.7 Hz, 1 H, Ar-H), 6.76 (t, J = 7.6 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 203.71, 163.40, 136.93, 135.60, 133.95, 133.59, 130.89, 130.36, 128.45, 127.27, 126.59, 126.40, 125.31, 124.43, 120.45, 118.86, 118.37 ppm. IR (neat): $\tilde{\nu}$ = 3049, 1628, 1508, 1483, 1446, 1328, 1307, 1244, 1206, 1148, 928, 794, 759, 631 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{17}H_{12}O_2$ [M]$^+$ 248.0837; found 248.0838.

(2-Hydroxyphenyl)(thiophen-2-yl)methanone (2.17): Yellow liquid (65 mg, 63 %). R_f (3 % ethyl acetate in hexane) = 0.42. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.61 (s, 1 H, Ar-OH), 7.96 (dd, J = 8.2, 1.4 Hz, 1 H, Ar-H), 7.75 (d, J = 4.6 Hz, 2 H, Ar-H), 7.54–7.50 (m, 1 H, Ar-H), 7.21–7.19 (m, 1 H, Ar-H), 7.07 (dd, J = 8.7, 0.9 Hz, 1 H, Ar-H), 6.97–6.93 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 191.15, 162.49, 142.21, 135.98, 134.51, 133.92, 131.87, 127.93, 119.44, 118.94, 118.44 ppm. IR (neat): $\tilde{\nu}$ = 3104, 2957, 1737, 1694, 1622, 1589, 1513, 1484, 1415, 1355, 1306, 1248, 1234, 1163, 894, 857, 802, 759, 724, 700, 652 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{11}H_8O_2S$ [M]$^+$ 204.0245; found 204.0243.

1,4-Phenylenebis[(2-hydroxyphenyl)methanone] (2.18): Yellow solid (145 mg, 91 %), m.p. 154–156 °C. R_f (10 % ethyl acetate in hexane) = 0.57. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.93 (s, 2 H, Ar-OH), 7.81 (s, 4 H, Ar-H), 7.59–7.54 (m, 4 H, Ar-H), 7.11 (d, J = 8.7 Hz, 2 H, Ar-H), 6.94–6.90 (m, 2 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.69, 163.38, 140.63, 136.91, 133.37, 128.94, 118.93, 118.84, 118.65 ppm. IR (KBr): $\tilde{\nu}$ = 2921, 1623, 1595, 1439, 1332, 1241, 1221, 1144, 934, 863, 754, 694, 529 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{20}H_{14}O_4$ [M]$^+$ 318.0892; found 318.0899.

(2-Hydroxyphenyl)[4-(methylthio)phenyl]methanone (2.19): Yellow liquid (79 mg, 65 %). R_f (3 % ethyl acetate in hexane) = 0.42. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.95 (s, 1 H, Ar-OH), 7.65–7.59 (m, 3 H, Ar-H), 7.52–7.49 (m, 1 H, Ar-H), 7.33 (d, J = 8.7 Hz, 2 H, Ar-H), 7.07 (d, J = 8.7 Hz, 1 H, Ar-H), 6.90–6.86 (m, 1 H, Ar-H), 2.55 (s, 3 H, SCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.38, 163.04, 144.83, 136.12, 133.93, 133.24, 129.93, 124.96, 119.20, 118.60, 118.41, 14.90 ppm. IR (neat): $\tilde{\nu}$ = 3050, 2921, 1624, 1589, 1483, 1401, 1334, 1245, 1223, 1089, 934, 760, 666 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{12}O_2S$ [M]$^+$ 244.0558; found 244.0554.

4-(2-Hydroxybenzoyl)benzaldehyde (2.20): Yellow solid (89 mg, 79 %), m.p. 78–80 °C. R_f (3 % ethyl acetate in hexane) = 0.10. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.88 (s, 1 H, Ar-OH), 10.13 (s, 1 H, CHO), 8.03 (d, J = 8.2 Hz, 2 H, Ar-H), 7.81 (d, J = 8.2 Hz, 2 H, Ar-H), 7.55 (dd, J = 7.9, 1.6 Hz, 1 H, Ar-H), 7.49 (dd, J = 8.2, 1.6 Hz, 1 H, Ar-H), 7.10 (d, J = 8.5 Hz, 1 H, Ar-H), 6.89 (dd, J = 7.7, 1.2 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.62, 191.42, 163.40, 142.88, 138.16, 137.01, 133.26, 129.54, 129.47, 118.95, 118.78, 118.68 ppm. IR (KBr): $\tilde{\nu}$ = 3067, 2839, 2740, 1693, 1623, 1602, 1482, 1441, 1387, 1338, 1241, 1216, 843, 749, 760, 730 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{10}O_3$ [M]$^+$ 226.0630; found 226.0639.

(2-Hydroxyphenyl)[3-(trifluoromethyl)phenyl]methanone (2.21):[12] Yellow liquid (113 mg, 85 %). R_f (3 % ethyl acetate in hexane) = 0.41. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.84 (s, 1 H, Ar-OH), 7.94 (s, 1 H, Ar-H), 7.86 (d, J = 7.3 Hz, 2 H, Ar-H), 7.68–7.64 (m, 1 H, Ar-H), 7.57–7.53 (m, 1 H, Ar-H), 7.51–7.49 (m, 1 H, Ar-H), 7.10 (d, J = 8.2 Hz, 1 H, Ar-H), 6.93–6.89 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.99, 163.37, 138.51, 136.93, 133.14, 132.25, 131.08 (q, $J_{C,F}$ = 33.5 Hz), 129.01, 128.41 (d, $J_{C,F}$ = 3.8 Hz), 125.90 (d, $J_{C,F}$ = 3.8 Hz), 123.58 (q, $J_{C,F}$ = 274 Hz), 119.01, 118.71 ppm. IR (neat): $\tilde{\nu}$ = 3071, 1632, 1485, 1447, 1348, 1301, 1221, 1166, 1129, 1073, 160, 705, 662 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_9F_3O_2$ [M]$^+$ 266.0555; found 266.0559.

(4-Fluorophenyl)(2-hydroxyphenyl)methanone (2.22):[10] White solid (88 mg, 81 %), m.p. 65–68 °C. R_f (3 % ethyl acetate in hexane) = 0.5. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.90 (s, 1 H, Ar-OH), 7.72 (dd, J = 8.7, 5.5 Hz, 2 H, Ar-H), 7.56 (dd, J = 8.0, 1.8 Hz, 1 H, Ar-H), 7.54–7.50 (m, 1 H, Ar-H), 7.19 (t, J = 8.7 Hz, 2 H, Ar-H), 7.08 (d, J = 8.2 Hz, 1 H, Ar-H), 6.89 (t, J = 8.0 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.96, 164.96 (d, $J_{C,F}$ = 254.8 Hz), 163.1, 136.39, 134.00 (d, $J_{C,F}$ = 2.9 Hz), 133.22, 131.77 (d, $J_{C,F}$ = 8.63 Hz), 118.95, 118.70, 118.48, 115.55 (d, $J_{C,F}$ = 22.04 Hz) ppm. IR (KBr): $\tilde{\nu}$ = 3072, 1909, 1627, 1601, 1508, 1483, 1445, 1345, 1243, 1234, 1148, 937, 851, 762, 726, 688, 609 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_9FO_2$ [M]$^+$ 216.0587; found 216.0589.

(3,5-Dichlorophenyl)(2-hydroxyphenyl)methanone (2.23):[12] Yellow solid (107 mg, 80 %), m.p. 88–90 °C. R_f (3 % ethyl acetate in hexane) = 0.5. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.70 (s, 1 H, Ar-OH), 7.58–7.53 (m, 4 H, Ar-H), 7.52–7.49 (m, 1 H, Ar-H), 7.09 (d, J = 8.5 Hz, 1 H, Ar-H), 6.94–6.91 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.45, 163.32, 140.33, 137.15, 135.34, 133.0, 131.64, 127.28, 119.11, 118.72, 118.42 ppm. IR (KBr): $\tilde{\nu}$ = 3077, 1623, 1562, 1483, 1333, 1303, 1249, 1222, 1148, 872, 816, 752, 706, 658 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_8Cl_2O_2$ [M]$^+$ 265.9901; found 265.9907.

(2-Hydroxyphenyl)(*o*-tolyl)methanone (2.24):[10] White solid (92 mg, 87 %), m.p. 60 °C. R_f (3 % ethyl acetate in hexane) = 0.62. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.26 (s, 1 H, Ar-OH), 7.50 (ddd, J = 7.8, 7.8, 1.8 Hz, 1 H, Ar-H), 7.42–7.39 (m, 1 H, Ar-H), 7.31–7.27 (m, 4 H, Ar-H), 7.06 (d, J = 8.7 Hz, 1 H, Ar-H), 6.83–6.79 (m, 1 H, Ar-H), 2.31 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 204.4, 163.26, 137.79, 136.78, 135.49, 133.69, 130.86, 130.11, 127.43, 125.29, 119.86, 118.87, 118.28, 19.55 ppm. IR (KBr): $\tilde{\nu}$ = 2922, 1989, 1830, 1629, 1484, 1448, 1333, 1310, 1248, 1149, 934, 829, 767, 646 cm^{-1}. HRMS (ES$^+$): calcd. for $C_{14}H_{13}O_2$ [M + H]$^+$ 213.0916; found 213.0916.

(2-Hydroxy-4-methoxyphenyl)(4-methoxyphenyl)methanone (3.1): White solid (108 mg, 84 %), m.p. 110–112 °C. R_f (10 % ethyl acetate in hexane) = 0.50. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.69 (s, 1 H, Ar-OH), 7.66 (d, J = 8.4 Hz, 2 H, Ar-H), 7.55 (d, J = 9.2 Hz, 1 H, Ar-H), 6.99 (d, J = 8.4 Hz, 2 H, Ar-H), 6.52 (d, J = 2.3 Hz, 1 H, Ar-H), 6.44–6.41 (m, 1 H, Ar-H), 3.89 (s, 3 H, OCH_3), 3.86 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.72, 166.06, 165.84, 162.48, 134.95, 131.37, 130.73, 113.60, 113.24, 107.11, 101.08, 55.59, 55.46 ppm. IR (KBr): $\tilde{\nu}$ = 3448, 3080, 2978, 2845, 2048, 1635, 1593, 1567, 1509, 1442, 1350, 1273, 1258, 1162, 1112, 1029, 922, 844, 798, 686 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{14}O_4$ [M]$^+$ 258.0892; found 258.0899.

4-(2-Hydroxy-4-methoxybenzoyl)benzonitrile (3.2): White solid (96 mg, 76 %), m.p. 118–120 °C. R_f (10 % ethyl acetate in hexane) = 0.46. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.41 (s, 1 H, Ar-OH), 7.80 (d, J = 8.2 Hz, 2 H, Ar-H), 7.71 (d, J = 8.2 Hz, 2 H, Ar-H), 7.34 (d, J = 9.0 Hz, 1 H, Ar-H), 6.53–6.52 (m, 1 H, Ar-H), 6.44–6.41 (m, 1 H, Ar-H), 3.88 (s, 3 H, OCH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 197.83, 166.86, 166.59, 141.97, 134.63, 132.16, 129.17, 117.96, 114.85, 112.52, 108.11, 101.17, 55.75 ppm. IR (KBr): $\tilde{\nu}$ = 3427, 3088, 2933, 2230, 1600, 1499, 1444, 1344, 1265, 1213, 1107, 1022, 964, 920, 860, 823, 773, 543 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{10}NO_3$ [M – H]$^+$ 252.0661; found 252.0664.

(2-Hydroxy-4-methoxyphenyl)[4-(trifluoromethyl)phenyl]methanone (3.3):[23] White solid (130 mg, 88 %), m.p. 66 °C. R_f (3 % ethyl acetate in hexane) = 0.26. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.51 (s, 1 H, Ar-OH), 7.77–7.72 (m, 4 H, Ar-H), 7.39 (d, J = 9.2 Hz, 1 H, Ar-H), 6.53 (d, J = 2.3 Hz, 1 H, Ar-H), 6.42 (dd, J = 9.2, 3.0 Hz, 1 H, Ar-H), 3.87 (s, 3 H, OCH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.58, 166.70, 166.55, 141.40, 134.89, 132.96 (q, $J_{C,F}$ = 32.4 Hz), 128.99,

125.38 (d, $J_{C,F}$ = 3.6 Hz), 123.64 (q, $J_{C,F}$ = 270.8 Hz), 112.78, 107.92, 101.14, 55.72 ppm. IR (KBr): $\tilde{\nu}$ = 3023, 2952, 2849, 1628, 1602, 1507, 1407, 1345, 1334, 1270, 1166, 1110, 1068, 853, 843, 784, 616 cm^{-1}. HRMS (EI^+): calcd. for $C_{15}H_{10}F_3O_3$ $[M - H]^+$ 295.0582; found 295.0583.

(4-Bromophenyl)(2-hydroxy-4-methoxyphenyl)methanone (3.4):[23] White solid (104 mg, 68 %), m.p. 97–99 °C. R_f (3 % ethyl acetate in hexane) = 0.40. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.54 (s, 1 H, Ar-OH), 7.63 (d, J = 8.4 Hz, 2 H, Ar-H), 7.51 (d, J = 8.4 Hz, 2 H, Ar-H), 7.44 (d, J = 8.4 Hz, 1 H, Ar-H), 6.52 (d, J = 3.1 Hz, 1 H, Ar-H), 6.43–6.40 (m, 1 H, Ar-H), 3.86 (s, 3 H, OCH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.67, 166.40, 166.34, 136.94, 134.85, 131.59, 130.43, 126.27, 112.82, 107.65, 101.10, 55.68 ppm. IR (KBr): $\tilde{\nu}$ = 3421, 3075, 2951, 1633, 1588, 1443, 1386, 1353, 1269, 1213, 1113, 1072, 1014, 1020, 918, 853, 824, 807 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_{11}BrO_3$ $[M]^+$ 305.9892; found 305.9897.

(2-Hydroxy-5-nitrophenyl)(4-methoxyphenyl)methanone (3.5): Yellow solid (108 mg, 79 %), m.p. 110–112 °C. R_f (10 % ethyl acetate in hexane) = 0.26. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.66 (s, 1 H, Ar-OH), 8.63 (s, 1 H, Ar-H), 8.37 (d, J = 9.2 Hz, 1 H, Ar-H), 7.75 (d, J = 8.4 Hz, 2 H, Ar-H), 7.17 (d, J = 9.2 Hz, 1 H, Ar-H), 7.06 (d, J = 8.4 Hz, 2 H, Ar-H), 3.93 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.64, 167.84, 163.90, 139.37, 132.04, 130.44, 129.32, 128.81, 119.39, 118.27, 114.31, 55.66 ppm. IR (KBr): $\tilde{\nu}$ = 2919, 2844, 1631, 1605, 1579, 1520, 1472, 1334, 1259, 1175, 1031, 961, 835, 753 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_{11}NO_5$ $[M]^+$ 273.0637; found 273.0635.

4-(2-Hydroxy-5-nitrobenzoyl)benzonitrile (3.6): Brown solid (118 mg, 88 %), m.p. 184–186 °C. R_f (10 % ethyl acetate in hexane) = 0.08. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.37 (s, 1 H, Ar-OH), 8.46 (d, J = 2.8 Hz, 1 H, Ar-H), 8.43 (dd, J = 9.2, 2.8 Hz, 1 H, Ar-H), 7.90 (d, J = 8.5 Hz, 2 H, Ar-H), 7.82 (d, J = 8.5 Hz, 2 H, Ar-H), 7.23 (d, J = 9.2 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.89, 167.91, 139.81, 139.61, 132.72, 131.62, 129.52, 129.03, 120.01, 117.48, 117.31, 116.55 ppm. IR (KBr): $\tilde{\nu}$ = 3081, 2232, 1626, 1575, 1524, 1469, 1405, 1342, 1252, 1200, 1149, 1092, 956, 852, 786 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_8N_2O_4$ $[M]^+$ 268.0484; found 268.0481.

(2-Hydroxy-5-nitrophenyl)[4-(trifluoromethyl)phenyl]methanone (3.7): White solid (134 mg, 86 %), m.p. 106–108 °C. R_f (10 % ethyl acetate in hexane) = 0.26. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.48 (s, 1 H, Ar-OH), 8.51 (d, J = 2.7 Hz, 1 H, Ar-H), 8.42 (dd, J = 9.2, 2.8 Hz, 1 H, Ar-H), 7.87 (d, J = 8.7 Hz, 2 H, Ar-H), 7.83 (d, J = 8.7 Hz, 2 H, Ar-H), 7.22 (d, J = 9.2 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.46, 167.95, 139.47 (d, $J_{C,F}$ = 24.9 Hz), 134.52 (q, $J_{C,F}$ = 32.6 Hz), 131.43, 129.43, 129.26, 126.02 (d, $J_{C,F}$ = 3.8 Hz), 123.35 (q, $J_{C,F}$ = 274.3 Hz), 122.16, 119.88, 117.54 ppm. IR (KBr): $\tilde{\nu}$ = 3089, 1942, 1632, 1617, 1578, 1470, 1343, 1328, 1167, 1151, 1128, 1065, 1017, 961, 877, 858, 846, 695 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_8F_3NO_4$ $[M]^+$ 311.0405; found 311.0405.

(4-Bromophenyl)(2-hydroxy-5-nitrophenyl)methanone (3.8): White solid (124 mg, 77 %), m.p. 155–157 °C. R_f (10 % ethyl acetate in hexane) = 0.38. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.51 (s, 1 H, Ar-OH), 8.55 (d, J = 2.8 Hz, 1 H, Ar-H), 8.40 (dd, J = 9.4, 2.4 Hz, 1 H, Ar-H), 7.74 (d, J = 8.7 Hz, 2 H, Ar-H), 7.62–7.58 (m, 2 H, Ar-H), 7.20 (d, J = 9.2 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 199.33, 167.87, 139.47, 134.99, 132.30, 131.11, 130.72, 129.23, 128.41, 119.71, 117.67 ppm. IR (KBr): $\tilde{\nu}$ = 3415, 3087, 1633, 1618, 1589, 1575, 1520, 1471, 1341, 1256, 962, 876, 790 cm^{-1}. HRMS (EI^+): calcd. for $C_{13}H_8BrNO_4$ $[M]^+$ 320.9637; found 320.9629.

4-Hydroxy-3-(4-methoxybenzoyl)benzaldehyde (3.9): White solid (100 mg, 78 %), m.p. 100–102 °C. R_f (10 % ethyl acetate in hexane) = 0.26. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.61 (s, 1 H, Ar-OH), 9.85 (s, 1 H, CHO), 8.19 (d, J = 1.5 Hz, 1 H, Ar-H), 8.04–8.02 (m, 1 H, Ar-H), 7.74 (d, J = 9.2 Hz, 2 H, Ar-H), 7.19 (d, J = 8.4 Hz, 1 H, Ar-H), 7.04 (d, J = 9.2 Hz, 2 H, Ar-H), 3.92 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.47, 189.82, 167.98, 163.55, 136.32, 135.97, 131.94, 129.42, 127.98, 119.48, 119.14, 114.09, 55.61 ppm. IR (KBr): $\tilde{\nu}$ = 2935, 2840, 1694, 1623, 1600, 1511, 1483, 1340, 1261, 1171, 1027, 839, 743, 616 cm^{-1}. HRMS (EI^+): calcd. for $C_{15}H_{12}O_4$ $[M]^+$ 256.0736; found 256.0739.

4-(5-Formyl-2-hydroxybenzoyl)benzonitrile (3.10): White solid (84 mg, 67 %), m.p. 162–164 °C. R_f (10 % ethyl acetate in hexane) = 0.12. ^1H NMR (400 MHz, $CDCl_3$): δ = 12.33 (s, 1 H, Ar-OH), 9.84 (s, 1 H, CHO), 8.08 (dd, J = 8.7, 2.1 Hz, 1 H, Ar-H), 8.02 (d, J = 2.1 Hz, 1 H, Ar-H), 7.87 (d, J = 8.5 Hz, 2 H, Ar-H), 7.80 (d, J = 8.5 Hz, 2 H, Ar-H), 7.24 (d, J = 9.2 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.52, 189.35, 168.05, 140.48, 137.19, 135.80, 132.54, 129.46, 128.29, 119.93, 118.24, 117.59, 116.08 ppm. IR (KBr): $\tilde{\nu}$ = 3433, 2923, 2853, 2239, 1684, 1630, 1489, 1477, 1344, 1268, 1194, 842, 797 cm^{-1}. HRMS (EI^+): calcd. for $C_{15}H_9NO_3$ $[M]^+$ 251.0582; found 251.0588.

(5-Bromo-2-hydroxyphenyl)(4-methoxyphenyl)methanone (3.11): Yellow solid (124 mg, 81 %), m.p. 122–124 °C. R_f (3 % ethyl acetate in hexane) = 0.30. ^1H NMR (400 MHz, $CDCl_3$): δ = 11.84 (s, 1 H, Ar-OH), 7.74–7.70 (m, 3 H, Ar-H), 7.56 (dd, J = 8.9, 2.8 Hz, 1 H, Ar-H), 7.02 (d, J = 9.2 Hz, 2 H, Ar-H), 6.98 (d, J = 8.7 Hz, 1 H, Ar-H), 3.91 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.80, 163.28, 161.79, 138.38, 135.12, 131.85, 129.61, 120.70, 120.36, 113.92, 110.13, 55.56 ppm. IR (KBr): $\tilde{\nu}$ = 3068, 2918, 2848, 2566, 1625, 1600, 1508, 1467, 1329, 1310, 1256, 1174, 1020, 941, 844, 791, 739, 688 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_{11}BrO_3$ $[M]^+$ 305.9892; found 305.9890.

4-(5-Bromo-2-hydroxybenzoyl)benzonitrile (3.12): Yellow solid (127 mg, 84 %), m.p. 140–142 °C. R_f (3 % ethyl acetate in hexane) = 0.14. ^1H NMR (400 MHz, $CDCl_3$): δ = 11.68 (s, 1 H, Ar-OH), 7.85 (d, J = 8.2 Hz, 2 H, Ar-H), 7.76 (d, J = 8.2 Hz, 2 H, Ar-H), 7.63 (dd, J = 9.0, 2.5 Hz, 1 H, Ar-H), 7.55 (d, J = 2.3 Hz, 1 H, Ar-H), 7.02 (d, J = 8.7 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.76, 162.29, 140.73, 139.85, 134.76, 132.44, 129.40, 120.87, 119.70, 117.70, 115.82, 110.65 ppm. IR (KBr): $\tilde{\nu}$ = 3063, 2229, 1630, 1603, 1560, 1466, 1329, 1294, 1240, 1201, 941, 849, 786, 589 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_8BrNO_2$ $[M]^+$ 300.9738; found 300.9731.

(5-Bromo-2-hydroxyphenyl)(4-bromophenyl)methanone (3.13): Yellow solid (117 mg, 66 %), m.p. 90–92 °C. R_f (3 % ethyl acetate in hexane) = 0.62. ^1H NMR (400 MHz, $CDCl_3$): δ = 11.77 (s, 1 H, Ar-OH), 7.69–7.54 (m, 6 H, Ar-H), 7.00–6.97 (m, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 199.26, 162.05, 139.20, 135.81, 134.97, 131.92, 130.66, 127.49, 120.61, 120.08, 110.39 ppm. IR (KBr): $\tilde{\nu}$ = 3550, 3476, 3415, 3085, 1623, 1587, 1599, 1462, 1394, 1369, 1287, 1233, 1218, 1180, 1148, 1010, 942, 833, 779, 671, 625 cm^{-1}. HRMS (EI^+): calcd. for $C_{13}H_8Br_2O_2$ $[M]^+$ 353.8891; found 353.8890.

(5-Chloro-2-hydroxyphenyl)(4-methoxyphenyl)methanone (3.14): Yellow liquid (97 mg, 74 %). R_f (3 % ethyl acetate in hexane) = 0.26. ^1H NMR (400 MHz, $CDCl_3$): δ = 11.82 (s, 1 H, Ar-OH), 7.73–7.70 (m, 2 H, Ar-H), 7.59 (d, J = 2.7 Hz, 1 H, Ar-H), 7.43 (dd, J = 8.7, 2.7 Hz, 1 H, Ar-H), 7.03–7.01 (m, 3 H, Ar-H), 3.91 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.89, 163.27, 161.34, 135.60, 132.14, 131.84, 129.63, 123.23, 120.05, 119.95, 113.91, 55.56 ppm. IR (neat): $\tilde{\nu}$ = 2936, 2840, 1627, 1596, 1510, 1469, 1331, 1261, 1235, 1172, 1029, 947, 829, 787, 616 cm^{-1}. HRMS (EI^+): calcd. for $C_{14}H_{11}ClO_3$ $[M]^+$ 262.0397; found 262.0396.

4-(5-Chloro-2-hydroxybenzoyl)benzonitrile (3.15): Yellow solid (113 mg, 88 %), m.p. 144–146 °C. R_f (10 % ethyl acetate in hexane) =

0.60. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.67 (s, 1 H, Ar-OH), 7.85 (d, J = 8.2 Hz, 2 H, Ar-H), 7.76 (d, J = 8.2 Hz, 2 H, Ar-H), 7.50 (dd, J = 9.0, 2.5 Hz, 1 H, Ar-H), 7.41 (d, J = 2.5 Hz, 1 H, Ar-H), 7.07 (d, J = 8.9 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.82, 161.85, 140.74, 137.09, 132.42, 131.74, 129.38, 123.82, 120.49, 119.03, 117.69, 115.79 ppm. IR (KBr): $\tilde{\nu}$ = 3074, 2231, 1631, 1605, 1566, 1465, 1406, 1330, 1286, 1242, 1230, 1201, 1177, 946, 837, 786, 738, 648, 547 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_7ClNO_2$ [M – H]$^+$ 256.0165; found 256.0168.

(4-Bromophenyl)(5-chloro-2-hydroxyphenyl)methanone (3.16): Yellow solid (77 mg, 73 %), m.p. 84–86 °C. R_f (3 % ethyl acetate in hexane) = 0.62. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.76 (s, 1 H, Ar-OH), 7.69–7.66 (m, 2 H, Ar-H), 7.57–7.54 (m, 2 H, Ar-H), 7.50–7.44 (m, 2 H, Ar-H), 7.03 (dd, J = 8.8, 4.6 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 199.31, 161.60, 136.42, 135.82, 131.95, 131.89, 130.64, 127.45, 123.51, 120.21, 119.42 ppm. IR (KBr): $\tilde{\nu}$ = 3084, 1629, 1606, 1588, 1465, 1394, 1329, 1288, 1228, 1178, 1071, 1012, 946, 830, 780, 647 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{13}H_8BrClO_2$ [M]$^+$ 309.9396; found 309.9391.

(2-Hydroxy-3-methoxyphenyl)(4-methoxyphenyl)methanone (3.17): Yellow liquid (120 mg, 93 %). R_f (10 % ethyl acetate in hexane) = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.09 (s, 1 H, Ar-OH), 7.73 (d, J = 9.2 Hz, 2 H, Ar-H), 7.22 (dd, J = 8.2, 1.4 Hz, 1 H, Ar-H), 7.08 (d, J = 8.2 Hz, 1 H, Ar-H), 6.98 (d, J = 8.7 Hz, 2 H, Ar-H), 6.85–6.81 (m, 1 H, Ar-H), 3.94 (s, 3 H, OCH_3), 3.89 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.06, 162.94, 152.95, 148.92, 131.89, 130.40, 124.52, 119.62, 117.83, 116.52, 113.59, 56.22, 55.49 ppm. IR (neat): $\tilde{\nu}$ = 3005, 2937, 2839, 1599, 1569, 1511, 1454, 1338, 1305, 1253, 1166, 1076, 1028, 980, 845, 775, 755 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{14}O_4$ [M]$^+$ 258.0892; found 258.0899.

(2-Hydroxynaphthalen-1-yl)(4-methoxyphenyl)methanone (3.18): Yellow solid (114 mg, 82 %), m.p. 132–134 °C. R_f (3 % ethyl acetate in hexane) = 0.07. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 10.64 (s, 1 H, Ar-OH), 7.92 (d, J = 9.2 Hz, 1 H, Ar-H), 7.76 (d, J = 8.2 Hz, 1 H, Ar-H), 7.65 (d, J = 8.7 Hz, 2 H, Ar-H), 7.42 (d, J = 8.2 Hz, 1 H, Ar-H), 7.30–7.19 (m, 3 H, Ar-H), 6.88 (d, J = 9.1 Hz, 2 H, Ar-H), 3.87 (s, 3 H, OCH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.55, 163.52, 160.01, 135.35, 132.52, 132.43, 132.17, 128.42, 126.58, 126.24, 123.59, 119.03, 115.04, 113.75, 55.47 ppm. IR (KBr): $\tilde{\nu}$ = 3317, 2927, 2841, 1623, 1596, 1509, 1435, 1319, 1246, 1170, 1026, 918, 824, 750, 612 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{18}H_{14}O_3$ [M]$^+$ 278.0943; found 278.0942.

(2-Hydroxynaphthalen-1-yl)[4-(trifluoromethyl)phenyl]methanone (3.19): Yellow solid (138 mg, 87 %), m.p. 108–110 °C. R_f (3 % ethyl acetate in hexane) = 0.18. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.37 (s, 1 H, Ar-OH), 7.98 (d, J = 9.1 Hz, 1 H, Ar-H), 7.78 (d, J = 8.2 Hz, 1 H, Ar-H), 7.73 (d, J = 8.2 Hz, 2 H, Ar-H), 7.67 (d, J = 8.7 Hz, 2 H, Ar-H), 7.32–7.28 (m, 1 H, Ar-H), 7.26 (d, J = 9.2 Hz, 1 H, Ar-H), 7.22–7.17 (m, 2 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.03, 162.25, 143.35, 137.14, 133.83 (q, $J_{C,F}$ = 32.9 Hz), 131.97, 129.60, 128.85, 128.46, 127.12, 126.03, 125.63 (d, $J_{C,F}$ = 3.8 Hz), 124.0, 123.57 (q, $J_{C,F}$ = 274 Hz), 119.25, 113.69 ppm. IR (KBr): $\tilde{\nu}$ = 3381, 3066, 1934, 1623, 1577, 1408, 1323, 1242, 1170, 1128, 1071, 1017, 920, 828 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{18}H_{11}F_3O_2$ [M]$^+$ 316.0711; found 316.0714.

1-[4-Hydroxy-3-(4-methoxybenzoyl)phenyl]ethanone (3.20): White solid (108 mg, 80 %), m.p. 106–108 °C. R_f (10 % ethyl acetate in hexane) = 0.17. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.42 (s, 1 H, Ar-OH), 8.32 (d, J = 2.3 Hz, 1 H, Ar-H), 8.10 (dd, J = 8.7, 2.3 Hz, 1 H, Ar-H), 7.74 (d, J = 9.2 Hz, 2 H, Ar-H), 7.11 (d, J = 8.7 Hz, 1 H, Ar-H), 7.03 (d, J = 9.2 Hz, 2 H, Ar-H), 3.91 (s, 3 H, OCH_3), 2.52 (s, 3 H, $COCH_3$) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.64, 195.80, 166.67, 163.41, 135.54, 134.34, 131.94, 129.57, 128.30, 118.72, 118.57, 113.98, 55.56, 26.24 ppm. IR (KBr): $\tilde{\nu}$ = 3006, 2933, 2842, 1679, 1623, 1601, 1511, 1482, 1421, 1342, 1266, 1244, 1173, 1028, 836, 794, 617 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{16}H_{14}O_4$ [M]$^+$ 270.0892; found 270.0897.

(3,5-Dichloro-2-hydroxyphenyl)(4-methoxyphenyl)methanone (3.21): Yellow solid (104 mg, 70 %), m.p. 108–110 °C. R_f (3 % ethyl acetate in hexane) = 0.24. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.33 (s, 1 H, Ar-OH), 7.71 (d, J = 8.7 Hz, 2 H, Ar-H), 7.58 (d, J = 2.8 Hz, 1 H, Ar-H), 7.54 (d, J = 2.3 Hz, 1 H, Ar-H), 7.02 (d, J = 9.2 Hz, 2 H, Ar-H), 3.91 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.44, 163.62, 157.16, 135.18, 132.01, 130.75, 129.14, 123.89, 123.04, 120.65, 114.04, 55.61 ppm. IR (KBr): $\tilde{\nu}$ = 3078, 2938, 2843, 1626, 1602, 1568, 1427, 1313, 1261, 1237, 1170, 1027, 976, 848, 787, 617 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{10}Cl_2O_3$ [M]$^+$ 296.0007; found 296.0011.

(3,5-Dibromo-2-hydroxyphenyl)(4-methoxyphenyl)methanone (3.22): Yellow solid (122 mg, 63 %), m.p. 144–146 °C. R_f (3 % ethyl acetate in hexane) = 0.21. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.48 (s, 1 H, Ar-OH), 7.87 (d, J = 2.8 Hz, 1 H, Ar-H), 7.72–7.70 (m, 3 H, Ar-H), 7.03 (d, J = 8.7 Hz, 2 H, Ar-H), 3.92 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.30, 163.63, 158.44, 140.73, 134.40, 132.03, 129.05, 121.12, 114.06, 113.10, 110.08, 55.62 ppm. IR (KBr): $\tilde{\nu}$ = 2935, 1621, 1602, 1567, 1421, 1311, 1261, 1237, 1169, 1025, 848, 786, 615 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{10}Br_2O_3$ [M]$^+$ 383.8997; found 383.8994.

(3-Bromo-5-chloro-2-hydroxyphenyl)(4-methoxyphenyl)methanone (3.23): Yellow solid (107 mg, 63 %), m.p. 126–128 °C. R_f (3 % ethyl acetate in hexane) = 0.23. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.45 (s, 1 H, Ar-OH), 7.75 (d, J = 2.3 Hz, 1 H, Ar-H), 7.71 (d, J = 8.7 Hz, 2 H, Ar-H), 7.58 (d, J = 2.7 Hz, 1 H, Ar-H), 7.02 (d, J = 8.7 Hz, 2 H, Ar-H), 3.91 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.39, 163.63, 158.02, 138.15, 132.02, 131.47, 129.07, 123.52, 120.47, 114.05, 112.75, 55.62 ppm. IR (KBr): $\tilde{\nu}$ = 3077, 2938, 2845, 1625, 1602, 1591, 1568, 1509, 1422, 1312, 1259, 1236, 1165, 1123, 1025, 967, 847, 786, 719, 615 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{10}BrClO_3$ [M]$^+$ 339.9502; found 339.9502.

(2-Hydroxynaphthalen-1-yl)(naphthalen-1-yl)methanone (3.24): White solid (123 mg, 83 %), m.p. 106–108 °C. R_f (3 % ethyl acetate in hexane) = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.72 (s, 1 H, Ar-OH), 8.28–8.25 (m, 1 H, Ar-H), 8.02–7.95 (m, 3 H, Ar-H), 7.72 (d, J = 6.88 Hz, 1 H, Ar-H), 7.61–7.54 (m, 2 H, Ar-H), 7.40–7.35 (m, 2 H, Ar-H), 7.29 (d, J = 9.2 Hz, 1 H, Ar-H), 7.21–7.17 (m, 1 H, Ar-H), 7.09 (d, J = 9.2 Hz, 1 H, Ar-H), 6.97–6.93 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 202.01, 164.02, 138.57, 137.64, 134.08, 132.35, 131.69, 129.88, 128.75, 128.57, 128.46, 127.85, 127.68, 127.13, 126.66, 125.53, 125.33, 124.86, 123.63, 119.43, 114.77 ppm. IR (KBr): $\tilde{\nu}$ = 3053, 1621, 1604, 1578, 1509, 1461, 1315, 1242, 1192, 1150, 1105, 910, 828, 792, 778, 497 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{21}H_{14}O_2$ [M]$^+$ 298.0994; found 298.0990.

(2-Hydroxy-5-nitrophenyl)(2-methoxyphenyl)methanone (3.25): White solid (102 mg, 75 %), m.p. 136–138 °C. R_f (10 % ethyl acetate in hexane) = 0.30. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.81 (s, 1 H, Ar-OH), 8.35–8.32 (m, 2 H, Ar-H), 7.59–7.55 (m, 1 H, Ar-H), 7.37 (dd, J = 7.6, 1.5 Hz, 1 H, Ar-H), 7.14–7.10 (m, 2 H, Ar-H), 7.07 (d, J = 8.4 Hz, 1 H, Ar-H), 3.78 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 201.25, 167.40, 156.58, 139.55, 133.35, 130.82, 130.18, 129.36, 126.09, 121.16, 119.19, 118.97, 111.75, 55.64 ppm. IR (KBr): $\tilde{\nu}$ = 3433, 3097, 2923, 2848, 1632, 1595, 1471, 1341, 1249, 1218, 751 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{11}NO_5$ [M]$^+$ 273.0637; found 273.0638.

(2-Hydroxy-4-methoxyphenyl)(2-methoxyphenyl)methanone (3.26): White solid (95 mg, 73 %), m.p. 74–76 °C. R_f (10 % ethyl

acetate in hexane) = 0.30. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.69 (s, 1 H, Ar-OH), 7.46–7.42 (m, 1 H, Ar-H), 7.26–7.20 (m, 2 H, Ar-H) 7.05–6.98 (m, 2 H, Ar-H), 6.46 (d, J = 2.3 Hz, 1 H, Ar-H), 6.33 (dd, J = 9.2, 2.3 Hz, 1 H, Ar-H), 3.83 (s, 3 H, OCH_3), 3.77 (s, 3 H, OCH_3) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 200.03, 166.28, 165.82, 156.29, 135.36, 131.51, 128.73, 127.88, 120.41, 114.31, 111.32, 107.52, 100.55, 55.62, 55.58 ppm. IR (KBr): $\tilde{\nu}$ = 3021, 2944, 2841, 1604, 1488, 1463, 1436, 1378, 1258, 1204, 1121, 1020, 920, 814, 759 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{14}O_4$ [M]$^+$ 258.0892; found 258.0892.

(3-Hydroxy-4-methoxyphenyl)(2-hydroxy-3,4,5-trimethoxyphenyl)methanone (3.27):[15] Yellow solid (123 mg, 73 %), m.p. 127–129 °C. R_f (10 % ethyl acetate in hexane) = 0.20. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.13 (s, 1 H, Ar-OH), 7.31 (d, J = 2.3 Hz, 1 H, Ar-H), 7.28–7.25 (m, 1 H, Ar-H), 6.94 (d, J = 8.2 Hz, 1 H, Ar-H), 6.91 (s, 1 H, Ar-H), 5.77 (s, 1 H, Ar-OH), 4.05 (s, 3 H, OCH_3), 3.98 (s, 3 H, OCH_3), 3.96 (s, 3 H, OCH_3), 3.73 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.98, 153.46, 149.76, 149.46, 145.41, 144.62, 141.48, 131.32, 122.49, 115.52, 113.73, 110.53, 109.86, 61.30, 61.10, 56.64, 56.09 ppm. IR (KBr): $\tilde{\nu}$ = 3365, 2935, 2838, 1572, 1491, 1449, 1349, 1274, 1208, 1132, 1095, 1044, 1020, 925, 896, 797, 761 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{17}H_{18}O_7$ [M]$^+$ 334.1053; found 334.1057.

4-(2-Hydroxy-5-nitrobenzoyl)benzaldehyde (3.28): White solid (99 mg, 73 %), m.p. 156–158 °C. R_f (30 % ethyl acetate in hexane) = 0.20. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.48 (s, 1 H, Ar-OH), 10.17 (s, 1 H, CHO), 8.51 (d, J = 2.7 Hz, 1 H, Ar-H), 8.42 (dd, J = 9.1, 2.7 Hz, 1 H, Ar-H), 8.10 (d, J = 8.7 Hz, 2 H, Ar-H), 7.86 (d, J = 8.2 Hz, 2 H, Ar-H), 7.22 (d, J = 9.6 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.73, 191.11, 167.92, 141.02, 139.58, 138.90, 131.41, 129.94, 129.60, 129.28, 119.85, 117.61 ppm. IR (KBr): $\tilde{\nu}$ = 3428, 2864, 1705, 1614, 1470, 1343, 1328, 1205, 1091, 837 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_9NO_5$ [M]$^+$ 271.0481; found 271.0471.

4-(2-Hydroxy-3-methoxybenzoyl)benzaldehyde (3.29): Yellow solid (96 mg, 75 %), m.p. 112–114 °C. R_f (10 % ethyl acetate in hexane) = 0.17. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.04 (s, 1 H, Ar-OH), 10.12 (s, 1 H, CHO), 8.01 (d, J = 8.2 Hz, 2 H, Ar-H), 7.82 (d, J = 8.2 Hz, 2 H, Ar-H), 7.12 (d, J = 8.2 Hz, 1 H, Ar-H), 7.08 (dd, J = 8.2, 1.4 Hz, 1 H, Ar-H), 6.86–6.82 (m, 1 H, Ar-H), 3.95 (s, 3 H, OCH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 200.75, 191.45, 153.51, 149.03, 142.88, 138.12, 129.49, 129.45, 124.33, 118.91, 118.35, 117.41, 56.26 ppm. IR (KBr): $\tilde{\nu}$ = 3416, 2937, 2840, 1705, 1625, 1607, 1453, 1438, 1336, 1304, 1256, 1205, 1075, 980, 835, 787, 751 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{12}O_4$ [M]$^+$ 256.0736; found 256.0734.

(2-Hydroxy-4-methoxyphenyl)(*o*-tolyl)methanone (3.30): Colourless liquid (88 mg, 73 %). R_f (10 % ethyl acetate in hexane) = 0.72. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.79 (s, 1 H, Ar-OH), 7.40–7.36 (m, 1 H, Ar-H), 7.29–7.23 (m, 3 H, Ar-H), 7.18 (d, J = 9.2 Hz, 1 H, Ar-H), 6.50 (d, J = 2.3 Hz, 1 H, Ar-H), 6.36–6.33 (m, 1 H, Ar-H), 3.85 (s, 3 H, OCH_3), 2.30 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 202.42, 166.52, 166.22, 138.08, 135.26, 130.75, 129.82, 127.24, 125.29, 114.02, 107.68, 100.84, 55.64, 19.48 ppm. IR (neat): $\tilde{\nu}$ = 3018, 2969, 2844, 1622, 1505, 1442, 1377, 1344, 1260, 1208, 1165, 1103, 1027, 968, 920, 838, 754, 614 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{15}H_{14}O_3$ [M]$^+$ 242.0943; found 242.0941.

(2-Hydroxy-5-nitrophenyl)(*o*-tolyl)methanone (3.31): White solid (68 mg, 53 %), m.p. 96–98 °C. R_f (10 % ethyl acetate in hexane) = 0.54. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.90 (s, 1 H, Ar-OH), 8.38 (dd, J = 9.2, 3.1 Hz, 1 H, Ar-H), 8.30 (d, J = 3.1 Hz, 1 H, Ar-H), 7.51–7.47 (m, 1 H, Ar-H), 7.39–7.29 (m, 3 H, Ar-H), 7.18 (d, J = 9.2 Hz, 1 H, Ar-H), 2.35 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 203.45, 167.98, 139.58, 136.16, 135.91, 131.57, 131.34, 131.26, 129.81, 127.83, 125.74, 119.54, 118.76, 19.69 ppm. IR (KBr): $\tilde{\nu}$ = 3091, 3024, 2930, 1942, 1633, 1615, 1579, 1519, 1472, 1427, 1339, 1251, 1219, 1159, 1119, 1085, 953, 927, 845, 758, 748, 721, 658, 638 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{14}H_{11}NO_4$ [M]$^+$ 257.0688; found 257.0682.

(5-Chloro-2-hydroxyphenyl)(pyridin-3-yl)methanone (4.1):[16] Yellow solid (107 mg, 92 %), m.p. 138–140 °C. R_f (10 % ethyl acetate in hexane) = 0.20. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.73 (s, 1 H, Ar-OH), 8.92 (d, J = 2.3 Hz, 1 H, Ar-H), 8.85 (dd, J = 4.8, 1.8 Hz, 1 H, Ar-H), 8.0 (td, J = 8.2, 1.8 Hz, 1 H, Ar-H), 7.51–7.47 (m, 3 H, Ar-H), 7.06–7.05 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.42, 161.73, 152.94, 149.70, 136.88, 136.44, 132.99, 131.81, 123.84, 123.45, 120.38, 119.49 ppm. IR (KBr): $\tilde{\nu}$ = 2922, 2848, 2578, 1647, 1593, 1496, 1432, 1289, 1253, 1197, 1117, 1047, 966, 885, 811 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{12}H_8ClNO_2$ [M]$^+$ 233.0244; found 233.0241.

(5-Bromo-2-hydroxyphenyl)(pyridin-3-yl)methanone (4.2):[16] Yellow solid (118 mg, 85 %), m.p. 146–148 °C. R_f (10 % ethyl acetate in hexane) = 0.20. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.76 (s, 1 H, Ar-OH), 8.92 (d, J = 1.8 Hz, 1 H, Ar-H), 8.85 (dd, J = 5.0, 1.8 Hz, 1 H, Ar-H), 8.01–7.99 (m, 1 H, Ar-H), 7.64–7.61 (m, 2 H, Ar-H), 7.50 (dd, J = 7.8, 5.0 Hz, 1 H, Ar-H), 7.02 (d, J = 8.7 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.37, 162.19, 152.97, 149.72, 139.66, 136.46, 134.83, 132.99, 123.49, 120.77, 120.15, 110.66 ppm. IR (KBr): $\tilde{\nu}$ = 2922, 2573, 1648, 1591, 1431, 1288, 1254, 1196, 1047, 960, 811, 761, 622, 522 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{12}H_8BrNO_2$ [M]$^+$ 276.9738; found 276.9739.

(3,5-Dichloro-2-hydroxyphenyl)(pyridin-3-yl)methanone (4.3):[16] Yellow solid (56 mg, 42 %), m.p. 122–124 °C. R_f (10 % ethyl acetate in hexane) = 0.20. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 12.21 (s, 1 H, Ar-OH), 8.92 (d, J = 2.0 Hz, 1 H, Ar-H), 8.87 (dd, J = 4.8, 1.6 Hz, 1 H, Ar-H), 8.01 (dt, J = 8.0, 2.0 Hz, 1 H, Ar-H), 7.64 (d, J = 2.5 Hz, 1 H, Ar-H), 7.52 (dd, J = 8.0, 7.8 Hz, 1 H, Ar-H), 7.45 (d, J = 2.5 Hz, 1 H, Ar-H) ppm. ^{13}C NMR (125 MHz, $CDCl_3$): δ = 198.19, 157.46, 153.28, 149.70, 136.57, 136.41, 132.56, 130.43, 124.38, 123.66, 123.58, 119.98 ppm. IR (KBr): $\tilde{\nu}$ = 3435, 3085, 2923, 1657, 1591, 1463, 1406, 1318, 1263, 1239, 1179, 1159, 1051, 979, 873, 832, 764, 707, 670 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{12}H_7Cl_2NO_2$ [M]$^+$ 266.9854; found 266.9851.

(2-Hydroxyphenyl)(pyridin-3-yl)methanone (4.4):[16] Yellow solid (94 mg, 94 %), m.p. 68–70 °C. R_f (10 % ethyl acetate in hexane) = 0.15. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 11.86 (s, 1 H, Ar-OH), 8.92 (d, J = 1.8 Hz, 1 H, Ar-H), 8.82 (dd, J = 4.8, 1.9 Hz, 1 H, Ar-H), 8.01 (td, J = 7.8, 1.8 Hz, 1 H, Ar-H), 7.57–7.53 (m, 2 H, Ar-H), 7.48 (dd, J = 7.4, 5.0 Hz, 1 H, Ar-H), 7.10 (d, J = 8.2 Hz, 1 H, Ar-H), 6.93–6.89 (m, 1 H, Ar-H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 199.29, 163.26, 152.43, 149.71, 137.03, 136.58, 133.63, 133.07, 123.36, 119.07, 118.88, 118.68 ppm. IR (KBr): $\tilde{\nu}$ = 3047, 2926, 1627, 1608, 1584, 1484, 1338, 1308, 1249, 1148, 935, 160, 709, 658 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{12}H_9NO_2$ [M]$^+$ 199.0633; found 199.0623.

***N*-[2-(4-Methoxybenzoyl)phenyl]-4-methylbenzenesulfonamide (5.1):** Colourless solid (158 mg, 83 %), m.p. 128–130 °C. R_f (20 % ethyl acetate in hexane) = 0.3. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.67 (s, 1 H, Ar-NH), 7.77 (d, J = 7.3 Hz, 1 H, Ar-H), 7.52–7.47 (m, 3 H, Ar-H), 7.39 (d, J = 9.2 Hz, 2 H, Ar-H), 7.36–7.34 (m, 1 H, Ar-H), 7.13–7.09 (m, 1 H, Ar-H), 6.98 (d, J = 7.9 Hz, 2 H, Ar-H), 6.86 (d, J = 9.2 Hz, 2 H, Ar-H), 3.88 (s, 3 H, OCH_3), 2.20 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 196.52, 163.43, 143.48, 138.28, 135.75, 133.05, 132.51, 132.23, 129.91, 129.45, 127.50, 127.18, 123.80, 123.59, 113.29, 55.54, 21.37 ppm. IR (neat): $\tilde{\nu}$ = 3251, 2934, 2841, 1629, 1598, 1488, 1390, 1307, 1257, 1162, 1091, 1027, 942, 901762, 690 cm^{-1}. HRMS (ES$^+$): calcd. for $C_{21}H_{19}NNaO_4S$ [M + Na]$^+$ 404.0932; found 404.0930.

***N*-(2-Benzoylphenyl)-4-methylbenzenesulfonamide (5.2):**[11] Colourless solid (148 mg, 84 %), m.p. 124–126 °C. R_f (20 % ethyl acetate

in hexane) = 0.4. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.99 (s, 1 H, Ar-NH), 7.79 (d, J = 8.7 Hz, 1 H, Ar-H), 7.57–7.49 (m, 4 H, Ar-H), 7.42–7.36 (m, 5 H, Ar-H), 7.10 (ddd, J = 7.8, 7.3, 0.9 Hz, 1 H, Ar-H), 7.03 (d, J = 8.2 Hz, 2 H, Ar-H), 2.23 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 198.46, 143.66, 138.95, 137.53, 135.81, 133.74, 133.04, 132.61, 129.81, 129.53, 128.06, 127.20, 126.25, 123.42, 123.11, 21.38 ppm. IR (neat): $\tilde{\nu}$ = 3251, 3063, 2954, 1634, 1599, 1578, 1489, 1450, 1393, 1340, 1259, 1167, 1091, 945, 901, 813, 702 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{20}H_{17}NO_3S$ [M]$^+$ 351.0929; found 351.0921.

4-Methyl-*N*-[2-(4-methylbenzoyl)phenyl]benzenesulfonamide (5.3):[11] Colourless solid (157 mg, 86 %), m.p. 126–128 °C. R_f (20 % ethyl acetate in hexane) = 0.4. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 9.89 (s, 1 H, Ar-NH), 7.79–7.77 (m, 1 H, Ar-H), 7.55–7.48 (m, 3 H, Ar-H), 7.37 (dd, J = 7.8, 1.8 Hz, 1 H, Ar-H), 7.29 (d, J = 8.2 Hz, 2 H, Ar-H), 7.19 (d, J = 7.8 Hz, 2 H, Ar-H), 7.11–7.07 (m, 1 H, Ar-H), 7.01 (d, J = 7.8 Hz, 2 H, Ar-H), 2.43 (s, 3 H, CH_3), 2.21 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 197.99, 143.58, 138.70, 135.82, 134.81, 133.43, 132.78, 130.12, 129.50, 128.73, 127.19, 126.75, 123.43, 123.30, 21.65, 21.37 ppm. IR (neat): $\tilde{\nu}$ = 3251, 3062, 2923, 1634, 1603, 1489, 1450, 1391, 1260, 1166, 1091, 941, 902, 814, 760, 727, 569 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{21}H_{19}NO_3S$ [M]$^+$ 365.1086; found 365.1081.

4-Methyl-*N*-{2-[4-(trifluoromethyl)benzoyl]phenyl}-benzenesulfonamide (5.4):[11] Colourless solid (172 mg, 82 %), m.p. 134–136 °C. R_f (20 % ethyl acetate in hexane) = 0.5. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 10.04 (s, 1 H, Ar-NH), 7.80 (d, J = 8.7 Hz, 1 H, Ar-H), 7.67 (d, J = 8.2 Hz, 2 H, Ar-H), 7.60 (d, J = 8.7 Hz, 2 H, Ar-H), 7.57–7.53 (m, 1 H, Ar-H), 7.50 (d, J = 8.3 Hz, 2 H, Ar-H), 7.34 (dd, J = 7.8, 1.8 Hz, 1 H, Ar-H), 7.13–7.07 (m, 3 H, Ar-H), 2.25 (s, 3 H, CH_3) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 197.41, 143.85, 140.67, 139.33, 135.89, 134.48, 133.88 (d, $J_{C,F}$ = 33.4 Hz), 133.03, 129.90, 129.58, 127.27, 125.13 (d, $J_{C,F}$ = 2.9 Hz), 123.46 (q, $J_{C,F}$ = 271.7 Hz), 123.46, 122.85, 21.35 ppm. IR (neat): $\tilde{\nu}$ = 3261, 2925, 1641, 1491, 1409, 1326, 1259, 1167, 1131, 1066, 943, 902, 761, 719, 693, 661 cm^{-1}. HRMS (EI$^+$): calcd. for $C_{21}H_{16}F_3NO_3S$ [M]$^+$ 419.0803; found 419.0809.

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