Copper-Assisted/Copper-Free Synthesis of Functionalized Dibenzo[*b*,*f*]oxepins and Their Analogs *via* a One-Pot Tandem Reaction

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A simple, convenient, and efficient method for the formation of functionalized dibenzo[*b*,*f*]oxepins and their analogs bearing both electron-donating and electron-withdrawing groups has been developed *via* a one-pot cascade reaction. Most starting materials are commercially available 2-(2-hydroxyphenyl)-acetonitriles and 2-haloarylaldehydes. The procedure makes use of Cs_2CO_3 as the base, and DMF as solvent under copper-assisted/copper-free conditions. The reaction has a comprehensive group tolerance for substrates. Most of the reactions were complete within 1 h in good-to-excellent yields, and the reaction temperatures were relatively low. The protocol could be scaled up to grams without lowering the yield. A reaction mechanism was also proposed.

Introduction. – Dibenzo[*b*,*f*]oxepin is an important framework in medicinal chemistry, and its derivatives occur in several medicinally relevant plants [1–6]. The scaffold has attracted considerable attention due to its diverse biological features such as anti-estrogenic [7], antidepressant [7–9], analgesic [10], anti-inflammatory [3][11][12], antipsychotic [12–15], angiotensin II receptor antagonistic [16], antioxidant [17], antimycobacterial [4], antidiabetic [18], and antitumor activities [6], as well as anti-apoptosis [19] properties (*Fig.*). The treatment of progressive neurodegenerative diseases [20] such as *Parkinson*'s and *Alzheimer*'s diseases [21] with synthetic dibenzo[*b*,*f*]oxepine derivatives is of particular interest.

Considerable efforts have been made to synthesize the dibenzo[*b*,*f*]oxepin skeleton since the report of *Manske* and *Ledingham* [22][23]. The most widely applied approaches to the synthesis of the scaffold involved constructing substrates in multiple steps *via* the *Ullmann* coupling reaction and the *Friedel–Crafts* reaction (*Scheme 1*, *Examples A* [17] and *B* [10][11][20][24]), but the total yields were not satisfying. *Yang et al.* reported a method *via* benzoin condensation to prepare dibenzo[*b*,*f*]oxepine by using the hypertoxic reagent KCN, and obtained the product in low yield (22–25%) [25]. Another reported strategy for the formation of this fused seven-membered ring involved the *Wagner–Meerwein* rearrangement of a number of structurally diverse 9-(1-hydroxyalkyl)xanthenes (*Scheme 1*, *Example C* [26]). This procedure required 3–5 wt-equiv. of P_2O_5, toxic benzotrifluoride as the solvent, and a long reaction time (24–96 h) at reflux temperature and gave the products generally in low-to-moderate yields (20–56%). Recently, *Cong et al.* reported a Mn^{III}-based oxidative 1,2-radical rearrangement to form dibenzo[*b*,*f*]oxepins by using a large excess of $Mn(OAc)_3$ (4 mol-equiv.) in boiling glacial AcOH in moderate yields as well [27]. In 2001, *Chernysheva et al.* [28] reported a one-pot procedure to prepare NO_2-substituted dibenz[*b*,*f*]ox-

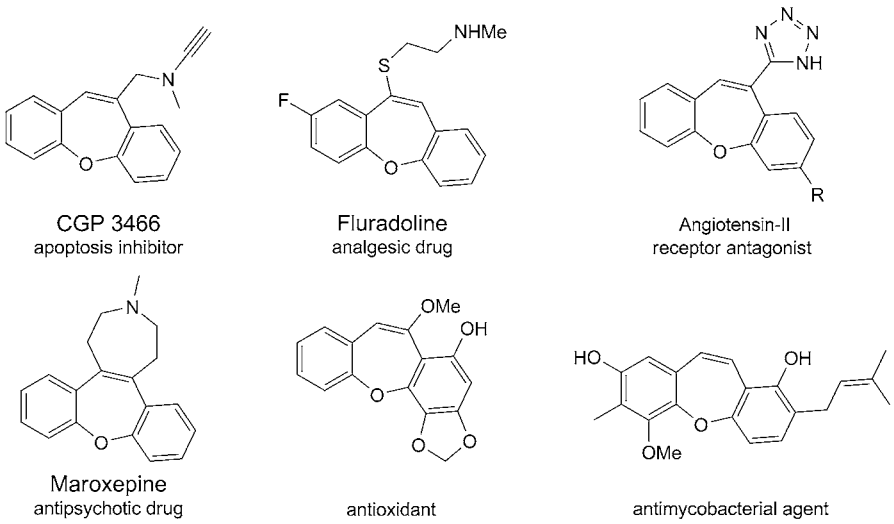


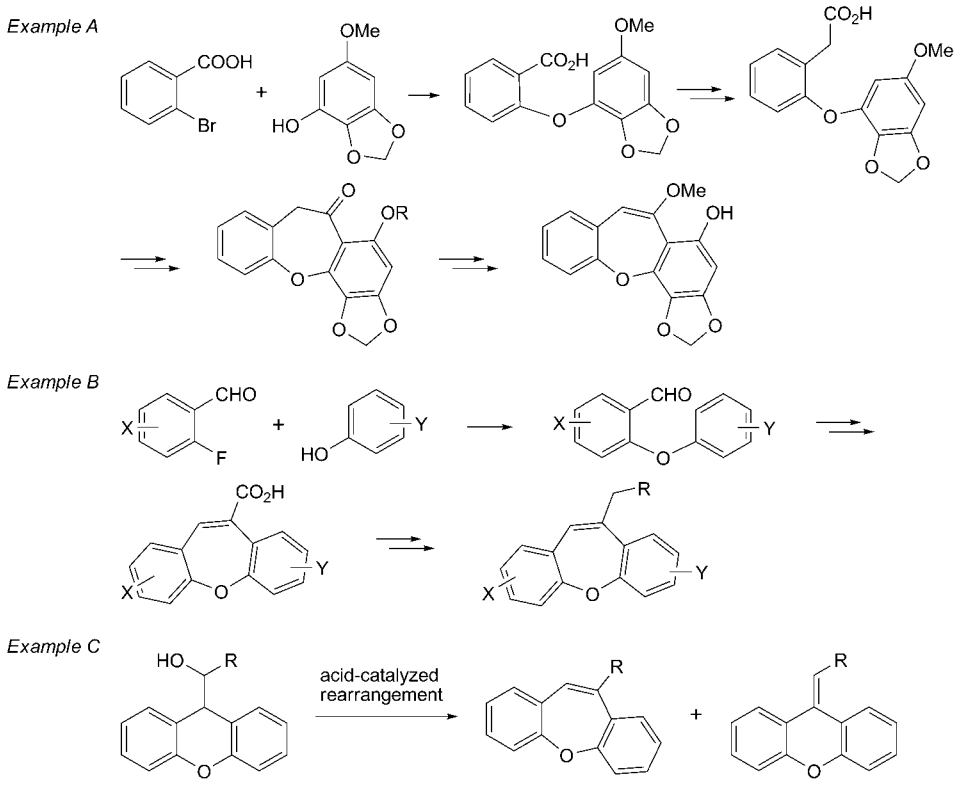
Figure. *Pharmacologically active dibenzo[*b,f*]oxepins*

epines. However, this method involved explosive 2,4,6-trinitrotoluene as the starting reagent. These existing methods have some inherent disadvantages, *i.e.*, *i*) multiple synthetic steps, *ii*) low total yields, *iii*) harsh and not environment-friendly conditions, and *iv*) long reaction times, and they cannot provide fast and efficient access to a library of functionalized dibenzo[*b*,*f*]oxepins and thus limit the molecular diversity for lead optimization and drug screening. Considering the promising biological activities of dibenzo[*b*,*f*]oxepins, a facile, practical, and versatile method that enables quick access to dibenzo[*b*,*f*]oxepins is highly desirable.

Here, we report a convenient method for preparing dibenzo[*b*,*f*]oxepins with various functional groups *via* a one-pot cascade reaction in good-to-excellent yields under Cu-assisted as well as Cu-free conditions.

Results and Discussion. – We started with commercially available 2-bromobenzaldehyde (**2a**) and 2-(2-hydroxyphenyl)acetonitrile (**1a**), which was prepared from 2-(2-methoxyphenyl)acetonitrile by deprotection of the methyl ether group with BBr_3 [29], as the model reaction. First, the reaction was catalyzed by CuI in dioxane and K_2CO_3 as the base at 100° (*Table 1*, *Entry 1*). The desired compound **3a** was obtained only in 20% yield. When DMF was used as the solvent, the reaction proceeded smoothly, resulting in an 88% yield (*Table 1*, *Entry 2*). Next, the bases were investigated. As shown in *Table 1*, the reaction went well with Cs_2CO_3, and the yield of **3a** was quite high (*Entry 6*). The yield was lower when DBU (=1,8-diazabicyclo[5.4.0]undec-7-ene) was used as base (*Table 1*, *Entry 5*), and the reaction was not complete at 100° after 5 h. With a prolonged time (12 h) and higher temperature (150°), the reaction afforded **3a** in 61% yield. The reaction did not work when EtONa and DMAP (=4-(dimethylamino)pyridine) were used as bases (*Table 1*, *Entries 3* and *4*). Then, the loading of CuI was investigated. When the reaction was conducted in the presence of an increased

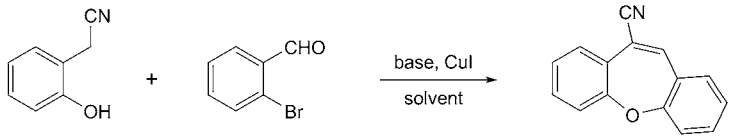
Scheme 1. *Reported Synthesis of Dibenzo[*b,f*]oxepins*



amount of CuI, the yield did not improve (*Table 1*, *Entry 7*). When the amount of CuI was decreased to 0.05 equiv. (*Table 1*, *Entry 8*), a comparable yield was obtained. To our delight, 0.01 equiv. of CuI (*Table 1*, *Entry 9*) was as effective without a prolonged reaction time. The reaction was also studied under a Cu-free condition (*Table 1*, *Entry 14*). Although **3a** was obtained in 60% yield, the starting material was not completely consumed, and the yield decreased with prolonged time. Next, the amount of base was explored. By decreasing the amount of Cs_2CO_3 (*Table 1*, *Entries 10* and *11*), a slightly lower yield of **3a** was obtained. Finally, when the reaction temperature was raised to 120°, the reaction was complete within 1 h, but the yield decreased (*Table 1*, *Entry 12*). The yield of **3a** was only 66% when the reaction was conducted at 80° (*Table 1*, *Entry 13*).

Under the optimal reaction conditions (0.01 equiv. of CuI, 3 equiv. of Cs_2CO_3, DMF, 100°, 1 h), we investigated the scope and limitations of the reaction employing a variety of *ortho*-haloarene-carbaldehydes and 2-(2-hydroxyphenyl)acetonitrile (**1a**). As compiled in *Table 2*, a number of 2-bromobenzaldehydes bearing both electron-donating (EDG) and electron-withdrawing groups (EWG) reacted very well. With 2-bromo-3-fluorobenzaldehyde (**2b**), the reaction proceeded smoothly with an excellent yield (*Table 2*, *Entry 1*). The effect of substitutions at C(4) of 2-bromobenzaldehyde

Table 1. *Optimization of the Reaction Conditions*[a])



1a **2a** **3a**

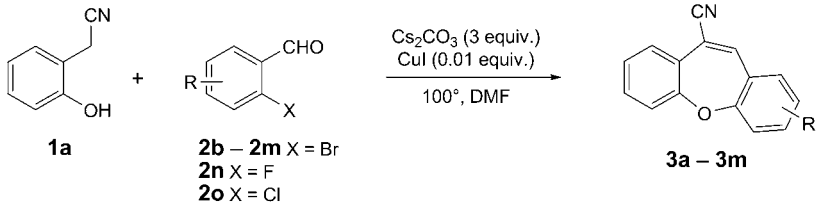
Entry	Base	CuI	Solvent	Time [h]	Temp. [°]	Yield [%][b])
1	K_2CO_3 (3 equiv.)	0.1 equiv.	Dioxane	1	100	20
2	K_2CO_3 (3 equiv.)	0.1 equiv.	DMF	1	100	88
3	EtONa (3 equiv.)	0.1 equiv.	DMF	1	100	0
4	DMAP (3 equiv.)	0.1 equiv.	DMF	1	100	0
5[c])	DBU (3 equiv.)	0.1 equiv.	DMF	17	100–150	61
6	Cs_2CO_3 (3 equiv.)	0.1 equiv.	DMF	1	100	89
7	Cs_2CO_3 (3 equiv.)	0.3 equiv.	DMF	1	100	87
8	Cs_2CO_3 (3 equiv.)	0.05 equiv.	DMF	1	100	86
9	**Cs_2CO_3 (3 equiv.)**	**0.01 equiv.**	**DMF**	**1**	**100**	**92**
10	Cs_2CO_3 (2 equiv.)	0.01 equiv.	DMF	1	100	84
11	Cs_2CO_3 (1.2 equiv.)	0.01 equiv.	DMF	1	100	84
12	Cs_2CO_3 (3 equiv.)	0.01 equiv.	DMF	1	120	75
13	Cs_2CO_3 (3 equiv.)	0.01 equiv.	DMF	1	80	66
14[d])	Cs_2CO_3 (3 equiv.)	0	DMF	1	100	60

[a]) Reaction conditions: **1a** (70 mg, 0.52 mmol), **2a** (93 mg, 0.5 mmol), solvent (8 ml). [b]) Yield of isolated **3a**. [c]) The reaction required a prolonged time (17 h) and higher temperature (150°) to complete. [d]) The amount of product decreased with a prolonged reaction time.

was then studied. A Me or MeO group had similar effects (*Table 2*, *Entries 2* and *3*). The substrate with an EDG such as MeO at C(5) (*Table 2*, *Entry 4*) gave an excellent yield, and the same results were obtained with an EWG at C(5) (*Table 2*, *Entries 5* and *6*). However, **2h** with the potent EWG CF_3 group at C(5) gave a slightly lower yield (*Table 2*, *Entry 7*), as did the electron-deficient 2-bromonicotinaldehyde (**2l**; *Table 2*, *Entry 11*). The polysubstituted 2-bromo-4,5-dimethoxybenzaldehyde (**2i**) was also a suitable substrate, and the reaction could be scaled up to grams without lowering the yields (*Table 2*, *Entry 8*). The bulky 1-bromonaphthalene-2-carbaldehyde (**2k**) reacted just as well under the standard conditions as the other substrates (*Table 2*, *Entry 10*). To our delight, the reaction of the electron-rich heterocyclic 3-bromothiophene-2-carbaldehyde (**2m**) also went smoothly and gave a high yield of **3m** (*Table 2*, *Entry 12*). Moreover, 2-fluoro- and 2-chlorobenzaldehydes (**2n** and **2o**, resp.) were also tested as the substrates to react with **1a**, and the yields were 76 (*Table 2*, *Entry 13*) and 61% (*Table 2*, *Entry 14*), respectively.

After having investigated the scope for *ortho*-haloarene-carbaldehydes, we then studied the reactions of 2-(2-hydroxyphenyl)acetonitriles. Both substrates with EDGs and EWGs, such as 2-(2-hydroxy-3-methoxyphenyl)acetonitrile (**1b**), 2-[2-hydroxy-4-(trifluoromethyl)phenyl]acetonitrile (**1c**), and 2-(5-bromo-2-hydroxyphenyl)acetonitrile (**1d**), were tested under the optimal reaction conditions (*Table 3*). Most reactions proceeded with high yields. When **1b** was used as the substrate, the structurally

Table 2. *One-Pot Cascade Reaction of 2-(2-Hydroxyphenyl)acetonitrile* (**1a**) *with Various* ortho-*Haloarene-carbaldehydes*[a])



1a **2b** – **2m** X = Br, **2n** X = F, **2o** X = Cl **3a** – **3m**

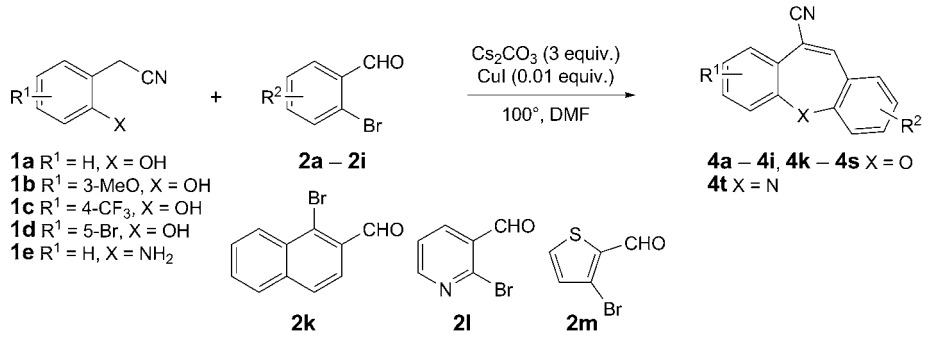
Entry	Substrate	Carbaldehyde		Product	Yield [%][b])
		R	X		
1	**2b**	3-F	Br	**3b**	98
2	**2c**	4-Me	Br	**3c**	86
3	**2d**	4-MeO	Br	**3d**	93
4	**2e**	5-MeO	Br	**3e**	98
5	**2f**	5-F	Br	**3f**	92
6	**2g**	5-Cl	Br	**3g**	95
7	**2h**	5-CF_3	Br	**3h**	79
8[c])	**2i**	4,5-$(MeO)_2$	Br	**3i**	98
9	**2j**	4,5-Dioxole	Br	**3j**	98
10	**2k**	1-Bromonaphthalene-2-carbaldehyde		**3k**	94
11	**2l**	2-Bromopyridine-3-carbaldehyde		**3l**	65
12	**2m**	3-Bromothiophene-2-carbaldehyde		**3m**	81
13	**2n**	H	F	**3a**	76
14	**2o**	H	Cl	**3a**	61

[a]) Reaction conditions: **1a** (70 mg, 0.53 mmol), **2b**–**2m** (0.50 mmol), Cs_2CO_3 (488 mg, 1.5 mmol), CuI (1 mg, 0.005 mmol), DMF (8 ml), reaction time (most of the reaction were complete within 1 h). [b]) Yield of isolated **3**. [c]) The reaction was scaled up to grams (**1a** (1.33 g, 10 mmol), **2i** (2.45 g, 10 mmol), Cs_2CO_3 (9.78 g, 30 mmol), CuI (20 mg, 0.1 mmol), and DMF (20 ml)); 97%.

hindered MeO group of **1b** led to a decrease in the yields of the product compared with the corresponding product of **1a** (compounds **4a**–**4e**, **4h**, **4i**, and **4k** *vs.* compounds **3a**–**3e**, **3h**, **3i**, and **3k**), except for **4f**, **4g**, **4l**, and **4m**. Yields of **4f**, **4g**, and **4m** were slightly higher than those of **3f**, **3g**, and **3m**, but the yield of **4l** (92%) was dramatically higher than that of **3l** (65%). When **1c** was treated with various 2-bromobenzaldehydes, the EWG CF_3 of **1c** also led to a decrease in the yields (compounds **4n**, **4o**, and **4p** *vs.* compounds **3a**, **3g**, and **3e**). In the case of **1d**, substituted 2-bromobenzaldehydes, **2g** and **2e**, gave higher yields than 2-bromobenzaldehyde (*Table 3*, *Entries 17* and *18 vs. Entry 16*). Furthermore, 2-bromobenzaldehyde with a 5-MeO group (*Table 3*, *Entry 15*) underwent the reaction in excellent yield (95%), while 2-bromobenzaldehyde with a 5-Cl group led to a decreased yield (*Table 3*, *Entries 14 vs. 13*). As 2-(2-aminophenyl)acetonitrile (**1d**) is an analog of **1a**, **1d** was treated with 2-bromobenzaldehyde under the standard conditions without any optimization, to give the corresponding product in only 21% yield (*Table 3*, *Entry 19*).

We also tried another strategy to construct dibenzo[*b*,*f*]oxepin under the same conditions (0.01 equiv. of CuI, 3 equiv. of Cs_2CO_3, DMF, 100°, 1 h; *Scheme 2*).

Table 3. *One-Pot Cascade Reaction of 2-(*ortho-*Hydroxy*/ortho-*Aminophenyl)acetonitriles with Substituted 2-Bromobenzaldehydes*[a])

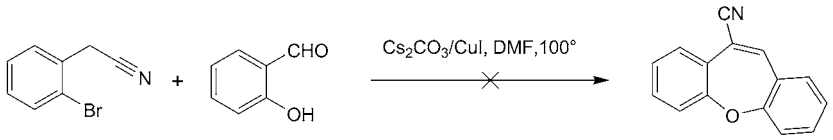


Entry	**1**	R^1	X	**2**	R^2	Product	Yield [%][b])
1	**b**	3-MeO	OH	**a**	H	**4a**	87
2	**b**	3-MeO	OH	**b**	3-F	**4b**	83
3	**b**	3-MeO	OH	**c**	4-Me	**4c**	80
4	**b**	3-MeO	OH	**d**	4-MeO	**4d**	71
5	**b**	3-MeO	OH	**e**	5-MeO	**4e**	90
6	**b**	3-MeO	OH	**f**	5-F	**4f**	98
7	**b**	3-MeO	OH	**g**	5-Cl	**4g**	97
8	**b**	3-MeO	OH	**h**	5-CF_3	**4h**	70
9	**b**	3-MeO	OH	**i**	4,5-$(MeO)_2$	**4i**	83
10	**b**	3-MeO	OH	**k**		**4k**	80
11	**b**	3-MeO	OH	**l**		**4l**	92
12	**b**	3-MeO	OH	**m**		**4m**	95
13	**c**	4-CF_3	OH	**a**	H	**4n**	72
14	**c**	4-CF_3	OH	**g**	5-Cl	**4o**	63
15	**c**	4-CF_3	OH	**e**	5-MeO	**4p**	95
16	**d**	5-Br	OH	**a**	H	**4q**	79
17	**d**	5-Br	OH	**g**	5-Cl	**4r**	92
18	**d**	5-Br	OH	**e**	5-MeO	**4s**	86
19	**e**	H	NH_2	**a**	H	**4t** [30]	21

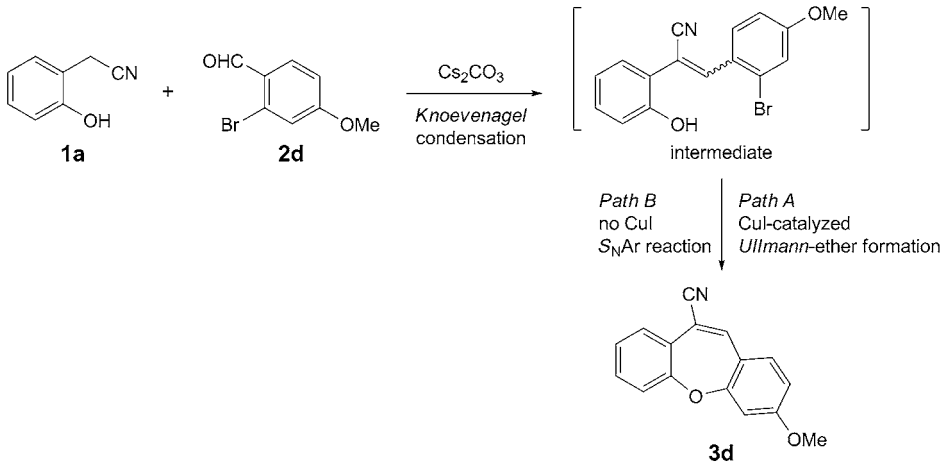
[a]) Reaction conditions: **1a**–**1d** (0.53 mmol), **2a**–**2m** (0.50 mmol), Cs_2CO_3 (488 mg, 1.5 mmol), CuI (1 mg, 0.005 mmol), and DMF (8 ml). [b]) Yield of isolated **4**.

Unfortunately, we did not obtain any desired product. This can be explained by the mechanism of the reaction. We presumed that the cascade includes two steps: the first step is a *Knoevenagel* condensation, followed by the *Ullmann* ether formation (*Scheme 3*). This was established by formation of the same intermediates, as revealed by LC/MS, under Cu-assisted and Cu-free conditions. The intermediate in the formation of **3d** was confirmed by ^{1}H- and ^{13}C-NMR, and MS data (*Scheme 3*). This intermediate could be converted to compound **3d** *via* cyclization in two pathways. When CuI was present, *Ullmann* ether formation occurred subsequently (*Path A*), or the aromatic nucleophilic substitution reaction (*Path B*) would occur to give **3d** under Cu-free condition. However, *Path A* gave **3d** with a preponderant high yield (92%; 56%

Scheme 2. *Another Strategy to Form Dibenzo[*b,f*]oxepin*



Scheme 3. *Proposed Reaction Mechanism*



for *Path B*; *Table 1*, *Entries 9* and *14*). When salicylaldehyde was used as the substrate in the presence of the base, the phenoxy anion decreased the activity of aldehyde, and *Knoevenagel* condensation could not occur under our conditions.

Conclusions. – We have developed a simple and efficient method for the synthesis of the pharmacologically important dibenzo[*b*,*f*]oxepin scaffold *via* Cu-assisted/Cu-free one-pot tandem reaction. Various substituted 2-(2-hydroxyphenyl)acetonitriles and substituted 2-haloarene-carbaldehydes are tolerated well in the reaction. By this procedure, a library of functionalized dibenzo[*b*,*f*]oxepins was achieved quickly with good-to-excellent yields. This approach also provides a practical method, because it could be easily scaled up to grams with excellent yields. Further studies for the synthesis of novel dibenzo[*b*,*f*]oxepin analogs and their biological evaluation are currently in progress.

Experiment Part

General. All the reagents, except **1a**, are commercially available, and they were used without further purification. Anal. TLC: *HSGF 254* (0.15–0.2 mm thickness, *Yantai Huiyou Company*, China). Column chromatography (CC): silica gel (200–300 mesh). M.p. *Büchi 510* melting-point apparatus; uncorrected. ^{1}H- and ^{13}C-NMR spectra: *Varian Mercury-300* and/or *Varian Mercury-400* spectrometers; δ in ppm rel. to Me_4Si as internal standard, J in Hz. LR- and HR-MS: *Finnigan/MAT-95* spectrometer.

2-(2-Hydroxyphenyl)acetonitrile (**1a**) [29]. The corresponding 2-(2-methoxyphenyl)acetonitrile was dissolved in anh. CH_2Cl_2, followed by slowly adding of 4N BBr_3 in CH_2Cl_2 (4–5 equiv.) at 0°. The mixture was stirred at r.t. for a few h, then poured onto crushed ice, and the white precipitate was collected by filtration. The product was obtained as white solid.

General Procedure for **3a**–**3m**, **4a**–**4i**, *and* **4k**–**4s**. To a mixture of **1** (0.53 mmol) and 2-bromobenzaldehyde **2** (0.5 mmol) in a 25-ml two-necked reaction flask were added Cs_2CO_3 (1.5 mmol), CuI (0.005 mmol), and DMF (8 ml). The mixture was degassed with Ar (3×) and then heated at 100° for 0.5–1 h. Most of the reactions were complete within 1 h. Once the reaction was completed (monitored by TLC), the mixture was poured onto crushed ice and then extracted with AcOEt (3×). The combined org. layers were washed with brine and dried (Na_2SO_4). Concentration and purification by CC afforded the products with desirable purities.

3-(2-Bromo-4-methoxyphenyl)-2-(2-hydroxyphenyl)prop-2-enenitrile (the intermediate in *Scheme 3*). Yellow lamellar crystals. M.p. 154–155°. ^{1}H-NMR (300 MHz, (D_6)DMSO): 10.36 (*s*, 1 H); 7.96 (*d*, *J* = 8.8, 1 H); 7.89 (*s*, 1 H); 7.40 (*dd*, *J* = 7.7, 1.5, 1 H); 7.35 (*d*, *J* = 2.6, 1 H); 7.25 (*td*, *J* = 7.8, 1.6, 1 H); 7.13 (*dd*, *J* = 8.8, 2.6, 1 H); 6.97–6.87 (*m*, 2 H); 3.83 (*s*, 3 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 161.44, 155.55, 144.14 (CH); 130.99 (CH); 130.78 (CH); 129.97 (CH); 126.80, 125.60, 121.26, 120.09 (CH); 118.60 (CH); 117.94, 116.82 (CH); 114.54 (CH); 110.70, 56.36 (Me). EI-MS: 329, 331 (40, M^+), 250 (100, $[M - Br]^+$). HR-EI-MS: 329.0033 (M^+, $C_{16}H_{12}BrNO_2^+$; calc. 329.0051).

*Dibenzo[*b,f*]oxepine-10-carbonitrile* (**3a**). Compound **3a** was obtained after the purification by flash chromatography (FC; SiO_2, 200–300 mesh; petroleum ether (PE)/AcOEt 100:1). Yellowish needles. M.p. 159–160° ([31]: 159–160°). IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.92 (*s*, 1 H); 7.60–7.48 (*m*, 4 H); 7.42–7.27 (*m*, 4 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 158.00; 157.22; 143.85; 133.90; 132.85; 131.45; 128.18; 126.55; 126.21; 126.12; 122.54; 121.94; 118.76; 112.75. EI-MS: 219 (M^+, 100). HR-EI-MS: 219.0681 (M^+, $C_{15}H_9NO^+$; calc. 219.0684).

*4-Fluorodibenzo[*b,f*]oxepine-10-carbonitrile* (**3b**). Compound **3b** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). White powder. M.p. 207–208°. IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 8.00 (*s*, 1 H); 7.63–7.49 (*m*, 3 H); 7.44–7.26 (*m*, 4 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 156.98; 153.91 (*d*, *J* = 248, C–F); 144.69 (*d*, *J* = 14, *C*–C–F); 142.95 (*d*, *J* = 4, *C*–C–C–F); 133.18; 130.51; 128.63; 127.06; 126.84 (*d*, *J* = 8, *C*–C–C–F); 126.73 (*d*, *J* = 4, *C*–C–C–C–F); 126.01; 122.46; 120.22 (*d*, *J* = 17.6, *C*–C–F); 118.51; 113.70. EI-MS: 237 (M^+, 100). HR-EI-MS: 237.0593 (M^+, $C_{15}H_8FNO^+$; calc. 237.0590).

*3-Methyldibenzo[*b,f*]oxepine-10-carbonitrile* (**3c**). Compound **3c** was obtained after the purification by FC (SiO_2; PE/AcOEt 70:1). Yellowish powder. M.p. 139–140°. IR (KBr): 2213.88 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.87 (*s*, 1 H); 7.58–7.47 (*m*, 2 H); 7.36 (*m*, 3 H); 7.20 (*s*, 1 H); 7.12 (*d*, *J* = 7.7, 1 H); 2.34 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 157.50; 156.60; 144.35; 143.34; 132.17; 130.77; 127.62; 126.38; 125.99; 125.81; 125.00; 122.07; 121.87; 118.44; 111.30; 20.83. EI-MS: 233 (M^+, 100). HR-EI-MS: 233.0833 (M^+, $C_{16}H_{11}NO^+$; calc. 233.0841).

*3-Methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**3d**). Compound **3d** was obtained after the purification by FC (SiO_2; PE/AcOEt 40:1). Yellowish powder. M.p. 149–150°. IR (KBr): 2211.95 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.81 (*s*, 1 H); 7.55–7.30 (*m*, 5 H); 6.99 (*d*, *J* = 2.2, 1 H); 6.88 (*dd*, *J* = 8.6, 2.4, 1 H); 3.82 (*s*, 3 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 164.39; 159.47; 156.54; 143.70; 132.66; 132.43; 127.92; 126.56; 126.50; 122.69; 120.92; 119.18; 112.41; 109.88; 107.52; 56.33. EI-MS: 249 (M^+, 100). HR-EI-MS: 249.0788 (M^+, $C_{16}H_{11}NO_2^+$; calc. 249.0790).

*2-Methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**3e**). Compound **3e** was obtained after the purification by FC (SiO_2; PE/AcOEt 60:1). Yellowish powder. M.p. 171–172°. IR (KBr): 2210.02 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.86 (*s*, 1 H); 7.58–7.48 (*m*, 2 H); 7.39–7.31 (*m*, 2 H); 7.28 (*d*, *J* = 8.4, 1 H); 7.13–7.06 (*m*, 2 H); 3.74 (*s*, 3 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 157.13; 156.39; 151.27; 143.26; 132.42; 128.29; 127.78; 125.95; 125.63; 122.26; 121.92; 118.72; 118.35; 114.86; 112.66; 55.65. EI-MS: 249 (M^+, 100). HR-EI-MS: 249.0792 (M^+, $C_{16}H_{11}NO_2^+$; calc. 249.0790).

*2-Fluorodibenzo[*b,f*]oxepine-10-carbonitrile* (**3f**). Compound **3f** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). Yellowish powder. M.p. 218–219°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.86 (*s*, 1 H); 7.63–7.47 (*m*, 2 H); 7.47–7.29 (*m*, 5 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 158.86 (*d*, *J* = 243, CF); 156.77; 153.74; 142.03; 132.68; 129.05 (*d*, *J* = 9, C–*C*H–C–F);

127.88; 126.21; 125.42; 123.18 (*d*, *J* = 9, CH–*C*H–C–F); 121.99; 119.72 (*d*, *J* = 24, *C*H–C–F); 118.01; 116.68 (*d*, *J* = 24, *C*H–C–F); 113.54. EI-MS 237 (M^+, 100). HR-EI-MS: 237.0591 (M^+, $C_{15}H_8FNO^+$; calc. 237.0590).

*2-Chlorodibenzo[*b,f*]oxepine-10-carbonitrile* (**3g**). Compound **3g** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). White powder. M.p. 197–198°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.86 (*s*, 1 H); 7.63–7.50 (*m*, 4 H); 7.42–7.33 (*m*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.59; 156.23; 141.86; 132.76; 132.72; 130.11; 129.65; 129.32; 127.92; 126.32; 125.37; 123.31; 122.08; 117.98; 113.60. EI-MS: 253 (M^+, 100). HR-EI-MS: 253.0302 (M^+, $C_{15}H_8ClNO^+$; calc. 253.0294).

*2-(Trifluoromethyl)dibenzo[*b,f*]oxepine-10-carbonitrile* (**3h**). Compound **3h** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). White powder. M.p. 107–108°. IR (KBr): 2223.52 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.99–7.89 (*m*, 3 H); 7.63–7.52 (*m*, 3 H); 7.47–7.35 (*m*, 2 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 160.58; 156.77; 142.43 (CH); 133.36 (CH); 130.65 (*d*, *J* = 2.5, *C*H–C–CF_3); 128.95; 128.75 (*d*, *J* = 2.5, *C*H–C–CF_3); 128.48 (CH); 127.05 (CH); 126.68 (*d*, *J* = 33, *C*–CF_3); 125.80; 125.14; 123.25 (CH); 122.98; 122.71 (CH); 118.39. EI-MS: 287 (M^+, 100). HR-EI-MS: 287.0554 (M^+, $C_{16}H_8F_3NO^+$; calc. 287.0558).

*2,3-Dimethoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**3i**). Compound **3i** was obtained after the purification by FC (SiO_2; PE/AcOEt 10:1). Yellow powder. M.p. 157–158°. IR (KBr): 2208.09 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.76 (*s*, 1 H); 7.57–7.45 (*m*, 2 H); 7.40–7.30 (*m*, 2 H); 7.07 (*s*, 1 H); 7.05 (*s*, 1 H); 3.84 (*s*, 3 H); 3.74 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.87; 153.46; 152.38; 146.45; 143.71; 132.37; 127.77; 126.44; 126.30; 122.43; 119.60; 119.12; 112.87; 110.28; 105.86; 56.41; 56.29. EI-MS: 279 (M^+, 100). HR-EI-MS: 279.0905 (M^+, $C_{17}H_{13}NO_3^+$; calc. 279.0895).

*[1,3]Dioxolo[4′,5′:4,5]benzo[1,2-*b*]benzo[*f*]oxepine-10-carbonitrile* (= *1,3,5-Trioxabenzo[4,5]cyclohept[1,2-*f*]indene-10-carbonitrile*; **3j**). Compound **3j** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). Yellow powder. M.p. 199–200°. IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.74 (*s*, 1 H); 7.57–7.45 (*m*, 2 H); 7.33 (*dd*, *J* = 9.0, 3.0, 2 H); 7.08 (*s*, 1 H); 7.02 (*s*, 1 H); 6.11 (*s*, 2 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.14; 153.03; 151.60; 144.96; 143.13; 132.18; 127.28; 126.10; 126.06; 121.90; 120.69; 118.61; 110.25; 108.32; 103.16; 102.71. EI-MS: 263 (M^+, 100). HR-EI-MS: 263.0584 (M^+, $C_{16}H_9NO_3^+$; calc. 263.0582).

*Benzo[*b*]naphtho[2,1-*f*]oxepine-8-carbonitrile* (**3k**). Compound **3k** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). Yellow powder. M.p. 223–224°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 8.67 (*d*, *J* = 7.6, 1 H); 8.07 (*s*, 1 H); 8.01 (*d*, *J* = 7.5, 1 H); 7.83 (*d*, *J* = 8.5, 1 H); 7.77–7.52 (*m*, 6 H); 7.42–7.348 (*t*, *J* = 7.5, 1 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.57; 153.20; 143.76; 135.71; 132.73; 128.39; 127.90; 127.80; 127.60; 126.50; 126.22; 125.12; 123.26; 122.71; 122.17; 118.31; 112.84. EI-MS: 269 (M^+, 100). HR-EI-MS: 269.0839 (M^+, $C_{19}H_{11}NO^+$; calc. 269.0841).

*Benzo[6,7]oxepino[2,3-*b*]pyridine-6-carbonitrile* (= *[1]Benzoxepino[2,3-*b*]pyridine-6-carbonitrile*; **3l**). Compound **3l** was obtained after the purification by FC (SiO_2; PE/AcOEt 5:1). White powder. M.p. 207–208°. IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 8.43 (*d*, *J* = 2.2, 1 H); 8.03 (*d*, *J* = 7.5, 1 H); 7.92 (*s*, 1 H); 7.64–7.53 (*m*, 2 H); 7.45–7.35 (*m*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 161.14; 155.56; 151.70; 141.86; 141.59; 133.34; 128.40; 126.98; 125.48; 123.12; 123.08; 122.77; 118.41; 113.77. EI-MS: 220 (M^+, 100). HR-EI-MS: 220.0633 (M^+, $C_{14}H_8N_2O^+$; calc. 220.0637).

*Benzo[*b*]thieno[2,3-*f*]oxepine-9-carbonitrile* (= *Thieno[3,2-*b*][1]benzoxepine-9-carbonitrile*; **3m**). Compound **3m** was obtained after the purification by FC (SiO_2; PE/AcOEt 5:1). Yellow powder. M.p. 159–160°. IR (KBr): 2213.88 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 8.00 (*d*, *J* = 4.6, 1 H); 7.83 (*s*, 1 H); 7.61–7.43 (*m*, 2 H); 7.40–7.33 (*m*, 1 H); 7.22 (*d*, *J* = 8.1, 1 H); 7.02 (*d*, *J* = 4.7, 1 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 158.10; 156.03; 136.89; 133.42; 132.56; 128.39; 126.23; 126.04; 121.92; 121.72; 121.65; 118.51; 109.41. EI-MS: 225 (M^+, 100). HR-EI-MS: 225.0240 (M^+, $C_{13}H_7NOS^+$; calc. 225.0248).

*6-Methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4a**). Compound **4a** was obtained after the purification by FC (SiO_2; PE/AcOEt 60:1). Yellowish powder. M.p. 171–172°. IR (KBr): 2210.02 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.93 (*s*, 1 H); 7.58–7.48 (*m*, 2 H); 7.33–7.24 (*m*, 4 H); 7.06 (*m*, 1 H); 3.90 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 157.54; 151.89; 144.61; 143.42; 133.24; 130.84; 128.13; 126.85; 126.12; 125.65; 121.69; 118.39; 114.96; 112.35; 56.25. EI-MS: 249 (M^+, 100). HR-EI-MS: 249.0799 (M^+, $C_{16}H_{11}NO_2^+$; calc. 249.0790).

*4-Fluoro-6-methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4b**). Compound **4b** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). Yellowish powder. M.p. 248–249°. IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, $CDCl_3$): 7.46 (*s*, 1 H); 7.28–7.23 (*m*, 1 H); 7.19–7.11 (*m*, 3 H); 7.11–7.05 (*m*, 1 H); 7.02 (*d*, *J* = 7.7, 1 H); 3.96 (*s*, 3 H). ^{13}C-NMR (125 MHz, $CDCl_3$): 155.74 (*d*, *J* = 252, CF); 153.65; 147.51; 147.27 (*d*, *J* = 13.9, *C*–C–F); 143.18 (*d*, *J* = 3.8, CH–CH–*C*H–C–F); 132.17; 128.78; 127.58 (CH); 127.16 (*d*, *J* = 7.6, CH–CH–C–F); 126.69 (*d*, *J* = 3.8, *C*H–C–C–C–F); 121.13 (*d*, *J* = 20.2, *C*H–C–F); 121.15 (CH); 119.80; 116.57; 116.48 (CH); 58.00 (Me). EI-MS: 267 (M^+, 100). HR-EI-MS: 267.0694 (M^+, $C_{16}H_{10}FNO_2^+$; calc. 267.0696).

*6-Methoxy-3-methyldibenzo[*b,f*]oxepine-10-carbonitrile* (**4c**). Compound **4c** was obtained after the purification by FC (SiO_2; PE/AcOEt 20:1). Yellowish powder. M.p. 164–165°. IR (KBr): 2215.81 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.87 (*s*, 1 H); 7.38 (*d*, *J* = 7.7, 1 H); 7.27–7.24 (*m*, 2 H); 7.12 (*s*, 1 H); 7.10 (*d*, *J* = 7.7, 1 H); 7.04 (*m*, 1 H); 3.90 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 157.51; 151.91; 144.54; 144.19; 143.44 (CH); 130.66 (CH); 126.98; 126.40 (CH); 126.09 (CH); 125.44; 122.10 (CH); 118.57; 118.36 (CH); 114.80 (CH); 111.38; 56.28 (Me); 20.93 (Me). EI-MS: 263 (M^+, 100). HR-EI-MS: 263.0949 (M^+, $C_{17}H_{13}NO_2^+$; calc. 263.0946).

*3,6-Dimethoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4d**). Compound **4d** was obtained after the purification by FC (SiO_2; PE/AcOEt 40:1). Yellowish powder. M.p. 173–174°. IR (KBr): 2211.95 (CN). ^{1}H-NMR (400 MHz, (D_6)DMSO): 7.83 (*s*, 1 H); 7.44 (*d*, *J* = 8.7, 1 H); 7.29–7.22 (*m*, 2 H); 7.02 (*dd*, *J* = 6.6, 2.6, 1 H); 6.90 (*dd*, *J* = 8.6, 2.6, 1 H); 6.82 (*d*, *J* = 2.6, 1 H); 3.89 (*s*, 3 H); 3.82 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 163.66; 158.85; 151.97; 143.91; 143.21 (CH); 132.07 (CH); 127.20; 126.16 (CH); 120.91; 118.76; 118.17 (CH); 114.56 (CH); 111.61 (CH); 109.49; 107.34 (CH); 56.24 (Me); 55.81 (Me). EI-MS: 279 (M^+, 100). HR-EI-MS: 279.0888 (M^+, $C_{17}H_{13}NO_3^+$; calc. 279.0895).

*2,6-Dimethoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4e**). Compound **4e** was obtained after the purification by FC (SiO_2; PE/AcOEt 40:1). Yellowish powder. M.p. 167–168°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (400 MHz, (D_6)DMSO): 7.88 (*s*, 1 H); 7.27–7.25 (*m*, 2 H); 7.22 (*d*, *J* = 9.1, 1 H); 7.12–7.03 (*m*, 3 H); 3.89 (*s*, 3 H); 3.74 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.29; 151.76; 151.26; 144.95; 143.28 (CH); 128.61; 126.76; 125.96 (CH); 122.35 (CH); 118.62 (CH); 118.43 (CH); 114.98 (CH); 114.65 (CH); 112.66; 56.22 (Me); 55.64 (Me). EI-MS: 279 (M^+, 100). HR-EI-MS: 279.0904 (M^+, $C_{17}H_{13}NO_3^+$; calc. 279.0895).

*2-Fluoro-6-methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4f**). Compound **4f** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). White powder. M.p. 211–212°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.85 (*s*, 1 H); 7.40–7.23 (*m*, 5 H); 7.08–7.02 (*m*, 1 H); 3.89 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 158.77 (*d*, *J* = 243, C–F); 153.71; 151.80; 144.54; 142.13; 129.40 (*d*, *J* = 9.1, C–*C*H–C–F); 126.59; 126.31; 123.25 (*d*, *J* = 9.1, *C*H–CH–C–F); 119.61 (*d*, *J* = 24.3, *C*H–C–F); 118.50; 118.11; 116.59 (*d*, *J* = 25.2, CH–C–F); 115.29; 113.56; 56.27 (Me). EI-MS: 267 (M^+, 100). HR-EI-MS: 267.0696 (M^+, $C_{16}H_{10}FNO_2^+$; calc. 267.0696).

*2-Chloro-6-methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4g**). Compound **4g** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). Yellowish powder. M.p. 235–236°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.89 (*s*, 1 H); 7.65–7.58 (*m*, 2 H); 7.35–7.28 (*m*, 3 H); 7.10–7.04 (*m*, 1 H); 3.90 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.16; 151.81; 144.35; 141.92 (CH); 132.64 (CH); 130.00 (CH); 129.67; 129.55; 126.54; 126.42 (CH); 123.37 (CH); 118.53 (CH); 118.08; 115.32 (CH); 113.61; 56.29 (Me). EI-MS: 283 (M^+, 100). HR-EI-MS: 283.0402 (M^+, $C_{16}H_{10}ClNO_2^+$; calc. 283.0400).

*6-Methoxy-2-(trifluoromethyl)dibenzo[*b,f*]oxepine-10-carbonitrile* (**4h**). Compound **4h** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). White powder. M.p. 180–181°. IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.97 (*s*, 1 H); 7.93 (*s*, 1 H); 7.88 (*dd*, *J* = 8.3, 1 H); 7.47 (*d*, *J* = 8.4, 1 H); 7.31–7.27 (*m*, 2 H); 7.10–7.02 (*m*, 1 H); 3.90 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 160.01; 151.89; 144.00; 141.96; 130.00 (*d*, *J* = 3.0, *C*H–C–CF_3); 128.82; 128.14 (*d*, *J* = 4.0, *C*H–C–CF_3); 126.66; 126.38 (*d*, *J* = 32, *C*–CF_3); 126.51; 123.59 (*d*, *J* = 270, CF_3); 122.84; 118.57; 117.98; 115.47; 113.89; 56.33 (Me). EI-MS: 317 (M^+, 100). HR-EI-MS: 317.0663 (M^+, $C_{17}H_{10}F_3NO_2^+$; calc. 317.0664).

*2,3,6-Trimethoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4i**). Compound **4i** was obtained after the purification by FC (SiO_2; PE/AcOEt 10:1). Yellow powder. M.p. 208–209°. IR (KBr): 2211.95 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.79 (*s*, 1 H); 7.28–7.24 (*m*, 2 H); 7.11 (*s*, 1 H); 7.04–7.00 (*m*, 1 H); 6.87 (*s*, 1 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 152.87; 151.90; 151.84; 146.10; 144.41; 143.36 (CH);

127.19; 125.99 (CH); 119.66; 118.82; 118.17 (CH); 114.66 (CH); 112.35 (CH); 109.99; 105.32 (CH); 56.29 (Me); 55.92 (Me); 55.92 (Me). EI-MS: 309 (M^+, 100). HR-EI-MS: 309.0998 (M^+, $C_{18}H_{15}NO_4^+$; calc. 309.1001).

*12-Methoxybenzo[*b*]naphtho[2,1-*f*]oxepine-8-carbonitrile* (**4k**). Compound **4k** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). Yellow power. M.p. 172–173°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 9.03 (*d*, *J* = 8.4, 1 H); 8.00 (*s*, 1 H); 7.95 (*d*, *J* = 8.4, 1 H); 7.80 (*d*, *J* = 8.5, 1 H); 7.73–7.63 (*m*, 2 H); 7.51 (*d*, *J* = 8.5, 1 H); 7.32–7.28 (*m*, 2 H); 7.12–7.05 (*m*, 1 H); 3.96 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 154.44; 151.91; 145.61; 144.25 (CH); 135.74; 128.35 (CH); 127.46 (CH); 127.35; 126.98 (CH); 126.83; 126.66 (CH); 126.53 (CH); 125.26 (CH); 123.99 (CH); 123.54; 118.72 (CH); 118.47; 115.17 (CH); 113.00; 56.16 (Me). EI-MS: 299 (M^+, 100). HR-EI-MS: 299.0948 (M^+, $C_{20}H_{13}NO_2^+$; calc. 299.0946).

*10-Methoxybenzo[6,7]oxepino[2,3-*b*]pyridine-6-carbonitrile* (=*10-Methoxy[1]benzoxepino[2,3-*b*]pyridine-6-carbonitrile*; **4l**). Compound **4l** was obtained after the purification by FC (SiO_2; PE/AcOEt 5:1). Yellowish powder. M.p. 152–153°. IR (KBr): 2221.59 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 8.44 (*d*, *J* = 4.0, 1 H); 8.04 (*d*, *J* = 7.4, 1 H); 7.92 (*s*, 1 H); 7.45 (*t*, *J* = 6.0, 1 H); 7.33 (*d*, *J* = 4.2, 2 H); 7.10 (*m*, 1 H); 3.90 (*s*, 3 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 161.61; 152.70; 151.52 (CH); 144.10; 142.06 (CH); 141.50 (CH); 127.13 (CH); 126.66; 123.10; 122.97 (CH); 119.16 (CH); 118.55; 116.21 (CH); 113.90; 56.81 (Me). EI-MS: 250 (M^+, 100) HR-EI-MS: 250.0736 (M^+, $C_{15}H_{10}N_2O_2^+$; calc. 250.0742).

*5-Methoxybenzo[*b*]thieno[2,3-*f*]oxepine-9-carbonitrile* (=*5-Methoxythieno[3,2-*b*][1]benzoxepine-9-carbonitrile*; **4m**). Compound **4m** was obtained after the purification by FC (SiO_2; PE/AcOEt 5:1). Yellow powder. M.p. 180–181°. IR (KBr): 2211.95 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.95 (*d*, *J* = 5.4, 1 H); 7.86 (*d*, *J* = 0.5, 1 H); 7.34–7.25 (*m*, 2 H); 7.07–6.99 (*m*, 1 H); 6.96 (*dd*, *J* = 5.4, 0.5, 1 H); 3.87 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 158.25; 151.64; 144.11; 137.01 (CH); 133.41 (CH); 127.38; 126.30 (CH); 122.48; 121.55 (CH); 119.06 (CH); 118.65; 115.42 (CH); 109.54; 56.28 (Me). EI-MS: 255 (M^+, 100). HR-EI-MS: 255.0354 (M^+, $C_{14}H_9NO_2S^+$; calc. 255.0354).

*7-(Trifluoromethyl)dibenzo[*b,f*]oxepine-10-carbonitrile* (**4n**). Compound **4n** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). Yellow powder. M.p. 108–110°. IR (KBr): 2219.67 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 8.10–8.01 (*m*, 1 H); 7.88–7.68 (*m*, 3 H); 7.66–7.46 (*m*, 3 H); 7.42–7.30 (*m*, 1 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 157.16; 156.57; 145.50 (CH); 138.35; 133.99 (CH); 132.08 (*d*, *J* = 32, *C*–CF_3); 131.31 (CH); 129.74; 129.00 (CH); 126.02 (*d*, *J* = 273, CF_3); 126.17 (CH); 122.87 (*d*, *J* = 3, *C*H–C–CF_3); 121.69 (CH); 119.36 (*C*H–C–CF_3); 117.86; 114.52. EI-MS: 287 (M^+, 100). HR-EI-MS: 287.0554 (M^+, $C_{16}H_8F_3NO^+$; calc. 287.0558).

*2-Chloro-7-(trifluoromethyl)dibenzo[*b,f*]oxepine-10-carbonitrile* (**4o**). Compound **4o** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). Yellow powder. M.p. 176–177°. IR (KBr): 2221.59 (CN). ^{1}H-NMR (400 MHz, (D_6)DMSO): 8.02 (*s*, 1 H); 7.89 (*s*, 1 H); 7.76–7.73 (*m*, 2 H); 7.69–7.64 (*m*, 2 H); 7.52 (*d*, *J* = 8.3, 1 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 161.59; 161.03; 149.21 (CH); 138.52 (CH); 137.52 (*d*, *J* = 32, C–CF_3); 135.59 (CH); 135.28; 134.62; 134.41 (CH); 134.14; 128.43 (*d*, *J* = 271, CF_3); 128.77 (CH); 128.32 (*d*, *J* = 4.0, CH–C–CF_3); 124.65 (*d*, *J* = 4.0, CH–C–CF_3); 122.78; 117.65. EI-MS: 321 (M^+, 100). HR-EI-MS: 321.0159 (M^+, $C_{16}H_7ClF_3NO^+$; calc. 321.0168).

*2-Methoxy-7-(trifluoromethyl)dibenzo[*b,f*]oxepine-10-carbonitrile* (**4p**). Compound **4p** was obtained after the purification by FC (SiO_2; PE/AcOEt 50:1). Yellowish powder. M.p. 181–182°. IR (KBr): 2221.59 (CN). ^{1}H-NMR (400 MHz, (D_6)DMSO): 8.02 (*s*, 1 H); 7.83 (*s*, 1 H); 7.75–7.68 (*m*, 2 H); 7.40 (*d*, *J* = 8.8, 1 H); 7.16 (*dd*, *J* = 8.8, 3.1, 1 H); 7.12 (*d*, *J* = 3.1, 1 H); 3.75 (*s*, 3 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 156.92; 156.67; 150.83; 145.38 (CH); 132.10 (*d*, *J* = 33, *C*–CF_3), 129.69; 129.06 (CH); 127.94; 123.32 (*d*, *J* = 272, CF_3); 122.74 (*d*, *J* = 3.0, *C*H–C–CF_3); 122.51 (CH); 119.25 (CH); 119.17 (*d*, *J* = 3.0, *C*H–C–CF_3); 117.89; 115.15 (CH); 111.51; 55.71 (Me). EI-MS: 317 (M^+, 100). HR-EI-MS: 317.0656 (M^+, $C_{17}H_{10}F_3NO_2^+$; calc. 317.0664).

*8-Bromodibenzo[*b,f*]oxepine-10-carbonitrile* (**4q**). Compound **4q** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). Light yellow powder. M.p. 172–173°. ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.98 (*s*, 1 H); 7.72 (*dd*, *J* = 8.6, 2.4, 1 H); 7.61–7.53 (*m*, 2 H); 7.51 (*dd*, *J* = 7.7, 1.3, 1 H); 7.39–7.33 (*m*, 2 H); 7.31 (*td*, *J* = 7.6, 1.2, 1 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 157.79; 156.44; 145.19 (CH); 135.44 (CH); 134.31 (CH); 131.74 (CH); 130.34 (CH); 128.33; 127.96; 126.53 (CH); 124.82 (CH);

122.01 (CH); 118.42; 111.46. EI-MS: 297, 299 (M^+, 100). HR-EI-MS: 296.9789 (M^+, $C_{15}H_8BrNO^+$; calc. 296.9789).

*8-Bromo-2-chlorodibenzo[*b,f*]oxepine-10-carbonitrile* (**4r**). Compound **4r** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). White powder. M.p. 194–195°. ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.92 (*s*, 1 H); 7.75 (*dd*, *J* = 8.1, 1.8, 1 H); 7.65–7.57 (*m*, 3 H); 7.43–7.35 (*m*, 2 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 156.47; 156.27; 143.68 (CH); 135.77 (CH); 133.64 (CH); 130.83 (CH); 130.53 (CH); 130.42; 129.54; 128.00; 124.84 (CH); 123.88 (CH); 118.68; 118.12; 112.76. EI-MS: 331, 333 (M^+, 100). HR-EI-MS: 330.9399 (M^+, $C_{15}H_7BrClNO^+$; calc. 330.9400).

*8-Bromo-2-methoxydibenzo[*b,f*]oxepine-10-carbonitrile* (**4s**). Compound **4s** was obtained after the purification by FC (SiO_2; PE/AcOEt 100:1). Light yellow powder. M.p. 175–176°. ^{1}H-NMR (300 MHz, (D_6)DMSO): 7.91 (*s*, 1 H); 7.71 (*dd*, *J* = 8.6, 2.3, 1 H); 7.56 (*d*, *J* = 2.3, 1 H); 7.33 (*d*, *J* = 8.6, 1 H); 7.28 (*d*, *J* = 8.7, 1 H); 7.10 (*m*, 2 H); 3.72 (*s*, 3 H). ^{13}C-NMR (125 MHz, (D_6)DMSO): 157.04; 156.77; 151.45; 145.03 (CH); 135.44 (CH); 130.37 (CH); 128.49; 128.26; 124.64 (CH); 122.78 (CH); 119.53 (CH); 118.41; 118.22; 115.57 (CH); 111.78; 56.17 (Me). EI-MS: 327, 329 (M^+, 100). HR-EI-MS: 326.9896 (M^+, $C_{16}H_{11}BrNO_2^+$; calc. 326.9895).

*5*H-*Dibenzo[*b,f*]azepine-10-carbonitrile* (**4t**) [30]. Compound **4t** was obtained after the purification by FC (SiO_2; PE/AcOEt 3:1). Brown powder. M.p. 218–219°. IR (KBr): 2217.74 (CN). ^{1}H-NMR (300 MHz, (D_6)DMSO): 12.61 (*s*, 1 H); 8.03–7.96 (*m*, 2 H); 7.67–7.51 (*m*, 5 H); 7.33 (*td*, *J* = 7.2, 1.1, 1 H); 7.26 (*td*, *J* = 7.2, 1.1, 1 H). ^{13}C-NMR (100 MHz, (D_6)DMSO): 144.74; 135.51; 129.98 (CH); 129.33 (CH); 129.33 (CH); 129.33; 128.26; 126.97 (CH); 126.97 (CH); 123.93 (CH); 122.05 (CH); 118.37 (CH); 117.00; 112.66 (CH). EI-MS: 218 (M^+, 100). HR-EI-MS: 218.0846 (M^+, $C_{15}H_{10}N_2^+$; calc. 218.0844).

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