Synthesis of 5′-bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone from *Garcinia nervosa* and of its isomer 3′-bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone

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The unambiguous syntheses of the naturally occurring 5′-bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone **1**, a constituent of *Garcinia nervosa*, and its positional isomer 3′-bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone **6** are described.

Keywords: *Garcinia*, bromochalcone, phloroacetophenone

Garcinia species have well known medicinal properties such as antimicrobial,[1] anti-inflammatory,[2] and are used in healing skin infections and wounds.[3] Ilyas, *et al.*[4] isolated a new bromochalcone from the leaves of *Garcinia nervosa* and assigned structure 5′-bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone **1** on the basis of its spectral data. In its ^{1}H NMR data, the assignment of a two proton singlet at δ 7.89 for the *trans*-α, β-olefinic protons appeared to be rather unusual although such an observation has been made earlier for 2′-hydroxy-4,4′,6′-trimethoxychalcone[5] and a bichalcone.[6] The simple structure and lack of any report of its synthesis prompted us to synthesise the bromochalcone **1**. Our retrosynthesis of **1** is depicted in Scheme 1.

2′-Hydroxy-4′,6′-dimethoxyacetophenone **3** was prepared from phloroglucinol using literature[7,8] procedures. Bromination[9] of **3** using $KBrO_3$ and HBr in glacial AcOH gave yellow needles, m.p. 200 °C, whose simple ^{1}H and ^{13}C NMR data were inadequate to establish conclusively that the mono-bromo derivative of **3** had the structure **4** or **5**. Hence the position of the Br atom was determined by the study of its long-range ^{1}H–^{13}C HMBC (Heteronuclear Multiple Bond Coherence) data in which the hydroxyl proton on C-2′ correlated to C-1′, C-2′ and C-3′ while the proton on C-5′ correlated to C-1′, C-3′, C-4′ and C-6′. The fact that the OH proton did not correlate to the carbon (C-5′) which is directly attached to the lone aromatic proton and the H-5′ also did not show correlation to C-2′ indicated that the aromatic proton is at the *p*-position with respect to the OH group (Fig. 1).

Thus the bromo derivative was assigned the structure 3′-bromo-2′-hydroxy-4′,6′-dimethoxyacetophenone **5** which was further supported by the study of its NOESY and high-resolution electrospray ionisation mass spectrometry (HRESIMS) data. The equivalence of the NOE from H-5′ to both the methoxy groups at C-4′ and C-6′ indicated that the lone aromatic proton is indeed at the C-5′ (Fig. 1).

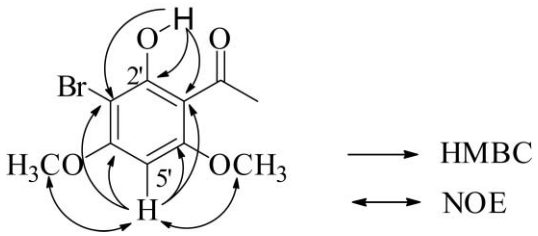


Fig. 1 HMBC and NOE correlations of **5**.

Condensation[7] of **5** with 4-methoxybenzaldehyde in the presence of 50% ethanolic KOH gave the expected chalcone **6** in quantitative yield (m.p. 180 °C; m.p. of natural[4] **1** is also 180 °C) and was fully characterised on the basis of its ^{1}H NMR, ^{13}C NMR, COSY and HMBC data. Interestingly, the ^{1}H NMR spectrum of **6** did show the two characteristic 1H doublets at δ 7.76 and 7.84 with J = 15.4 Hz for the *trans*-α, β olefinic protons respectively as against the singlet observed[4] for these protons in the natural chalcone **1**.

In the ^{1}H–^{13}C HMBC experiment on **6**, the OH proton at C-2′ showed correlations with C-1′, C-2′ and C-3′ while the proton at C-5′ correlated to C-1′, C-3′, C-4′ and C-6′, thus establishing the structure **6** of our synthetic chalcone (Fig. 2)

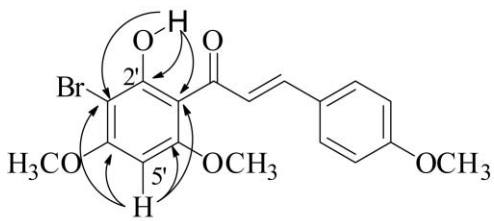
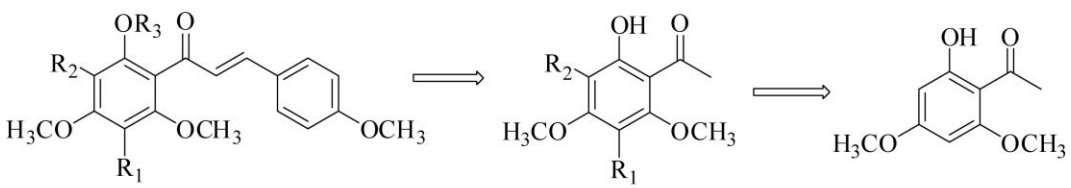


Fig. 2 Selected HMBC correlations of **6**.



1 R_1=Br, R_2=H, R_3=H
2 R_1=Br, R_2=H, R_3=Ac
6 R_1=H, R_2=Br, R_3=H
7 R_1=H, R_2=Br, R_3=Ac

4 R_1=Br, R_2=H
5 R_1=H, R_2=Br

3

Scheme 1

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which was further supported by the presence of a pseudomolecular ion peak $[M + H]^+$ at *m/z* 395.0332 in its HRESIMS data.

The chalcone **6** on acetylation[4] using acetic anhydride and pyridine furnished the acetate **7** (m.p. 178–180 °C; lit.[4] m.p. of **2** is 120–122 °C). The presence of strong carbonyl bands at 1770 and 1660 cm^{-1} in its IR spectrum and a 3H singlet at δ 2.16 in its ^{1}H NMR spectrum established the presence of the acetate group and hence the structure **7** which was further supported by the presence of a pseudomolecular ion peak at *m/z* 457.0244 $[M + Na]^+$ in its mass spectrum. Although the melting points of the natural and synthetic chalcones (**1** and **6**) were identical (180 °C), the melting points as well as the NMR data of their respective acetates (**2** and **7**) differed considerably.

Thus bromination[9] of **3** using $KBrO_3$ and HBr gave **5** and did not give the desired bromo derivative **4**. Several other brominating reagents[10–18] were tried under varying reaction conditions but all gave exclusively **5**. We then resorted to an alternative route to **4** involving protection of the two OH groups in phloroacetophenone **8** followed by bromination, methylation and then deprotection. Of the various protecting groups used, protection by tosyl[19] group worked. This new route is depicted in Scheme 2.

Selective esterification of **8** using two equivalents of *p*-TsCl and anhydrous K_2CO_3 in dry acetone[19] gave the di-*p*-tosylate **9**. In its ^{1}H NMR spectrum, two *ortho* coupled doublets at δ 7.32 and 7.72 for 4H each and two (3H) singlets at δ 2.46 and 2.49 established the presence of two *p*-tosyl groups and hence the structure 2′-hydroxy-4′,6′-di-*p*-tosyloxyacetophenone **9** which was further supported by the presence of a pseudomolecular ion peak at *m/z* 477.0675 $[M + H]^+$ in its HRESIMS data. Bromination[9] of **9** using $KBrO_3$ and HBr in glacial AcOH gave lemon yellow crystals having m.p. 114 °C. The presence of a singlet at δ 6.63 (H-5′, 1H) in its ^{1}H NMR spectrum established nuclear monobromination. Its HRESIMS measurement showed a pseudomolecular ion peak at *m/z* 556.9765 $[M + H]^+$ (Calcd for $C_{22}H_{20}{}^{81}BrO_8S_2$: 556.9763), supporting the formation of 3′-bromo-2′-hydroxy-4′,6′-di-*p*-tosyloxyacetophenone **10**. Methylation[8] of **10** with Me_2SO_4 and anhydrous K_2CO_3 in dry acetone gave 3′-bromo-4′,6′-di-*p*-tosyloxy-2′-methoxyacetophenone **11** as colourless shiny crystals having m.p. 128 °C. The structure of **11** was established by the study of its NMR and MS data. Appearance of a 3H singlet at δ 3.72 due to methoxy group in its ^{1}H NMR spectrum supported its formation. The position of Br at C-3′ in **11** was unambiguously established from the ^{1}H–^{13}C HMBC correlation studies of H-5′ to C-3′, C-4′ and C-6′ (Fig.3).

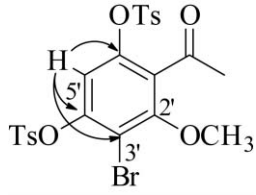
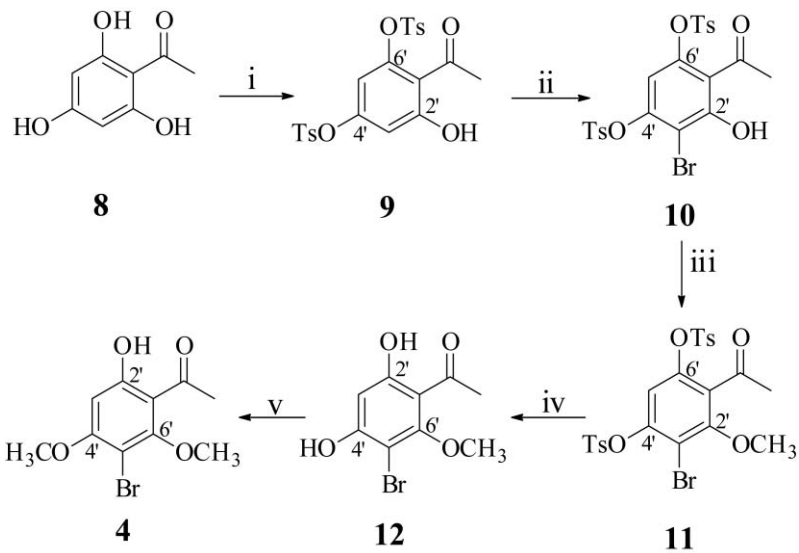


Fig. 3 Selected HMBC correlations of **11**.

Alkaline hydrolysis[19] of the bromo-di-*p*-tosylate **11** to the required 5′-bromo-2′,4′-dihydroxy-6′-methoxyacetophenone **12** was indicated by the presence of two 1H singlets at δ 6.25 ($C_{4'}$-OH) and δ 13.22 (chelated $C_{2'}$-OH) in its ^{1}H NMR spectrum. Selective methylation[8] of the non-chelated hydroxyl group at C-4′ gave the required 5′-bromo-2′-hydroxy-4′,6′-dimethoxyacetophenone **4** as colourless solid having m.p. 102 °C and its structure was established by the study of its NMR and MS data. Finally condensation[20] of **4** with 4-methoxybenzaldehyde gave the chalcone **1**, identical in all respects (mp and spectral data including the singlet for the *trans* olefinic protons in the ^{1}H NMR) with the natural **1**. Moreover, the data (m.p., ^{1}H NMR) of the acetate of the synthetic **1** also matched well with the acetate **2** of the natural **1**. This is the first report of the synthesis of the bromochalcone[4] **1** and its positional isomer **6**.

Experimental

Melting points were determined in open capillary tubes and are uncorrected. IR spectra were recorded as KBr diluted pellets on a Shimadzu (IR Prestige-21) FTIR spectrophotometer. ^{1}H and ^{13}C NMR spectra were recorded at 300 and 75 MHz respectively on a Bruker WT 300 FT-NMR instrument with TMS as internal standard and chemical shifts are recorded in δ values. High-resolution mass measurements of all the new compounds except that for **4** were recorded on QSTARXL MS/MS mass spectrometer, Applied Biosystems, Switzerland. All yields refer to isolated products unless stated otherwise. All solvents were distilled prior to use. Petroleum ether refers to hydrocarbon



Scheme 2 Reagents and conditions (i) *p*-TsCl (2 equiv.), K_2CO_3 (3 equiv.), acetone, reflux, 5 h, 71%; (ii) $KBrO_3$, HBr, rt, 30 min, 97%; (iii) Me_2SO_4 (1 equiv.), K_2CO_3 (3 equiv.), acetone, reflux, 4 h, 85%; (iv) KOH (0.04 equiv.), MeOH, reflux, 4 h, 79%; (v) Me_2SO_4 (1 equiv.), K_2CO_3 (3 equiv.), acetone, reflux, 3 h, 67%.

fraction boiling in the range 60–80 °C and ether refers to diethyl ether. Phloroacetophenone **8** and 2′-hydroxy-4′,6′-dimethoxyacetophenone **3** were prepared by using the procedures reported in literature.[7,8]

3′-Bromo-2′-hydroxy-4′,6′-dimethoxyacetophenone (**5**): To a stirred solution of **3** (0.290 g, 1.48 mmol) and $KBrO_3$ (0.085 g, 0.50 mmol) in glacial acetic acid (2 mL) was added drop by drop HBr (48%, 2.6 mmol, 0.3 mL). The mixture was stirred at room temperature for 30 min, diluted with cold water (5 mL) and stirred for further 15 min. Yellow solid separated was collected by filtration, washed with dilute $NaHSO_3$, water and dried at 100 °C to afford **5** (0.313 g, 83%). Recrystallisation from benzene gave pale brown needles m.p. 186–188 °C while recrystallisation from $CHCl_3$-petroleum ether mixture afforded pale yellow needles m.p. 200 °C. IR (cm^{-1}): 1632 (C=O), 1581 (C=C). ^1H NMR ($CDCl_3$) δ: 2.63 (s, 3H, –COCH_3), 3.93 (s, 3H, 6′-OCH_3), 3.96 (s, 3H, 4′-OCH_3), 6.0 (s, 1H, H-5′), 14.59 (s, 1H, O*H*). ^{13}C NMR ($CDCl_3$) δ: 32.9 (–CO*C*H$_3$), 55.7 (6′-O*C*H$_3$), 56.2 (4′-O*C*H$_3$), 86.6 (C-5′), 91.5 (C-3′), 106.4 (C-1′), 161.8 (C-6′), 162.5 (C-2′), 162.6 (C-4′), 203.2 (*C*O). HRESIMS: *m/z* 274.9921 $[M + H]^+$; Calcd for $C_{10}H_{11}O_4{}^{79}Br$, 274.9919.

3′-Bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone (**6**): A mixture of **5** (0.115 g, 0.41 mmol) and 4-methoxybenzaldehyde (0.056 g, 0.4 mmol, 0.050 mL) in alcoholic KOH (50%, 2.5 mL) was kept at room temperature for 72 h. The dark yellow mass was diluted with water (3 mL) and acidified with aqueous HCl. Yellow solid separated was filtered, washed with water and dried to afford **6** (0.142 g, quantitative). Recrystallisation from $CHCl_3$-MeOH mixture gave yellow flakes m.p. 180 °C. IR (cm^{-1}): 3420 (OH), 1625 (C=O). ^1H NMR ($CDCl_3$) δ: 3.86 (s, 3H, 2′-OCH_3), 3.99 (s, 3H, 4′-OCH_3), 4.0 (s, 3H, 4-OCH_3), 6.07 (s, 1H, H-5′), 6.94 (d, 2H, H-3 and H-5, J = 9 Hz), 7.57 (d, 2H, H-2 and H-6, J = 9 Hz), 7.76 (d, 1H, H-α, J = 15.4 Hz), 7.84 (d, 1H, H-β, J = 15.4 Hz), 14.94 (s, 1H, –O*H*). ^{13}C NMR ($CDCl_3$) δ: 55.4 (6′-O*C*H$_3$), 56.0 (4′-O*C*H$_3$), 56.3 (4-O*C*H$_3$), 87.1 (C-5′), 91.9 (C-3′), 106.9 (C-1′), 114.4 (C-3, C-5), 124.5 (C-8), 128.0 (C-1), 130.2 (C-2, C-6), 143.5 (C-7), 161.6 (C-4′), 161.7 (C-4), 162.2 (C-6′), 163.2 (C-2′), 192.6 (C-9). HRESIMS: *m/z* 395.0332 $[M + H]^+$; Calcd for $C_{18}H_{17}O_5{}^{81}Br$: 395.0317.

2′-Acetoxy-3′-bromo-4,4′,6′-trimethoxychalcone (**7**): Chalcone **6** (25 mg, 0.0636 mmol) in Ac_2O (2 mL) and dry pyridine (1 mL) was heated on a boiling water bath for 2 h. The reaction mixture was cooled, poured over crushed ice containing few drops of conc. HCl and the solid separated out was collected by filtration, washed with water and dried in an oven at 100 °C to afford **7** (0.0161 g, 73%). Recrystallisation from $CHCl_3$–MeOH mixture gave greenish shiny flakes m.p. 178–180 °C. IR (cm^{-1}): 1770 (C=O), 1660 (C=O), 1597 (C=C). ^1H NMR ($CDCl_3$) δ: 2.16 (s, 3H, –OCOCH_3), 3.79 (s, 6H, 2 × -OCH_3), 3.92 (s, 3H, –OCH_3), 6.40 (s, 1H, H-5′), 6.78 (d, 1H, H-α, J = 16 Hz), 6.85 (d, 2H, H-3 and H-5, J = 9 Hz), 7.43 (d, 2H, H-2 and H-6, J = 9 Hz), 7.37 (d, 1H, H-β, J = 16 Hz). HRESIMS: *m/z* 457.0244 $[M + Na]^+$; Calcd for $C_{20}H_{19}O_6{}^{79}BrNa$: 457.0263.

2′-Hydroxy-4′,6′-di-p-tosyloxyacetophenone (**9**): A mixture of **8** (1.008 g, 6 mmol), *p*-TsCl (2.286 g, 12 mmol) and anhydrous K_2CO_3 (2.484 g, 18 mmol) in dry acetone (25 mL) was heated to reflux for 5 h. The reaction mixture was cooled to room temperature, diluted with water and extracted with ether. The combined organic extracts were washed with water, dried over anhydrous Na_2SO_4 and concentrated to afford a residual solid which was chromatographed on silica gel with petroleum ether/ethyl acetate (8:2) to afford **9** as colourless solid (2.016 g, 71%). Recrystallisation from petroleum ether gave colourless crystals m.p. 78 °C. IR (cm^{-1}): 1634 (C=O), 1595 (C=C), 1377 (S=O). ^1H NMR ($CDCl_3$) δ: 2.67 (s, 3H, –COCH_3), 6.35 (d, 1H, H-3′, J = 2.4 Hz), 6.44 (d, 1H, H-5′, J = 2.4 Hz), 12.74 (s,1H, –O*H*), For the tosyl group at C-4′: 2.49 (s, 3H, –CH_3), 7.72 (d, 4H, J = 8.4 Hz), For the tosyl group at C-6′: 2.46 (s, 3H, –CH_3), 7.37 (dt, 4H, J = 8.1 Hz). ^{13}C NMR ($CDCl_3$) δ: 32.5 (–CO*C*H$_3$), 107.6 (C-3′), 110.2 (C-5′), 113.8 (C-1′), 150.6 (C-6′), 153.6 (C-4′), 164.5 (C-2′), 203.2 (*C*O), For the tosyl group at C-4′: 21.8, 128.6, 130.3, 131.9, 146.7, For the tosyl group at C-6′: 21.8, 128.4, 130.1, 131.7, 146.2. HRESIMS: *m/z* 477.0675 $[M + H]^+$; Calcd for $C_{22}H_{21}O_8S_2$: 477.0678.

3′-Bromo-2′-hydroxy-4′,6′-di-p-tosyloxyacetophenone (**10**): HBr (48%, 0.2 mL, 1.84 mmol) was added to a mixture of **9** (0.5044 g, 1.05 mmol) and $KBrO_3$ (0.06 g, 0.35 mmol) in glacial acetic acid (2 mL). The reaction mixture was stirred for 30 min at room temperature, diluted with cold water (5 mL) and stirred for further 15 min to afford **10** as yellow solid (0.57 g, 97%) which on recrystallisation from $CHCl_3$–petroleum ether mixture gave lemon yellow crystals m.p. 114 °C. IR (cm^{-1}): 1627 (C=O), 1595 (C=C), 1387 (S=O). ^1H NMR ($CDCl_3$) δ: 2.74 (s, 3H, –COCH_3), 6.68 (s, 1H, H-5′), 13.6 (s, 1H, –O*H*), For the tosyl group at C-4′: 2.50 (s, 3H, –CH_3), 7.79 (dt, 4H, J = 7.1 and 2.1 Hz), For the tosyl group at C-6′: 2.46 (s, 3H, –CH_3), 7.34 (d, 2H, J = 8.4 Hz), 7.42 (d, 2H, J = 8.4 Hz),. ^{13}C NMR ($CDCl_3$) δ: 32.4 (–CO*C*H$_3$), 105.2 (C-5′), 108.0 (C-3′), 113.8 (C-1′), 149.3 (C-6′), 151.1 (C-4′), 161.4 (C-2′), 203.3 (*C*O), For the tosyl group at C-4′: 21.8, 129.9, 130.4, 132.1, 146.8, For the tosyl group at C-6′: 21.8, 128.6, 131.4, 146.3. HRESIMS: *m/z* 556.9765 $[M + H]^+$; Calcd for $C_{22}H_{20}{}^{81}BrO_8S_2$: 556.9763.

3′-Bromo-4′,6′-di-p-tosyloxy-2′-methoxyacetophenone (**11**): A mixture of **10** (1.32 g, 2.378 mmol), anhydrous Me_2SO_4 (0.2996 g, 2.378 mmol) and anhydrous K_2CO_3 (0.984 g, 7.134 mmol) in dry acetone (20 mL) was heated to reflux for 4 h. The reaction mixture was cooled to room temperature, diluted with water and extracted with ether. The combined organic extracts were washed with water, dried over anhydrous Na_2SO_4 and concentrated to afford **11** as colourless solid (1.593 g, 85%). Recrystallisation from benzene-petroleum ether mixture gave colourless shiny crystals m.p. 128 °C. IR (cm^{-1}): 1710 (C=O), 1585 (C=C), 1377 (S=O). ^1H NMR ($CDCl_3$) δ: 2.56 (s, 3H, –COCH_3), 3.72 (s, 3H, –OCH_3), 7.00 (s, 1H, H-5′), For the tosyl group at C-4′: 2.47 (s, 3H, –CH_3), 7.74 (d, 2H, J = 8.1 Hz), 7.78 (d, 2H, J = 8.7 Hz), For the tosyl group at C-6′: 2.42 (s, 3H, –CH_3), 7.36 (d, 4H, J = 6.6 Hz). ^{13}C NMR ($CDCl_3$) δ: 31.8 (–CO*C*H$_3$), 62.9 (–O*C*H$_3$), 111.7 (C-3′), 114.1 (C-5′), 130.2 (C-1′), 146.4 (C-6′), 148.1 (C-4′), 155.6 (C-2′), 197.3 (*C*O), For the tosyl group at C-4′: 21.7, 129.9, 130.1, 132.1, 146.2, For the tosyl group at C-6′: 21.7, 128.5, 128.6, 131.5, 144.5. HRESIMS: *m/z* 570.9948 $[M + H]^+$; Calcd for $C_{23}H_{22}{}^{81}BrO_8S_2$: 570.9919.

5′-Bromo-2′,4′-dihydroxy-6′-methoxyacetophenone (**12**): A mixture of **11** (0.958 g, 1.683 mmol) and KOH (3.76 g, 0.0673 mmol) in a mixture of ethanol (30 mL) and water (30 mL) was heated to reflux for 4 h, cooled, neutralised with acetic acid and extracted with ether. The combined organic extracts were washed with saturated $NaHCO_3$, water, dried over anhydrous Na_2SO_4 and concentrated to afford residual oil which was chromatographed over silica gel with petroleum ether-ethyl acetate (98:2) to afford **12** as colourless solid (0.3483 g, 79%). Recrystallisation from petroleum ether gave colourless flakes m.p. 116 °C. IR (cm^{-1}): 3302 (OH), 1581 (C=C). ^1H NMR ($CDCl_3$) δ: 2.70 (s, 3H, –COCH_3), 3.89 (s, 3H, –OCH_3), 6.25 (s, 1H, –O*H*), 6.45 (s, 1H, H-3′), 13.22 (s, 1H, –O*H*). ^{13}CNMR ($CDCl_3$) δ: 31.1 (–CO*C*H$_3$), 61.9 (–O*C*H$_3$), 97.1 (C-5′), 100.6 (C-3′), 110.6 (C-1′), 158.8 (C-6′), 165.0 (C-2′), 166.4 (C-4′), 202.9 (*C*O). HRESIMS: *m/z* 262.9748 $[M + H]^+$; Calcd for $C_9H_{10}{}^{81}BrO_4$: 262.9742.

5′-Bromo-2′-hydroxy-4′,6′-dimethoxyacetophenone (**4**): A mixture of **12** (0.095 g, 0.362 mmol), anhydrous Me_2SO_4 (0.0456 g, 0.362 mmol) and anhydrous K_2CO_3 (0.15 g, 1.086 mmol) in dry acetone (10 mL) was heated to reflux for 3 h. The reaction mixture was cooled to room temperature, diluted with water and extracted with ether. The combined organic extracts were washed with water, dried over anhydrous Na_2SO_4 and concentrated to leave residual oil which was chromatographed over silica gel with petroleum ether–ether (9:1) to afford **4** as colourless solid (0.0665 g, 67%). Recrystallisation from petroleum ether gave colourless needles m.p. 102 °C. IR (cm^{-1}): 1627 (C=O), 1585 (C=C). ^1H NMR ($CDCl_3$) δ: 2.71 (s, 3H, –COCH_3), 3.89 (s, 3H, 6′-OCH_3), 3.91 (s, 3H, 4′-OCH_3), 6.32 (s, 1H, H-3′), 13.49 (s, 1H, –O*H*). ^{13}C NMR ($CDCl_3$) δ: 31.2 (–CO*C*H$_3$), 51.0 (–O*C*H$_3$), 56.6 (–O*C*H$_3$), 97.2 (C-3′), 97.7 (C-5′), 110.1 (C-1′), 160.4 (C-6′), 162.2 (C-4′), 165.4 (C-2′), 203.1 (*C*O). HRMS: *m/z* 275.9816 $[M]^+$ Calcd. for $C_{10}H_{11}{}^{81}BrO_4$: 275.9820.

5′-Bromo-2′-hydroxy-4,4′,6′-trimethoxychalcone (**1**): To a mixture of **4** (0.02 g, 0.0727 mmol) and 4-methoxybenzaldehyde (0.01 g, 0.073 mmol) in ethanol (1 mL), KOH (0.1 g) in water (1 mL) was added drop-wise and the reaction mixture was stirred for 4 h at 45 °C. The yellow-orange mixture was diluted with water (3 mL) and acidified with conc. HCl. Yellow solid separated was filtered, washed with water and dried to afford **1** (0.02 g, 70%). Recrystallisation from $CHCl_3$-MeOH mixture gave yellow flakes m.p. 178 °C (lit.[4] m.p. 180 °C). IR (cm^{-1}): 2963 (OH), 1626 (C=O), 1605 (C=C). ^1H NMR ($CDCl_3$) δ: 3.79 (s, 3H, –OCH_3), 3.86 (s, 3H, –OCH_3), 3.93 (s, 3H, –OCH_3), 6.36 (s, 1H, H-3′), 6.93 (d, 2H, H-3 and H-5, J = 8.1 Hz), 7.62 (d, 2H, H-2 and H-6, J = 8.1 Hz), 7.87 (s, 2H, H-α and H-β), 13.65 (s, 1H, –O*H*). ^{13}C NMR ($CDCl_3$) δ: 55.4 (6′-O*C*H$_3$), 56.6

(4′-O*C*H$_3$), 62.3 (4-O*C*H$_3$), 97.3 (C-3′), 114.0 (C-5′), 114.4 (C-3, C-5), 123.2 (C-8), 127.7 (C-1′), 130.4 (C-2, C-6), 144.4 (C-7), 159.5 (C-4), 161.7 (C-2′), 161.8 (C-4′), 165.5 (C-6′), 192.5 (C-9). HRESIMS: *m/z* 395.0323 [M + H]$^+$; Calcd for $C_{18}H_{18}{}^{81}BrO_5$: 395.0317.

2′-Acetoxy-5′-bromo -4,4′,6′-trimethoxychalcone (**2**): A mixture of **1** (7.5 mg, 0.019 mmol) in Ac_2O (1 mL) and dry pyridine (0.5 mL) was heated on a boiling water bath for 2 h. The reaction mixture was cooled, poured over crushed ice containing few drops of conc. HCl and the solid separated out was collected by filtration, washed with water and dried to afford **2** as yellow solid (0.006 g, 72%), m.p. 126–28 °C (lit.[4] m.p. 122–26 °C). IR (cm^{-1}): 1766 (C=O), 1638 (C=O), 1599 (C=C). ^{1}H NMR ($CDCl_3$) δ: 2.17 (s, 3H, –OCOC*H*$_3$), 3.80 (s, 3H, –OC*H*$_3$), 3.83 (s, 3H, –OC*H*$_3$), 3.93 (s, 3H, –OC*H*$_3$), 6.54 (s, 1H, H-3′), 6.90 (d, 2H, H-3 and H-5, *J* = 8.7 Hz), 6.92 (d, 1H, H-α, *J* = 16.0 Hz), 7.39 (d, 1H, H-β, *J* = 16.0 Hz), 7.49 (d, 2H, H-2 and H-6, *J* = 8.7 Hz). HRESIMS: *m/z* 474.9940 [M + K]$^+$; Calcd for $C_{20}H_{19}O_6{}^{81}BrK$: 474.9982.

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