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Synthesis of 2-Hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones

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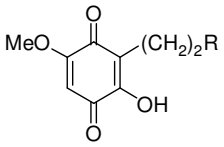
A short, efficient synthesis of 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones is described. Ultrasound-assisted Wittig reaction of alkyltriphenyl phosphonium bromides with 2-hydroxy-3,6-dimethoxybenzaldehyde in basic aqueous condition followed by reduction with Na/*n*-BuOH gave 3,6-dimethoxy-2-alkylphenols. Oxidation of 3,6-dimethoxy-2-alkylphenols with Fremy's salt produced 2,5-dimethoxy-3-alkyl-1,4-benzoquinones. Selective hydrolysis with perchloric acid converted 2,5-dimethoxy-3-alkyl-1,4-benzoquinones to 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones.

Key Words: 2-Hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones, 2-Hydroxy-3,6-dimethoxybenzaldehyde, Wittig reaction, Ultrasound irradiation.

INTRODUCTION

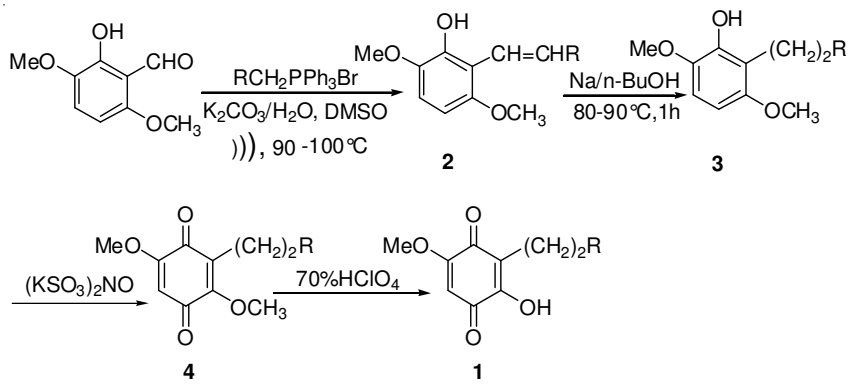
2-Hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones occur widely in nature, particularly in plants. Most of them show potent biological activity like antimicrobial, anticancer and 5-lipoxygenase inhibitory activities. The naturally occurring 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones such as 5-O-methyl-embelin (**1a**), irisoquin (**1b**), ardisianone B (**1c**), maesanin (**1d**), pallasone C (**1e**) have been isolated from natural sources[1].



1a	$R=CH_3(CH_2)_8$	5-O-Methyl-embelin
1b	$R=CH_3(CH_2)_{15}$	Irisoquin
1c	$R=CH_3(CH_2)_3CH\overset{Z}{=}CH(CH_2)_5$	Ardisianone B
1d	$R=CH_3(CH_2)_3CH\overset{Z}{=}CH(CH_2)_7$	Maesanin
1f	$R=CH_3(CH_2)_5CH\overset{Z}{=}CH(CH_2)_7$	Pallasone C

Fig. 1. 2-Hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones

There are two strategies for the synthesis of 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones: (i) elaboration of the side chain on the aromatic ring, the route is complicated and has a lower yield[2] (ii) direct alkylation of the aromatic ring, the necessity for odd alkylbromide as the starting material for the reaction limits the number of compounds available for this kind of approach to 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones synthesis in general[3]. We now report a simple and efficient route to 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones based on the ultrasound-assisted Wittig reaction (**Scheme-I**).



Scheme-I

EXPERIMENTAL

NMR spectra were determined on Bruker AV-300 spectrometer spectrometer, coupling constants (*J*) were measured in Hz; elemental analysis were recorded on a PEA-1110 elemental analyzer; melting points were determined on a Mel-Temp capillary tube apparatus and were uncorrected. Ultrasound irradiation was effected in a water bath of a CQ250 ultrasonic cleaner (frequency: 40 KHz; power: 250 W). 2-Hydroxy-3,6-dimethoxybenzaldehyde[4], (Z)-1-bromo-9-cetene[5], (Z)-1-bromo-9-tetradecene were prepared by reported method[6]. Commercially available reagents were used throughout without further purification unless otherwise stated while dioxane and DMSO were freshly distilled from sodium and molecular sieve, respectively.

General procedure for the preparation of 3: The alkyltriphenylphosphonium bromide (15 mmol), potassium carbonate (30 mmol), DMSO (10 mL) containing water (30 mmol) and 2-hydroxy-3,6-dimethoxy benzaldehyde (15 mmol) were successively introduced into a 100 mL reaction vessel. The mixture was heated at 90-100 °C and stirred under ultrasound irradiation for 1 h, then cooled to 25 °C, treated with 10 mL of water and acidified with 6 N HCl, extracted with two 15 mL portions of ether, the combined organic layer was washed successively with water, saturated $NaHCO_3$ and brine and then dried over anhydrous magnesium sulfate, filtered and concentrated. The crude product was eluted on silica gel elution by using hexane:ethyl acetate (7:1) to yield a colourless oil **2**.

Sodium metal (9.2 g, 400 mmol) was added to a solution of **2** in anhydrous *n*-BuOH (100 mL) at room temperature. The resulting mixture was heated at 80-90 °C and stirred for 1 h. The reaction was quenched by addition of aqueous AcOH (20 %, 50 mL). After hexane was added to this mixture, it was heated at reflux and the aqueous layer was removed with a Dean Stark trap overnight. The organic layer then was filtered and concentrated *in vacuo*. The crude product was eluted on silica gel elution by using hexane:ethyl acetate (3:1) to yield **3**.

3,6-Dimethoxy-2-undecylphenol (3a): A colourless oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.88 (d, *J* = 8.5 Hz, 1H), 6.50 (d, *J* = 8.5 Hz, 1H), 5.80 (brs, exch. D_2O, 1H), 3.88 (s, 3H), 3.74 (s, 3H), 2.60 (t, *J* = 7.4 Hz, 2H), 1.70-1.20 (m, 18H), 0.90 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ: 150.2, 143.5, 139.8, 119.8, 107.8, 100.6, 57.8, 55.0, 31.8, 29.9-29.2 (8C), 23.4, 22.5, 14.2. Anal. calcd. for $C_{19}H_{32}O_3$: C, 73.98; H, 10.46. found: C, 74.10; H, 10.38.

3,6-Dimethoxy-2-octadecylphenol (3b): A white solid, m.p. 50-51 ºC (lit.[3b], m.p. 49.5-51.5 ºC); ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.80 (d, *J* = 8.6 Hz, 1H), 6.42 (d, *J* = 8.6 Hz, 1H), 5.86 (brs, exch. D_2O, 1H), 3.82 (s, 3H), 3.69 (s, 3H), 2.68 (t, *J* = 7.5 Hz, 2H), 1.60-1.20 (m, 32H), 0.88 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ: 153.4, 144.8, 140.6, 120.4, 107.1, 100.2, 56.9, 55.2, 31.4, 30.2, 29.9-29.0 (15C), 24.1, 22.0, 14.1; Anal. calcd. for $C_{26}H_{46}O_3$: C, 76.79; H, 11.40. found: C, 76.49; H, 11.32.

3,6-Dimethoxy-2-[(Z)-8-tridecenyl]phenol (3c): A colourless oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.80 (d, *J* = 8.7 Hz, 1H), 6.42 (d, *J* = 8.7 Hz, 1H), 5.82 (brs, exch. D_2O, 1H), 5.50-5.35 (m, 2H), 3.88 (s, 3H), 3.62 (s, 3H), 2.64 (t, *J* = 7.6 Hz, 2H), 2.25-1.80 (m, 4H), 1.65-1.25 (m, 14H), 0.92 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ: 152.1, 144.6, 141.6, 130.8, 129.4, 120.2, 108.1, 101.0, 56.5, 55.2, 32.0, 29.9-29.1 (5C), 27.0, 26.5, 24.2, 22.6, 14.1; Anal. calcd. for $C_{21}H_{34}O_3$: C, 75.41; H, 10.25. found: C, 75.20; H,10.30.

3,6-Dimethoxy-2-[(Z)-10-pentadecenyl]phenol (3d): A colourless oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.70 (d, *J* = 8.8 Hz, 1H), 6.38 (d, *J* = 8.8 Hz, 1H), 5.79 (brs, exch. D_2O, 1H), 5.50-5.30 (m, 2H), 3.80 (s, 3H), 3.69 (s, 3H), 2.68 (t, *J* = 7.5 Hz, 2H), 2.25-1.80 (m, 4H), 1.70-1.25 (m, 18H), 0.90 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ: 150.8, 144.0, 140.2, 130.1, 129.8, 119.8, 107.8, 101.5, 57.0, 55.4, 31.7, 29.8-29.1 (7C), 27.5, 26.8, 23.6, 22.4, 14.2; Anal. calcd. for $C_{23}H_{38}O_3$: C, 76.20; H, 10.56. found: C, 76.34; H, 10.68.

3,6-Dimethoxy-2-[(Z)-10-heptadeceny]phenol (3e): A colourless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.68 (d, *J* = 8.6 Hz, 1H), 6.35 (d, *J* = 8.6 Hz, 1H), 5.70 (brs, exch. D_2O, 1H), 5.45-5.30 (m, 2H), 3.85 (s, 3H), 3.71 (s, 3H), 2.60 (t, *J* = 7.5 Hz, 2H), 2.30-1.85 (m, 4H), 1.65-1.25 (m, 22H), 0.88 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 151.6, 144.8, 141.6, 130.8, 129.8, 119.0, 107.2, 100.9, 56.8, 55.6, 31.8, 29.8-29.1 (9C), 27.4, 26.9, 23.2, 22.6, 14.1. Anal. calcd. for $C_{25}H_{42}O_3$: C, 76.87; H, 10.84. found: C, 76.77; H,10.80.

General procedure for the preparation of 4: To a stirred mixture of $NaH_2PO_4 \cdot H_2O$ (37 mmol) in water (350 mL), containing aliquat 336 (7 mmol) and the phenol **3** (5 mmol) in dichloromethane (80 mL). Potassium nitrosodisulfonate (12.5 mmol) was added and the mixture was shaken vigorously until a colour change to yellow became permanent. The organic layer was collected and the aqueous layer was extracted with dichloromethane (3 × 150 mL). The combined organic extracts were washed with water (3 × 150 mL), brine (3 × 150 mL), dried over anhydrous magnesium sulfate, filtered and concentrated to yield the crude quinone. The product was eluted on silica gel elution by using n-hexane:ethyl acetate (4:3) to yield the 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones **(4)**.

2,5-Dimethoxy-3-undecyl-1,4-benzoquinone (4a): A white solid, m.p. 53-55 ºC (lit.[3b], m.p. 54-56 ºC); δ: 5.78 (s, 1H), 4.05 (s, 3H), 3.84 (s, 3H), 2.46 (t, *J* = 7.1 Hz, 2H), 1.40-1.20 (m, 18H), 0.92 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 185.8, 183.0, 158.0, 155.8, 131.2, 105.8, 60.9, 57.1, 31.9, 29.8-29.3 (6C), 28.5, 23.4, 22.5, 14.2; Anal. calcd. for $C_{19}H_{30}O_4$: C, 70.77; H, 9.38. found: C, 70.65, H, 9.30.

2,5-Dimethoxy-3-octadecyl-1,4-benzoquinone (4b): A white solid, m.p. 79-81 ºC (lit.[3b], m.p. 78-80 ºC); ^{1}H NMR (300 MHz, $CDCl_3$) δ: 5.70 (s, 1H), 4.00 (s, 3H), 3.88 (s, 3H), 2.42 (t, *J* = 6.9 Hz, 2H), 1.40-1.20 (m, 32H), 0.89 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 184.6, 182.3, 158.7, 155.2, 130.3, 105.28, 60.2, 56.7, 32.0, 29.8-29.3(13C), 28.2, 23.7, 22.0, 14.1; Anal. calcd. for $C_{26}H_{44}O_4$: C, 74.24; H, 10.54. found: C, 74.18, H, 10.46.

2,5-Dimethoxy-3-[(Z)-10-tridecenyl]-1,4-benzoquinone (4c): A colourless oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ: 5.75 (s, 1H), 5.45-5.25(m, 2H), 4.080 (s, 3H), 3.80 (s, 3H), 2.46 (t, *J* = 7.0 Hz, 2H), 2.20-1.85(m, 4H)1.40-1.20 (m,16H), 0.89 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 183.2, 182.1, 159.0, 155.2, 130.9, 129.8, 129.6, 105.0, 60.8, 56.2, 31.8, 29.7-29.2(4C), 28.6,27.12, 26.7, 23.2, 22.5, 14.2; Anal. calcd. for $C_{21}H_{32}O_4$: C, 72.38; H, 9.26. found: C, 72.29, H, 9.14.

2,5-Dimethoxy-3-[(Z)-10-pentadecenyl]-1,4-benzoquinone (4d): A colourless oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ: 5.70 (s, 1H), 5.45-5.20(m, 2H), 4.00 (s, 3H), 3.85 (s, 3H), 2.46 (t, *J* = 6.9 Hz, 2H), 2.20-1.85 (m, 4H) 1.40-1.20 (m, 18H), 0.90 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 183.6, 182.0, 158.2, 155.8, 131.1, 129.8, 129.6, 105.3, 61.2, 56.8, 32.0, 29.7-29.2 (6C), 28.5,27.2, 26.9, 23.4, 22.0, 14.1. Anal. calcd. for $C_{23}H_{36}O_4$: C, 73.37; H, 9.64. found: C, 73.20, H, 9.69.

2,5-Dimethoxy-3-[(Z)-10-eptadecenyl]-1,4-benzoquinone (4e): A colourless oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ: 5.75 (s, 1H), 5.45-5.20 (m, 2H), 4.02 (s, 3H), 3.80 (s, 3H), 2.40 (t, *J* = 7.0 Hz, 2H), 2.20-1.85 (m, 4H) 1.40-1.20 (m, 22H), 0.88 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 183.6, 182.9, 158.5, 155.2, 130.8, 129.9, 129.8, 105.4, 60.9, 56.5, 32.1, 29.7-29.0 (8C), 28.4, 27.2, 26.9, 23.2, 22.50, 14.1; Anal. calcd. for $C_{25}H_{40}O_4$: C,74.22; H, 9.97. found: C, 74.16, H, 9.80.

General procedure for the preparation of 1: To a solution of **4** (1 mmol) in CH_2Cl_2 (10 mL) was added 6 drops of 70 % $HClO_4$ at room temperature and the

mixture was stirred 2 h. The reaction mixture was washed with saturated $NaHCO_3$ and saturated NaCl, dried over anhydrous magnesium sulfate, filtered and concentrated to yield the crude quinone. Recrystallization form EtOH gave **1** as yellow crystals.

5-O-Methyl-embelin (1a): A yellow crystal, m.p. 93-94 ºC (lit.[3b], m.p. 90-95 ºC); ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 7.30 (brs, exch. D_2O, 1H), 5.80 (s, 1H), 3.79 (s, 3H), 2.47 (t, *J* = 6.9 Hz, 2H), 1.44 (m, 2H), 1.30-1.20 (m, 4H), 0.90 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 182.9, 181.0, 163.9, 150.3, 120.2, 106.2, 57.0, 31.9, 29.8-29.2 (6C), 28.6, 22.8, 22.1, 14.1; Anal. calcd. for $C_{18}H_{28}O_4$: C, 70.10; H, 9.15. found: C, 70.18, H, 9.21.

Irisoquin (1b): A yellow crystal, m.p. 98-99 ºC (lit.[3b], m.p. 100.3-101.5 ºC); ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 7.26 (brs, exch. D_2O, 1H), 5.88 (s, 1H), 3.82 (s, 3H), 2.47 (t, *J* = 7.0 Hz, 2H), 1.60-1.20 (m, 30H), 0.90 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 182.5, 181.8, 162.9, 152.7, 121.4, 104.8, 57.9, 31.9, 29.8-29.2(13C), 28.4, 22.8, 22.5, 14.2; Anal. calcd. for $C_{25}H_{42}O_4$: C, 73.85; H, 10.41. found: C, 73.79, H, 10.48.

Ardisianone B (1c): A yellow crystal, m.p. 62-64 ºC (lit.[3a], m.p. 63 ºC); ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.29 (brs, exch. D_2O, 1H), 5.80 (s, 1H), 5.40-5.30 (m, 2H), 3.80 (s, 3H), 2.46 (t, *J* = 7.2 Hz, 2H), 2.20-1.80 (m, 4H), 1.60-1.20 (m, 12H), 0.89 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 183.0, 181.9, 159.2, 151.4, 129.9,124.3, 120.5, 103.4, 57.2, 32.5, 29.7-29.0(4C), 28.7, 27.8, 26.9, 23.0, 22.2, 14.0; Anal. calcd. for $C_{20}H_{30}O_4$: C, 71.82; H, 9.04. found: C, 71.76, H, 9.06.

Maesanin (1d): A yellow crystal, m.p. 65-66 ºC (lit.[3b], m.p. 68-70 ºC); ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.20 (brs, exch. D_2O, 1H), 5.82 (s, 1H), 5.45-5.30 (m, 2H), 3.85 (s, 3H), 2.40 (t, *J* = 7.4 Hz, 2H), 2.20-1.85 (m, 4H), 1.60-1.20 (m, 18H), 0.89 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 183.6, 182.9, 156.5, 151.2, 129.9, 129.8, 121.3, 105.4, 57.9, 32.1, 29.7-29.0 (6C), 28.2, 27.2, 26.9, 23.0, 22.2, 14.0; Anal. calcd. for $C_{22}H_{34}O_3$: C, 72.89; H, 9.45. found: C, 72.80, H, 9.36.

Pallasone C (1e): a yellow crystal, m.p. 60-62 ºC (lit.[3b], m.p. 62-64 ºC); ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.30 (brs, exch. D_2O, 1H), 5.82 (s, 1H), 5.45-5.25 (m, 2H), 3.80 (s, 3H), 2.39 (t, *J* = 7.2 Hz, 2H), 2.20-1.90 (m, 4H), 1.60-1.20 (m, 22H), 0.88 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (75 MHz; $CDCl_3$) δ: 183.9, 182.0, 158.6, 151.5, 130.2, 129.8, 120.9, 103.4, 56.9, 31.6, 29.7-29.0 (8C), 28.4, 27.2, 26.9, 23.0, 22.5, 14.0; Anal. calcd. for $C_{24}H_{38}O_4$: C, 73.81; H, 9.81. found: C, 73.74, H, 9.72.

RESULTS AND DISCUSSION

Compound **1** was prepared starting from 2-hydroxy-3,6-dimethoxybenzaldehyde, as outlined in **Scheme-I**. Ultrasound-assisted Wittig reaction of alkyltriphenyl phosphonium bromides with 2-hydroxy-3,6-dimethoxybenzaldehyde in present of K_2CO_3 and using DMSO/water as solvent afforded a double bond of the styrene **2a-2e** in 68-79 % yields. Reduction of **2a-2e** were attempted by catalytic hydrogenolysis over Pd/C, but the means wasn't suitable for synthesis of 3,6-dimethoxy-2-

alkenylphenols in that the isolated olefin was reductced. However, compounds **2a-2e** were treated with metallic sodium in *n*-butanol to obtain **3a-3e** in 71-82 % yields, where the conjugated olefin was reduced but the isolated olefin was not affected[7], followeg by oxidation of **3a-3e** with Fremy's salt produced compounds **4a-4e** in 79-93 % yields, selective hydrolysis with perchloric acid converted 2,5-dimethoxy-3-alkyl-1,4-benzoquinones into the title compounds **1a-1e** in a good yields (Table-1).

TABLE-1
SYNTHESIS OF 2-HYDROXY-5-METHOXY-3-ALKYL-1,4-BENZOQUINONES

Entry	R	**2**	Yield (%)[a]	**3**	Yield (%)[b]	**4**	Yield (%)[c]	**1**	Yield (%)[d]
1	$CH_3(CH_2)_8$	**2a**	78	**3a**	82	**4a**	93	**1a**	68
2	$CH_3(CH_2)_{15}$	**2b**	75	**3b**	78	**4b**	87	**1b**	72
3	$CH_3(CH_2)_3CH=*CH(CH_2)_5$	**2c**	73	**3c**	71	**4c**	79	**1c**	69
4	$CH_3(CH_2)_3CH=*CH(CH_2)_7$	**2d**	68	**3d**	73	**4d**	83	**1d**	60
5	$CH_3(CH_2)_5CH=CH(CH_2)_7$	**2e**	70	**3e**	73	**4e**	85	**1e**	74

*Z isomer; [a]Total yield of the Z and E mixture; [b]Isolated yield; [c]Isolated yield; [d]Isolated yield.

Wittig reaction is one of the most versatile synthetic methods for preparation of olefins from carbonyl compounds and it is classically carried out using a hydride or organometallic base in anhydrous aprotic solvents under an inert atmosphere. During synthesis of phenol **2**, the solid-liquid transfer technique was applied to the Wittig reaction. The salt-free system is a more environmentally friendly strategy than the methods utilizing lithium bases[8]. To exploit simple and suitable condition for synthesis of phenol **2**, the reaction of undecyltriphenyl phosphonium bromides with 2-hydroxy-3,6-dimethoxybenzaldehyde was chosen as a model and its behaviour was studied under a variety of conditions *via* TLC and ^{1}H NMR and ^{13}C NMR spectroscopy (Table-2).

TABLE-2
RESULTS OF THE REACTIONS OF UNDECYLTRIPHENYLPHOSPHONIUM BROMIDE AND 2-HYDROXY-3,6-DIMETHOXYBENZALDEHYDE IN THE PRESENCE OF DIFFERENT CONDITIONS*

Entry	Base	Solvent	Time (h)	Ultrasound	Yield (%)**
1	NaOH	Dioxance/ water	1	+	26
2	NaOH	Dioxance/water	5	-	0
3	NaOH	DMSO/water	1	+	31
4	NaOH	DMSO/water	5	-	0
5	K_2CO_3	Dioxance/ water	1	+	34
6	K_2CO_3	Dioxance/water	5	-	21
7	K_2CO_3	DMSO/water	1	+	78
8	K_2CO_3	DMSO/water	5	-	54

*2-Hydroxy-3,6-dimethoxybenzaldehyde: butyltriphenylphosphonium bromide:base:water = 1:1:2:2, the reaction carried out at 90-100 ºC; **Total yield of the Z and E mixture.

According to Table-2, the best result was obtained in present of K_2CO_3, ultrasound irradiation and using DMSO/water as solvent (entry 7). The results also emphasized the importance of using ultrasound irradiation (entry 1, 3, 5, 7), which could shorten reaction time and improve yield.

Conclusion

In summary, a general methodology to synthesize a range of 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones in excellent yield based on ultrasound-assisted Wittig reaction. It is believed that this methodology has valuable addition to the existing methods in the field of 2-hydroxy-5-methoxy-3-alkyl-1,4-benzoquinones synthesis.

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