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Research Article

SYNTHESIS, CHARACTERIZATION OF NOVEL P-(SUBSTITUTED PHENYL) - 2 (SUBSTITUTED PHENYL) ETHENE DERIVATIVES

NILESH JAIN*[1], SARITA SINGHAL[1] AND SURENDRA KUMAR JAIN[2]

***Mahatma Jyoti Rao Phoole University, NH-8 near Achrol, Jaipur, Rajasthan, India-302019,[2]Sagar Institute of Research & Technology-Pharmacy, Ayodhya Bypass Road Bhopal, MP,India-462041, Email :** nilujain01@yahoo.co.in

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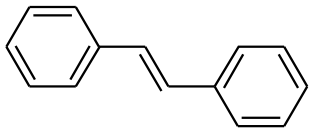
ABSTRACT

Objective: Stilbene based compounds are widely represented in nature and have become particular interest because of their wide range of biological activities. The aim of research work was to synthesize many synthetic compounds using stilbene as the essential pharmacophore. **Methods:** A series of novel P-(substituted phenyl) - 2 (substituted phenyl) Ethene derivatives (1a-1q) have been synthesized by the witting reactions i.e. Substituted benzyl chloride reacted with the phosphonium chloride salt give the P substituted benzyl (chloro) triphenyl phosporane (1) which on further reaction with substituted benzaldehyde yielded the corresponding 1a–1q. **Results:** The yield of synthesized compound was found to be in the range of 60-85%.Synthesized compounds were characterized by their physiochemical properties like solubility, melting point, IR spectroscopy, ^{1}H NMR spectroscopy, Fab MASS and elemental analysis and result of analysis confirm the structure of synthesize compound. **Conclusion:** This procedure appears to be a promising and conceptually straightforward route for the synthesis of various Cis-stilbenes. The synthesis and characterization of other phenyl substituted compounds using this method are under investigation, and will be reported in due course.

Keywords: Witting reactions, Substituted benzaldehyde, Substituted benzyl chloride

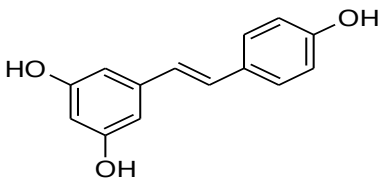
INTRODUCTION

The name stilbene was derived from the Greek word *stilbos*, which means shining. Stilbene are chemically derivatives of trans 1,2-diphenylethylene.

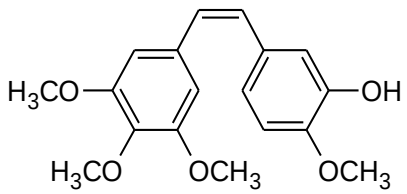


Stilbene

Stilbene based compounds are widely represented in nature and have become particular interest because of their wide range of biological activities [1]. Stilbene itself does not occur in nature, but its hydroxylated or methoxylated derivatives are abundantly found in nature. Some of these such as trans-resveratrol [2], the cis-stilbene combrestatinA-4 and stilbene based vitamin A analogue have shown unique potentialities for treatment of cancer [3, 4].



Trans –Resveratrol



Combrestatin A-4

Stilbenes, such as resveratrol, piceatannol, and pinosylvin, are compounds found in numerous medicinal plants and food products [5-7]. The natural stilbene most relevant and more described in the literature is resveratrol, which was first isolated from Chinese and Japanese medicinal plants in 1963 [8]. In 1992, this compound was postulated to explain some of the cardioprotective effects of red wine (the so-called-French paradox) [9-11]. Since then, dozens of studies have indicated that resveratrol plays an important role in preventing or slowing the progression of many diseases and illnesses, such as inflammation [12-15], cancer [6,7,13] and heart diseases[8,16]. Recently, additional properties of resveratrol have been documented, such as radical scavenging, antioxidant activity [15, 17], neuroprotection [15, 18], antiviral activity [15, 19], antibacterial activity [20-22], antitubercular activity [23-25]. In 1985 Moreno *et al* [26], synthesized stilbene derivatives by using Wittig reaction, but the yield was very less (10%). In 1990 Kikumoto *et al* [27], they have synthesized stilbenes as an intermediate of the final compound [2 (ω – Aminoalkoxy) phenyl] ethyl] benzene. The starting material was triphenyl phosphonium salt with different aldehyde by Wittig reaction.

In 1992 Yamataka *et al* [28], have reported relative reactivity and Stereoselectivity of substituted benzaldehydes in the Wittig reaction with benzylidene triphenyl phospharane. In 1997 Orsini et *al* [29], carried out a synthesis of new stilbene derivatives by a Wittig reaction between the 3,5- bis –(tert-butyldimethylsilyloxy) benzaldehydes and the phosphonium ylide obtained from (4-methoxybenzyl)- triphenyl-phosphonium chloride, but the product obtained was a Z/ E mixture (ratio 2:3:1), of 3,4,5 –tri-hydroxyl-stilbene. They have synthesized a new derivative of resveratrol and shown the antiplatelet aggregation activity. In the present study of research for stilbene derivatives, we try to synthesize some new methoxylated and hydroxylated stilbenes as well as other halogen containing stilbenes by using Wittig reaction.

The title products reported were characterized on the basis of solubility, melting point, IR spectroscopy, ^{1}H NMR spectroscopy, Fab MASS and elemental analysis.

MATERIALS AND METHODS

Commercial reagents and solvents were procured from S.D Fine, Sigma Aldrich, Hi-Media, Merck, Loba Chemical (India). The purity of all the synthesized compounds were checked by thin layer

chromatography on silica gel G as a stationary phase and different solvent systems as a mobile phase using iodine vapors as a detecting agent The melting points were determined by open capillary method using jindal melting point apparatus and are uncorrected. The IR spectra (in KBr pellets) were recorded on a Bruker Alpha FTIR Spectrophotometer. Proton NMR spectra were done on Bruker Avance II 400 NMR Spectrometer using tetramethyl silane as internal standard. Mass spectra of the compounds were carried out on JOEL SX 102/DA- 600 Mass spectrometer using fast atom bombardment (FAB) technique in positive ion mode.

Chemistry

A series of P-(substituted phenyl) - 2 (substituted phenyl) Ethene has been synthesized. Substituted benzyl chloride reacted with the phosphonium chloride salt give the P substituted benzyl (chloro) triphenyl phosporane (1) which on further reaction with substituted benzaldehyde yielded the corresponding 1a–1q.

General methods

The title compounds were prepared in following steps:

Procedure for preparation of benzyl (chloro) triphenyl phosphorane (1)

In 250ml round bottom flask, a solution of benzyl chloride (20.25g, 0.16 mol) and PPh_3 (41.5g, 0.17 mol) in CH_3CN (100 ml) was stirred for 12 hr under reflux. The reaction mixture was concentrated by evaporation to give a residue. The crude product 1, was purified by crystallization from $CHCl_3$ / Et_2O, affording 95% yield (58.3 g) as a white solid: mp 324-326 ^oC [30].

General procedure for synthesis of compound (1a-1q)

A well-stirred suspension of phosphonium chloride salt (2 m mol) and aryl aldehyde (2 m mol) in benzene (20 ml) was prepared and Sodium hydride (72.0 mg, 3 m mol) was added under 0-5 ^0C and the mixture were allowed to come to room temperature. After the additional stirring for 16 hr, excess sodium hydride was quenched by the addition of methanol (1 ml). Solvent from the reaction mixture were evaporated at reduced pressure. Residue was extracted with 30 ml mixture of chloroform and water; separate the organic and aqueous layer. Aqueous layer contains the phosphonium oxide as an impurity Distilled off the organic layer and residue was purified by preparative column chromatography using 5% EtOH in hexane as the eluent or by recrystalization with ethanol. Synthetic pathway for preparation of compounds is shown in Scheme 1 (Figure 1).

SCHEME 1

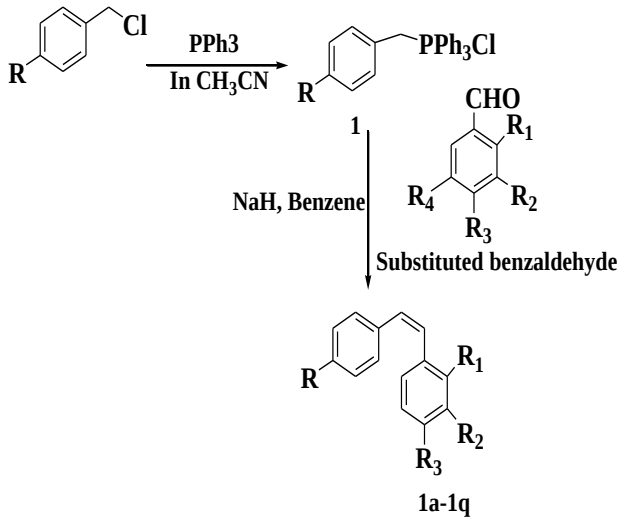


Figure1: Synthetic pathway for preparation of compounds

RESULTS

In present work focus was made manly on the synthesis of stilbene as the essential pharmacophore and investigation in combination with various substitutions in Ar and Ar' ring. To accomplish the synthesis of desired compounds, Scheme 1 presents a synthetic route of conventional Wittig reaction entails the reaction of a phosphonium ylide with an aldehyde or a ketone. Substituted benzyl chloride is treated with PPh_3 in presence of base to give P-Substituted benzyl (chloro) triphenyl phosphorane **1** with a yield of 95% as white solid. The synthesized compound **1** was treated with the substituted benzaldehyde in the presence of sodium hydride to give the desired compounds **1a-1q** with yield in range of 60-80%. The reaction was monitored by TLC. The physical data of synthesized compounds is given in Table 1.

Table 1: Physical Data of P-(Substituted Phenyl) - 2 (Substituted Phenyl) Ethene Derivatives

COMPOUND	R	R_1	R_2	R_3	MOLECULAR FORMULA	MOLECULAR WEIGHT
1a	-CH3	-H	-NO2	-H	$C_{15}H_{13}O_2N$	239
1b	-H	-H	-NO2	-H	$C_{14}H_{11}O_2N$	225
1c	-CH3	-H	-H	-NO2	$C_{15}H_{13}O_2N$	239
1d	-H	-H	-OCH3	-H	$C_{15}H_{14}O$	210
1e	-Cl	-H	-H	-OCH3	$C_{15}H_{13}ClO$	244
1f	-F	-H	-H	-OH	$C_{14}H_{11}FO$	214
1g	-CH3	-H	-H	-Cl	$C_{15}H_{13}Cl$	228
1h	-OH	-H	-Cl	-Cl	$C_{14}H_{10}Cl_2O$	265
1i	-OH	-H	-OCH3	-OCH3	$C_{16}H_{16}O3$	256
1j	-OH	-H	-F	-F	$C_{14}H_{10}F_2O$	232
1k	-OH	-H	-OH	-OCH3	$C_{16}H_{16}O_3$	256
1l	-OH	-H	-OCH3	-OH	$C_{15}H_{14}O_3$	242
1m	-CH3	-H	-Cl	-Cl	$C_{15}H_{12}Cl_2$	263
1n	-Cl	-H	-OCH3	-OCH3	$C_{16}H_{15}ClO_2$	274
1o	-Cl	-H	-OH	-OCH3	$C_{15}H_{13}ClO_2$	260
1p	-CH3	-H	-F	-F	$C_{15}H_{12}F_2$	230
1q	-Cl	-H	-OC2H5	-OH	$C_{16}H_{15}ClO_2$	274

Spectral data

1-[(Z)-2-(4-Methylphenyl)Ethenyl]-3-Nitrobenzene (1a)

Light yellow Powder, yield 60%, mp 95-98 ^0C, R_f Value 0.42, IR (KBr, cm^{-1}): 3026 (C-H Str (Ar)), 2822(C-H (Aliphatic)), 1604(C=C (Aliphatic)), 1524 (N=O), 850 (C-N (Ar nitro)). ^1H NMR (400 MHz, $CDCl_3$, ppm): 2.41 (s, 3H, -CH3), 6.49 – 6.59 (m, 2H, CH=CH), 7.24 (s, 3H, -CH3), 7.54 – 7.59 (m, 2H, Ar'-H), 7.71 –8.34 (m, 1H, Ar'-H). MS, m/z (%): 239 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{13}O_2N$: C, 75.30; H, 5.48; N, 5.85. Found: C, 75.26; H, 5.39; N, 5.23.

1-Nitro-3-[(Z)-2-Phenylethenyl] Benzene (1b)

White powder, yield 65%, mp 85-88^{0}C, R_f Value 0.50, IR (KBr, cm^{-1}): 2944 (C-H Str (Ar)), 2830 (C-H (Aliphatic)), 1606 (C=C (Aliphatic)), 1523 (N=O), 850 (C-N (Ar nitro)). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 6.51 – 6.60 (m, 2H, CH=CH), 7.15 – 7.21 (ddt, 1H, Ar-H), 7.24 – 7.32 (m, 3H, Ar-H), 7.55 – 7.60 (dt, 1H, Ar'-H), 7.71 – 8.35 (t, 1H, Ar'-H).MS, m/z (%): 225 $[M+H]^+$ (100%). Anal. Calcd. for $C_{14}H_{11}O_2N$: C, 74.65; H, 4.92; N, 6.22. Found: C, 75.04; H, 4.71; N, 6.43.

1-Methyl-4-[(Z)-2-(4-Nitrophenyl)Ethenyl]Benzene(1c)

White powder, yield 70%, mp 148-150^{0}C, R_f Value 0.46, IR (KBr, cm^{-1}): 3028 (C-H Str (Ar)), 2924(C-H (Aliphatic)), 1604 (C=C (Aliphatic)), 1523(N=O),850 (C-N (Ar- nitro)). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 2.41 (s, 3H, -CH3), 6.51 – 6.56-6.65 (dt, 1H, CH-CH), 7.24 (s, 3H, Ar-H), 7.69 - 8.45 (m, 2H, Ar'-H). MS, m/z (%): 239 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{13}O_2N$: C, 75.30; H, 5.48; N, 5.85. Found: C, 75.02; H, 5.24; N, 5.42.

1-Methoxy-3-[(Z)-2-Phenylethenyl] Benzene (1d)

Light Green powder, yield 75%, mp 66-68^{0}C, R_f Value 0.53, IR (KBr, cm^{-1}): 3083 (C-H Str (Ar)), 3033(C-H (Aliphatic)), 1597(C=C (Aliphatic)), 2832 (-OCH_3). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 3.86 – 3.89 (s, 3H, -CH3), 6.49 – 6.57 (m, 2H, CH=CH), 6.83 –6.97 (dt, 1H, Ar'-H), 7.09 – 7.13 (t, 1H, Ar'-H), 7.24 – 7.33 (m, 2H, Ar-H), 7.33 – 7.44 (m, 4H, Ar-H). MS, m/z (%): 210 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{14}O$: C, 85.68; H, 6.71.Found: C, 85.09; H, 6.31.

1-Chloro-4-[(Z)-2-(4-Methoxyphenyl)Ethenyl]Benzene (1e)

Pale Yellow powder, yield 60%, mp 109-110C, Rf Value 0.48, IR (KBr, cm^{-1}): 3028 (C-H Str (Ar)), 2962 (C-H (Aliphatic)), 1593 (C=C (Aliphatic)), 2839 (-OCH3 Ar), 758 (C-Cl (Ar) mono). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 3.88 (s, 3H-CH3), 6.43 – 6.48 (m, 1H, CH=CH), 7.21 – 7.23 (dt, 1H Ar'-H), 7.43 – 7.48 (m, 2H, Ar'-H), 7.56 – 7.58 (m, 1H, Ar-H). MS, m/z (%): 244 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{13}ClO$: C, 73.62; H, 5.35. Found: C, 73.19; H, 5.11.

4-[(Z)-2-(4-Fluorophenyl)Ethenyl]Phenol(1f)

Pale Yellow powder, yield 75%, mp 145-147^{0}C, R_f Value 0.63, IR (KBr, cm^{-1}): 1704 (C=C (Aliphatic)), 3351 (-OH), 1015 (C-F (Ar) mono). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 4.74 (s, 1H,-OH), 6.47 – 6.48 (s, 4H, - CH=CH), 6.72 – 6.77 (m, 2H), 7.39 – 7.43 (d, 3H, Ar'-H), 7.53 – 7.66 (m, 6H, Ar-H). MS, m/z (%): 214 $[M+H]^+$ (100%). Anal. Calcd. for $C_{14}H_{11}FO$: C, 78.49; H, 5.18. Found:C, 78.21; H, 5.71

1-Chloro-4-[(Z)-2-(4-Methylphenyl)Ethenyl]Benzene (1g)

White Crystalline powder, yield 65%, mp 87-880C, Rf Value 0.62, IR (KBr, cm^{-1}): 3027 (C-H Str (Ar)), 2923 (C-H (Aliphatic)), 1603 (C=C (Aliphatic)),727 (C-Cl (Ar) mono).. ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 2.48 (t, 2H, -CH3), 6.47 (d, 1H, - CH=CH), 7.31 – 7.34 (m, 2H, Ar'-H), 7.41 – 7.43 (m, 1H, Ar'-H), 7.53 – 7.58 (m, 1H, Ar-H).MS, m/z (%): 228 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{13}Cl$: C, 78.77; H, 5.73. Found: C, 78.39; H, 5.20.

4-[(Z)-2-(3,4-Dichlorophenyl)Ethenyl]Phenol (1h)

Pale yellow powder, yield 67%, mp 217-219^{0}C, R_f Value 0.48, IR (KBr, cm^{-1}): 3032 (C-H Str (Ar)), 2869 (C-H (Aliphatic)), 1694 (C=C (Aliphatic)), 821 (C-Cl (Ar) Poly), 3445 (-OH). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 4.68 (s, 1H, Ar-OH), 6.36 – 6.40 (d, 2H, CH=CH), 6.63 – 6.65 (m, 2H, Ar-H), 7.25 – 7.31 (m, 5H, Ar'-H).MS, m/z (%): 264 $[M+H]^+$ (100%). Anal. Calcd. for $C_{14}H_{10}Cl_2O$: C, 63.42; H, 3.80. Found: C, 63.31; H, 3.69.

4-[(Z)-2-(3,4-Dimethoxyphenyl)Ethenyl]Phenol(1i)

Light brown powder, yield 70%, mp 224-226^{0}C, R_f Value 0.49, IR (KBr, cm^{-1}): 2962(C-H Str (Ar)), 2836 (C-H (Aliphatic)), 1595 (C=C (Aliphatic)), 2939 (-OCH_3 Ar). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 3.84 – 3.86 (d, 6H, -CH3), 4.79 (s, 1H, Ar- OH), 6.37 – 6.38 (d, 2H, CH=CH), 7.04 (d, 1H, Ar'-H), 7.21(d, 2H, Ar'-H), 7.30 – 7.31 (m, 2H, Ar-H).MS, m/z (%): 253 $[M+H]^+$ (100%). Anal. Calcd. for $C_{16}H_{16}O3$: C, 74.98; H, 6.29. Found: C, 74.77; H, 6.18.

4-[(Z)-2-(3,4-Difluorophenyl)Ethenyl]Phenol(1j)

Pale yellow green powder, yield 75%, mp 158-160^{0}C, R_f Value 0.41, IR (KBr, cm^{-1}): 3032 (C-H Str (Ar)), 1599 (C=C (Aliphatic)), 1264 (C-F (Ar) Poly). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 4.75 (s, 1H, Ar- OH),), 6.35 – 6.40 (m, 2H, CH=CH), 6.63 – 6.65 (m, 2H, Ar-H), 7.02 – 7.09 (m, 2H, Ar'-H), 7.28 – 7.30 (m, 2H, Ar-H).MS, m/z (%): 231 $[M+H]^+$ (100%). Anal. Calcd. for $C_{14}H_{10}F_2O$: C, 72.41; H, 4.34. Found: C, 72.34; H, 4.10.

2-Ethoxy-4-[(Z)-2-(4-Hydroxyphenyl)Ethenyl]Phenol(1k)

White crystalline powder, yield 65%, mp 301-303^{0}C, R_f Value 0.53, IR (KBr, cm^{-1}): 3060 (C-H Str (Ar)), 1599 (C=C (Aliphatic)), 1747(C-O), 2966 (-OCH_3 Ar). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 2.95 (t, 3H,-CH_3), 4.13 (q, 2H,—OC_2H_5), 4.71 (s, 1H, Ar- OH), 5.79 (s, 1H, Ar'- OH), 6.32 – 6.38 (m, 2H, CH=CH), 6.63 – 6.65 (m, 2H, Ar-H), 6.77 (dd, 1H, Ar'-H), 7.02 – 7.05 (m, 2H, Ar'-H), 7.28 – 7.33 (m, 2H, Ar-H). MS, m/z (%): 256 $[M+H]^+$ (100%). Anal. Calcd. for $C_{16}H_{16}O_3$: C, 74.98; H, 6.29. Found: C, 74.81; H, 6.12

5-[(Z)-2-(4-Hydroxyphenyl)Ethenyl]-2-Methoxyphenol(1l)

White crystalline powder, yield 65%, mp 290-293^{0}C, R_f Value 0.56, IR (KBr, cm^{-1}): 3031 (C-H Str (Ar)), 2982 (C-H (Aliphatic)), 1644.52 (C=C (Aliphatic)), 2932 (-OCH_3 Ar), 3429 (-OH). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 3.85 (s, 3H, -OCH_3), 4.84 (s, 1H, Ar- OH), 5.75 (s, 1H, Ar'-OH), 6.32 – 6.36 (m, 2H, CH=CH), 6.63 – 6.65 (m, 2H, Ar-H), 7.30-7.32 (dd, 2H, Ar-H). MS, m/z (%): 243 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{14}O_3$: C, 74.36; H, 5.82. Found: C, 74.29; H, 5.73.

1,2-Dichloro-4-[(Z)-2-(4-Methylphenyl)Ethenyl]Benzene (1m)

White powder, yield 70%, mp 129-131^{0}C, R_f Value 0.57, IR (KBr, cm^{-1}): 3029 (C-H Str (Ar)), 2868 (C-H (Aliphatic)), 1591 (C=C (Aliphatic)), 819 (C-Cl (Ar) Poly). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 2.41 (s, 3H, -CH_3)6.39 – 6.44 (m, 2H, CH=CH), 7.24 (ddd, 1H, Ar'-H), 7.28 – 7.35 (m, 2H, Ar-H). MS, m/z (%): 263 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{12}Cl_2$: C, C, 68.46; H, 4.60. Found: C, 68.24; H, 4.49.

4-[(Z)-2-(4-chlorophenyl)ethenyl]-1,2-dimethoxybenzene(1n)

Brown powder, yield 70%, mp 155-157^{0}C, R_f Value 0.48, IR (KBr, cm^{-1}): 3027 (C-H Str (Ar)), 2839 (C-H (Aliphatic)), 1593 (C=C (Aliphatic)), 2962 (-OCH_3 Ar), 758(C-Cl (Ar) mono). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 3.85 (d, 6H, -CH_3), 6.41 (d, 2H, CH=CH), 7.11 – 7.12 (m, 1H, Ar'-H), 7.21 (d, 1H, Ar'-H), 7.30 (d, 1H, Ar'-H), 7.34 – 7.30 (m, 2H, Ar-H). MS, m/z (%): 273 $[M+H]^+$ (100%). Anal. Calcd. for $C_{16}H_{15}ClO_2$: C, 69.95; H, 5.50. Found: C, 69.87; H, 5.34.

5-[(Z)-2-(4-Chlorophenyl)Ethenyl]-2-Methoxyphenol(1o)

Yellowish Green powder, yield 75%, mp 220-222^{0}C, R_f Value 0.49, IR (KBr, cm^{-1}): 3027 (C-H Str (Ar)), 2841 (C-H (Aliphatic)), 1680 (C=C (Aliphatic)), 2957 (-OCH_3 Ar), 761 (C-Cl (Ar) mono). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 3.85 (s, 3H, -CH_3), 5.75 (s, 1H, Ar'-OH), 6.35 – 6.39 (m, 2H, CH=CH), 7.07 (d, 2H, Ar'-H), 7.34-7.50 (m, 2H, Ar-H). MS, m/z (%): 261 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{13}ClO_2$: C, 69.10; H, 5.03.Found:C, 68.94; H, 4.98.

1,2-Difluoro-4-[(Z)-2-(4-Methylphenyl)Ethenyl]Benzene(1p)

Pale Yellow powder, yield 80%, mp 70-74^{0}C, R_f Value 0.46, IR (KBr, cm^{-1}): 3030 (C-H Str (Ar)), 1593 (C=C (Aliphatic)), 1601(C=C (Aliphatic)), 1206 (C-F (Ar) Poly). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 2.41 (s, 3H, -CH_3) 6.37-6.43 (d, 2H, CH=CH), 7.05 – 7.09 (m, 3H, Ar'-H), 7.23 – 7.29 (m, 1H, Ar-H). MS, m/z (%): 2232 $[M+H]^+$ (100%). Anal. Calcd. for $C_{15}H_{12}F_2$: C, 78.24; H, 5.25. Found:C, 78.10; H, 5.41.

4-[(Z)-2-(4-Chlorophenyl)Ethenyl]-2-Ethoxyphenol(1q)

White crystalline powder, yield 75%, mp 232-235^{0}C, R_f Value 0.53, IR (KBr, cm^{-1}): 3963 (C-H Str (Ar)), 2838 (C-H (Aliphatic)), 1592 (C=C (Aliphatic)), 1507(C=O Ar), 1026 (C-Cl (Ar) mono), 3383 (-OH). ^{1}H NMR (400 MHz, $CDCl_3$, ppm): 2.83 (t, 3H, -CH_3), 4.13 (q, 2H,-OC_2H_5), 5.81 (s, 1H, Ar'- OH), 6.36 (s, 2H, CH=CH), 6.83 – 6.84 (m, 1H, Ar'-H), 7.48 – 7.50 (m, 2H, Ar-H).MS, m/z (%): 274 $[M+H]^+$ (100%). Anal. Calcd. for $C_{16}H_{15}ClO_2$: C, 69.95; H, 5.50. Found: C, 69.87; H, 5.44.

DISCUSSION

The IR spectra data of **1a-1q** are revealed that the presence of C-H Str (Ar) peak at 2944-3083 cm^{-1}, 1603- 1550 cm^{-1} (C=C (Aliphatic)), 2939 cm^{-1} (-OCH_3 Ar), 700-800 cm^{-1} (C-Cl (Ar)),~1100 cm^{-1}(C-F (Ar)). The ^{1}H NMR spectra data of 1a-1q are revealed a fine singlet at δ: 3.86 – 3.89 (s, 3H, -CH3), δ: 6.49 – 6.59 (m, 2H, CH=CH), from stilbene, respectively. The resonance peaks that appeared at δ: 7.32 – 7.59 (m, 2H, Ar'-H), δ: 7.71 –8.34 (m, 1H, Ar-H) could be assigned to the contribution of aromatic protons from stilbene moiety. The structures of the all compounds **1a-1q** were also confirmed by their element analysis and MASS spectral data. The spectral data of all compounds **1a-1q** was shown below that confirmed their structures.

CONCLUSION

The result of IR spectra and NMR spectra confirmed the structure of synthesized compound. The elemental analysis of **1a-1q** was in good agreement with those calculated values for the expected molecular formula. The mass spectrum illustrated the molecular ion peak found to be correct which will conform the structure of respective **1a-1q.** All the above spectral data supported the synthesis of compound **1a-1q**. The structures of the all compounds **1a-1q** were also confirmed by their analytical and spectral data.

REFERENCES

1. Becher KB. Synthesis of Stilbenes. Synthesis 1983; 341-368.
2. Dorrie J, Gerauer H, Wachter Y, Zunino S. Resveratrol induces extensive apoptosis by depolarizing mitochondrial membranes and activating caspase-9 in acute lymphoblastic leukemia cells. Cancer Res 2001; 61: 4731-4739.
3. Lin CM, Ho HH, Pettit GR, Hamel E. Antimitotic natural products combretastatin A-4 and combretastatin A-2 studies. Biochemistry 1989; 28:6984-6995.
4. Simoni D, Giannini G, Baraldi PG, Romagnoli R, Roberti M, Rondanin R. Convenient synthesis of unsymmetrically substituted terphenyls of biologically active stilbenes via a Double Suzuki cross- coupling protocol. Tetrahedron lett 2003; 44:3005-3008.
5. Chong J, Poutaraud A, Hugueney P. Metabolism and roles of stilbenes in plants. Plant Sci 2009; 177: 143–155
6. Robert M, Pizzirani D, Recanatini M, Simoni D, Grimaudo S, Cristina AD et al. Identification of a terphenyl derivative that blocks the cell cycle in the G0-G1 phase and induces differentiation in leukemia cells. J Med Chem 2006; 49:3012-3018.
7. Breinbauer R, Vetter IR, Waldmann H. From protein domains to drug candidates - natural products as guiding principles in compound library design and synthesis. Angew Chem Int Ed Engl 2002; 41:2878–2890.
8. Baur JA, Sinclair DA. Therapeutic potential of resveratrol: the *in vivo* evidence. Nat Rev Drug Discov 2006; 5:493-506.
9. Renaud S, De Lorgeril M. Wine, alcohol, platelets, and the French paradox for coronary heart disease. Lancet 1992; 339:1523-1526.
10. Baur JA, Pearson, KJ, Price NL, Jamieson HA, Lerin C, Kalra A, et al. Resveratrol improves health and survival of mice on a high-calorie diet. Nature 2006; 444: 337–342.
11. Kimura Y, Okuda H, Arichi S. Effects of stilbenes on arachidonate metabolism in leukocytes. Biochim Biophys Acta 1985; 834:275–278.
12. Park EJ, Min HY, Ahn YH, Bae CM, Pyee JH, Lee SK. Synthesis and inhibitory effects of pinosylvin derivatives on prostaglandin E2 production in lipopolysaccharide-induced mouse macrophage cells. Bioorg Med Chem Lett 2004; 14: 5895–5898.
13. Heynekamp JJ, Webwe WM, Hunsker LA, Gonzales AM, Orlando RA. Substituted trans-stilbenes, including analogs of the natural product resveratrol, inhibit the tumor necrosis factor-alpha-induced activation of nuclear factor-kappa B. J Med Chem 2006; 49:7182–7189.
14. Lion CJ, Matthews CS, Stevens MFG, Westwell AD. Synthesis, antitumor evaluation, and apoptosis-inducing activity of hydroxylated (E)-stilbenes. J Med Chem 2005; 48: 1292–1295.
15. Botella L, Nájara C. Synthesis of methylated resveratrol and analogues by Heck reactions in organic and aqueous solvents. Tetrahedron 2006; 60: 5563–5570.
16. Velder J, RitterS, Lex J, Schmalz HG A. simple access to biologically important trans-stilbenes via Ru-catalyzed cross metathesis. Synthesis 2006; 2: 273–278.
17. Jang DS, Kang BS, Ryu SY, Chang IM, Min KE, Kim Y. Inhibitory effects of resveratrol analogs on unopsonized zymosan-induced oxygen radical production. Biochem Pharmacol 1999; 57: 705-712.
18. Gupta YK, Chaudhary G, Srivastava AK. Protective effect of resveratrol against pentylenetetrazole-induced seizures and its modulation by an adenosinergic system. Pharmacology 2002; 65: 170-174.
19. Docherty JJ, Fu MMH, Stifler BS, Limporos RJ, Pokabla CM, Delucia AL. Resveratrol inhibition of herpes simplex virus replication. Antiviral Res 1999; 43: 135–145.
20. Chen G, Shan W, Wu Y, Ren L, Dong J, Ji Z. Synthesis and anti-inflammatory activity of resveratrol analogs. Chem Pharm Bull 2005; 53:1587–1590.
21. Sundar I, Chang FN. The role of guanosine-3',5'-bis-pyrophosphate in mediating antimicrobial activity of the antibiotic 3,5-dihydroxy-4-ethyl-trans-stilbene. Antimicrob Agents Chemother 1992; 36: 2645–2651.
22. Subramanian M, Shadakshari U, Chattopadhyay, S. A mechanistic study on the nuclease activities of some hydroxystilbenes. Bioorg Med Chem 2004; 12: 1231–1237.
23. Kabir MS, Engelbrecht K, Polanowski R, Krueger,SM, Ignasiak R, Rott M, et al. New classes of Gram-positive selective antibacterials: inhibitors of MRSA and surrogates of the causative agents of anthrax and tuberculosis. Bioorg Med Chem Lett 2008; 18: 5745–5749.
24. Skretas G, Meligova AK, Villalonga-Barber C, Mitsiou DJ, Alexis MN, Micha-Screttas M, et al. Engineered chimeric enzymes as tools for drug discovery: generating reliable bacterial screens for the detection, discovery, and assessment of estrogen receptor modulators. J Am Chem Soc 2007; 129: 8443–8457.
25. Lechner D, Gibbons S, Bucar F. Plant phenolic compounds as ethidium bromide efflux inhibitors in *Mycobacterium smegmatis*. J Antimicrob Chemother 2008; 62; 345–348.
26. Moreno M, pleixats M, Christina S. Synthesis of stilbene derivatives by using Wittig reaction. J. Med. Chem. 1985; 21: 932-941.
27. Ryoji K, Hiroto H, Kunihiron N, Masanori O, Yoshikuni T, Synthesis and platelet Aggregation Inhibitory and Antithrombotic properties of [2-[(w-Aminoalkoxy) phenyl] ethyl] benzenes. J. Med. Chem.1990; 33: 1818-1823.
28. Yamataka H, Nagareda K, Ando K, Hanafusa T. Relative reactivity and stereoselectivity in the Wittig reaction of substituted benzaldehydes with Benzylidenetriphenylphospharane. J. Org. Chem. 1992; 57: 2865-2869.
29. Orsini F, Pelizzoni F, Bellini B, Miglierini C. Synthesis of biologically active polyphenolic glycosides (combretastatin and resveratrol series). Carbohydr. Res.1997; 301: 95-109.
30. Kikumoto R, Hara H, Ninomiya K, Osakabe M, Sugano M, Fukami H, Tamao Y. Syntheses and platelet aggregation inhibitory and antithrombotic properties of [2-[(a-aminoalkoxy)phenyl]ethyl]benzenes. J Med Chem 1990; 33:1818-1823.