Research Paper

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Synthesis, X-Ray Powder Diffraction Study & Antimicrobial Activities of 1-(4-Butoxy 2-Hydroxyphenyl) Ethylidene-3,4 Dimethoxybenzohydrazide

Chemistry

KEYWORDS : Heterocyclic compounds, Schiff base, Powder XRD, Antimicrobial and antifungal activities

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ABSTRACT

A novel heterocyclic derivative, 1-(4-butoxy-2-hydroxyphenyl) ethylidene-3,4 dimethoxy benzohydrazide was synthesized by schiff base method. The synthesized product has been characterized by FTIR, ^{13}C and ^{1}H NMR. The powder X-ray diffraction (XRD) pattern has been recorded to investigate the structural properties and it confirms that the title compound, $C_{23}H_{30}N_2O_5$ belongs to monoclinic system with a = 18.0720(5), b = 5.3107(5), c = 13.1141(6) Å and β = 103.002(3)°. Antimicrobial and antifungal activities of the title compound have been tasted against E.coli, P.aeruginosa, S.aureus and S.pyogenes bacteria and also tested against C. albicans and A. niger after C. albicans fungus with Gentamycin and K. Nystatin as reference standards drug respectively.

INTRODUCTION

Every first step of life starts with hetero-cyclic compounds. Every man's potential to think, intelligence, behavior, character depends on his gene. The basic skeleton of the genetic material (DNA) is made up of hetrocycles like adenine, guanine, cytosine and thymine. Heterocyclic compounds are a class of organic compounds whose molecules contains one or more ring of atoms with at least one heteroatom being an element other then carbon, most frequently oxygen, nitrogen or sulphur. Heterocyclic compounds probably constitute the largest and most varied family of organic compounds [1-2]. They have widely used in medicine and pharmacy industry. Also they have important in dye chemistry, organic electronic materials and as chelating agents [3-6].

Looking towards the importance of heterocyclic compounds [7-10], Authors wish to report the synthesis of 1-(4-butoxy-2-hydroxy phenyl) ethylidene -3,4 dimethoxy benzohydrazide by schiff base method with the characterizations by IR, ^{1}H and ^{13}C NMR. We also included powder X-ray diffraction study and antimicrobial and anti fungal activities of title compound. The chemical structure of the title compound using ball and stick diagram as shown in Figure 1.

EXPERIMENTAL SECTION

Materials and Methods

All chemicals and regents were commercially available from Sigma Aldrich, Merck and were used without further purification. Glassware was oven dried for several hours. General Melting points were determined on an electro thermal melting point apparatus. Completion of reaction and purity of all compounds were checked on aluminum coated TLC plates 60 F245 (E. Merck) using n-hexane: ethyl acetate (7.5:2.5, v/v) as mobile phase and visualized under ultraviolet (UV) light, or iodine vapor. Elemental analysis (% C, H, N) was carried out by a Perkin-Elmer 2400 CHN analyzer. An FTIR spectra of the title compound was recorded on a Perkin-Elmer FT-IR spectrophotometer in (KBr). Mass spectrum was scanned on a Shimadzu LCMS 2010 spectrophotometer. ^{1}H NMR spectra was recorded on a Varian Gemini 300 MHz and ^{13}C NMR spectra on a Varian Mercury-400 (100 MHz) in DMSO-d6 as a solvent and tetramethylsilane (TMS) as an internal standard. Chemical shifts were reported in parts per million (ppm).

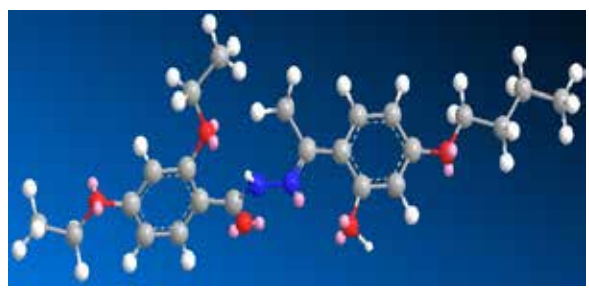


Figure 1: Chemical structure (ball and stick diagram) of the title compound

Synthesis of 1-(4-butoxy-2-hydroxyphenyl) ethylidene -3, 4-dimethoxy benzohydrazide

1-(2-hydroxy-4-butoxyphenyl) ethanone (0.208 gm, 0.01 mole) and 3,4-dimethoxybenzohydrazide (0.150 gm, 0.01 mole) were dissolved in dry benzene (50 ml). The solution was refluxed gently for 20-24 hours using dean and stark apparatus and water librated was removed. Completion of reaction was checked by TLC and then benzene was distilled out under pressure. The crude mass was poured in water. The resulting solid obtained was filtered and washed with petroleum ether. The product was crystallized from ethanol as dark yellow needles. The reaction scheme of the synthesized compound has been seen in Fig.2.

Characterization of compound

Yield: 67%, m.p.:182°C, RF Value: 0.32, [Solvent system-Toluene: Ethyl acetate (10: 1)]. Analysis: $C_{21}H_{26}N_2O_5$, Found: C–65.29%, H–6.79%, N–7.21%.

IR (cm^{-1}): 3198 (Ar–OH,Phenol), 1156 (C-O, Phenol), 1268 [C-O-C ,(sym)Ether], 1134 [C-O-C (asym,)Ether], 1643(C=O str. Schiff base),1589,(N=C str. Schiff base),3222(N-H str.,Schiff base)

^{1}H NMR ($CDCl_3$) δppm: 0.893-0.931,(3H,triplet,-CH_2-CH_3),1.360-1.453,(2H,sextet,-CH_2-CH_3),1.629-1.698,(2H,quintet,-CH_2-CH_2-CH_3), 2.344, (3H, singlet, N=C-CH_3), 3.716(3H,singlet,O-CH_3),3.784(3H,singlet,O-CH_3)3.955-4.044,(2H,triplet,-OCH_2),6.431-6.475, (1H,doublet,Ar-H, J= 1.2 Hz.) 6.827-6.899, (2H, complex,Ar –H), 6.941, (1H,singlet, Ar –H), 7.457--6.899, (2H,complex,Ar –H), 7.48, (1H, singlet,-NH), 13.440,(1H,singlet,-OH)

^{13}C NMR ($CDCl_3$) δppm: 161.484(C-1), 14.05(C-2), 167.668 (C-3), 66.809 (C-4), 160.944 (C-5), 106.402(C-6), 129.932 (C-7), 105.124 (C-8), 155.855(C-9), 102.424 (C-10), 67.653(C-

11), 31.113 (C-12), 19.154 (C-13), 14.132(C-14), 128.457(C-15), 153.301 (C-17), 112.311 (C-19), 121.606 (C-16), 151.925 (C-18),121.712(C-20), 56.734(C-21), 56.722(C-22)

Powder X-ray diffraction study

The powder X-ray diffraction study has been used as a non-destructive fingerprinting technique in laboratory and industry for several decades. Every solid crystalline compound gives its own unique X-ray diffraction pattern consisting of a set of Bragg peaks. The diffraction pattern for a compound can be considered analogous to a fingerprint or barcode, with the peak positions determined by the unit cell symmetry and lattice parameters. When we collect XRD data, we can use these fingerprints to identify not only what phases are present in our sample but also index the pattern to obtain information about the unit cell size and shape. The experimental 2θ range was 2–120° with a step size of 0.01° and a counting time of 60s per step. The powder diffraction pattern was analyzed with the help of FullProf programme [11] and EXPO 2009 software [12]. The lattice parameters of the compounds were calculated and summarized in Table 1. The powder X-ray diffraction pattern of the title compound has been shown in figure 3.

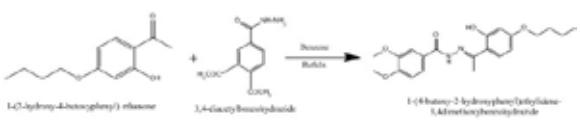


Figure 2: Reaction scheme of the title synthesized compound

TABLE – 1
Crystallographic Data

Compound Name	1-(4-butoxy-2-hydroxy phenyl) ethylidene -3, 4-di methoxy benzohydrazide
Molecular Weight	$C_{21}H_{26}N_2O_5$
System	Monoclinic
a(Å)	18.0513 (0.0298)
b(Å)	11.0950 (0.0600)
c(Å)	12.8601 (0.0363)
a (°)	90.0000
b(°)	103.6946 (0.2519)
g(°)	90.0000
Volume (Å^3)	2502.43



Figure 3: Powder diffraction pattern for the title compound

Antimicrobial and Antifungal activities

Synthesized title compound has been screened for their antimicrobial activity against different panel of organisms, i.e., E.coli, P.aeruginosa, S.aureus, S.pyogenes and antifungal strains C. albicans., and A. niger using Gentamycin and K. Nystatin as reference standards respectively. The Serial dilution technique was followed by micro method as per NCCLS-1992 manual [13-14]. The observed Minimum Inhibitory Concentrations (MIC) values for bacterial and fungal strains of the title compound are presented in Table 2.

TABLE – 2
Minimal Inhibition Concentrations of Bacterial Strains (MIC) in µg/ml

	Bacterial activity (MIC) in µg/ml			
	S. aureus MTCC 96	**S. pyogenus MTCC 443**	**E. coli MTCC 442**	**P. aeruginosa MTCC 441**
Title compound	25	250	50	500
Gentamycin	0.25	0.50	0.05	1.0
	Fungal activity (MIC) in µg/ml			
	C. albicans MTCC 227		**A. niger MTCC 282**	
Title compound	125		125	
K.Nystatin	100		100	

CONCLUSIONS

The present research work has been concerned with the development of new heterocyclic compounds in terms of chemical structure and biological activities. A novel drug of the heterocyclic compound, 1-(4-butoxy-2-hydroxy phenyl) ethylidene -3, 4-di methoxy benzohydrazide has been synthesized by Schiff base method. The spectroscopic conformation of the title compound has been done by FTIR, ^{1}H NMR and ^{13}C NMR. The powder X-ray diffraction pattern show the synthesized compound has crystalline nature. The crystallographic data show that, it crystallized in monoclinic system. The results of antimicrobial study reveals that the title synthesized drug are good response against S. aureus bacteria compared to other panel of organism. From the results of antifungal study, it is clear that the title compound exhibited degree of inhibition against the fungal.

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