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Journal of Chemical and Pharmaceutical Research, 2016, 8(3):617-623

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Microwave assisted rapid synthesis and antibacterial screening of N-[3-chloro-2-(substituted)-4-oxoazetidin-1-yl]-benzamides

Dhairyashil S. Salunkhe[1] and Pravina B. Piste[2*]

[1]*Department of Chemistry, Government Polytechnic, Karad*
[2]*P. G. Department of Chemistry, Yashavantrao Chavan Institute of Science, Satara, (Maharashtra) India-415001*

ABSTRACT

N-[3-chloro-2-(Substituted)-4-oxoazetidin-1-yl] - (Substituted) benzamides (4a-x) have been synthesized from different aromatic esters (1a-x) with hydrazine hydrate yielded benzohydrazides (2a-x) followed by condensation with aromatic aldehydes gave Schiff bases (3a-x). These Schiff bases with dimethyl formamide in presence of triethyl amine and chloroacetyl chloride by microwave irradiation produced azetidinones (4a-x). The synthesized compounds (4a-x) were screened for their antibacterial activity against four microorganisms: Staphylococcus aureus (Gram positive), Bacillus subtilis (Gram positive), Pseudomonas aeruginosa (Gram negative) and Escherichia coli (Gram negative). The antifungal activities of these compounds were also tested against two different fungal species Aspergillus niger and Penicillum notatum. They were found to exhibit good antibacterial and antifungal activities.

Keywords: Azetidinones, antimicrobial and antifungal activities, microwave.

INTRODUCTION

Many compounds containing the β-lactam ring possess various interesting biological properties [1]. Even more than 70 years after the discovery of penicillin, β-lactam antibiotics remain as one of the most important contributions of science to Humanity [2]. The β-lactam skeleton is the common structural element of the widely used penicillin, cephalosporin, thienamycine, nocardicin, aztreonam and carumonam [3]. Resistance to a number of anti-microbial agents such as β-lactam antibiotics, macrolides, quinolones and vancomycin among a variety of clinically significant species of bacteria is becoming increasingly important global problem [4]. The development of several synthetic and semi-synthetic β-lactam antibiotics by the pharmaceutical industry was due to the growing resistance of bacteria towards the β-lactam antibiotics and the need for medicines with a more specific antibacterial activity [5]. Azetidinones are the carbonyl derivatives of azetidines containing carbonyl group at the position-2. These are also known as 2-azetidinones or more commonly β–lactam and their chemistry is of great importance because of the use of β -lactam derivatives as antibacterial agents [6]. Recently, some other type of biological activity such as antibacterial [7-8], CNS activity [9], tryptase inhibitory [10], antifungal [11], antitubercular [12], cholesterol absorption inhibition and enzyme inhibition activity [13] antitumor [14], have been reported in compounds containing 2-azetidinone ring.

The present work deals with the synthesis of the titled compounds by the use of green approach starting from aromatic esters and their antimicrobial screening.

EXPERIMENTAL SECTION

All chemicals were of synthetic grade (S.D. Fine Chem. Ltd. Mumbai, India). Melting points were determined in open capillaries method and are uncorrected. The Infrared spectra were obtained on Perkin Elmer FT-IR spectrometer. The samples were examined as KBr discs 5%w/w. All the compounds were analysed for C, H and N on Carlo-Erba elemental analyser.^{1}H NMR and ^{13}C NMR spectra were recorded on Bruker Avon 300MHz spectrometer using $CDCl_3$/ DMSO as solvent and TMS as internal standard, the chemical shifts are reported in ppm. Multiplicities are indicated by's' (singlet),'d' (doublet),'t' (triplet),'q (quartet),'m' (multiplet), bs (broad singlet).

General procedure for Synthesis of substituted Benzohydrazide (2a-x)

An equimolar quantity of compound 1 (0.01 mol) and hydrazine hydrate (0.01 mol) was taken in borocil beaker and irradiated to the microwave radiation for 2-3min (50 W).The completion of the reaction was monitored by silica gel-G coated TLC plates. After the completion of the reaction the product was filtered and purified over a silica gel packed column chromatography using chloroform: methanol (8:2 v/v) as eluent. The purified product was recrystallized from ethanol to yield benzohydrazides

General procedure for Synthesis of N'-[(E)-(substituted) phenyl methylidene]benzohydrazide 3(a - x)

The compound 2 (0.01 mol) and substituted benzaldehyde (0.01 mol) in ethanol (50 ml) in the presence of 2-4 drops glacial acetic acid kept in microwave for a period of 2-3 min (50W). The completion of the reaction was monitored by silica gel-G coated TLC plates. The product was filtered, cooled and purified over a silica gel packed column chromatography using Methanol: Chloroform (7:3 v/v) system as eluent The purified product was dried under vacuum and recrystallized from ethanol at room temperature to furnish Schiff bases **.**

General procedure for Synthesis of N-[3-chloro-2-(Substituted)-4-oxoazetidin -1-yl] -(Substituted) benzamide 4(a - x)

The equimolar mixtue of compound **3** and dimethyl formamide was taken in round bottom flask. To it chloroacetyl chloride (0.01 mol) and triethylamine were added slowly. Then it was placed inside a micro oven for about 3-4 min. It was then diluted with ice cold water. The solid product formed was filtered dried and recrystallized from ethanol. These reactions are summarized in Scheme 1. The purity of the compounds was monitored by TLC and the structure of the compounds was deduced on the basis of their elemental analysis and spectral data.

Scheme

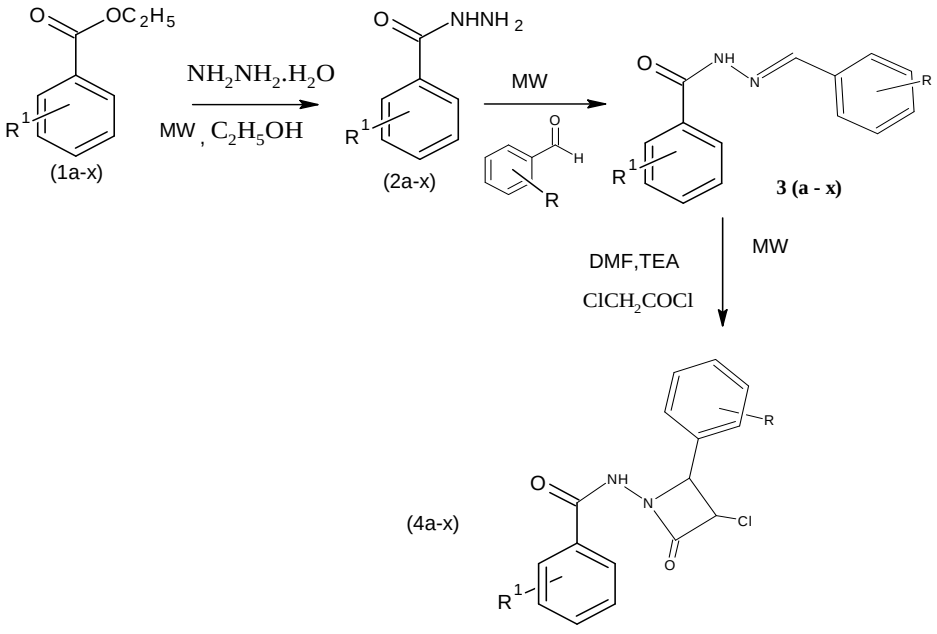


Table 1. Physical and elemental data of synthesized compounds 4(a -x)

Compound	R1	R	MP ^{0}C	Yield %	% of C, H, N, calculated (found)		
					C	H	N
4a	H	H	173	72	63.90(63.74)	4.36(4.28)	9.31(9.27)
4b	H	4-Cl	168	79	57.33(57.19)	3.61(3.58)	8.36(8.31)
4c	H	4-OH	181	78	60.67(60.48)	4.14(4.08)	8.84(8.79)
4d	H	3-NO_2	158	72	55.58(55.29)	3.50(3.41)	12.15(12.01)
4e	H	4-NO_2	158	74	55.58(55.37)	3.50(3.38)	12.15(12.02)
4f	H	4-OCH_3	151	78	61.73(61.45)	4.57(4.42)	8.47(8.35)
4g	2-OH	H	186	70	60.67(60.24)	4.14(3.99)	8.84(8.71)
4h	2-OH	4-Cl	177	72	54.72(54.48)	3.44(3.35)	7.98(7.84)
4i	2-OH	4-OH	191	71	57.75(57.62)	3.94(3.87)	8.42(8.37)
4j	2-OH	3-NO_2	173	74	53.12(52.99)	3.34(3.28)	11.62(11.57)
4k	2-OH	4-NO_2	173	76	53.12(53.01)	3.34(3.26)	11.62(11.54)
4l	2-OH	4-OCH_3	174	79	58.88(58.72)	4.36(4.29)	8.08(7.97)
4m	4-OH	H	184	71	60.67(60.28)	4.14(3.97)	8.84(8.69)
4n	4-OH	4-Cl	172	74	54.72(54.46)	3.44(3.34)	7.98(7.82)
4o	4-OH	4-OH	187	73	57.75(57.61)	3.94(3.86)	8.42(8.35)
4p	4-OH	3-NO_2	169	77	53.12(52.97)	3.34(3.26)	11.62(11.55)
4q	4-OH	4-NO_2	169	69	53.12(53.03)	3.34(3.25)	11.62(11.53)
4r	4-OH	4-OCH_3	162	71	58.88(58.73)	4.36(4.28)	8.08(7.96)
4s	3,4,5-OH	H	202	72	55.10(54.98)	3.76(3.73)	8.03(7.95)
4t	3,4,5-OH	4-Cl	194	70	50.15(50.05)	3.16(3.07)	7.31(7.29)
4u	3,4,5-OH	4-OH	210	71	52.69(52.57)	3.59(3.48)	7.68(7.60)
4v	3,4,5-OH	3-NO_2	189	73	48.81(48.74)	3.07(3.00)	10.67(10.58)
4w	3,4,5-OH	4-NO_2	189	75	48.81(48.76)	3.07(2.97)	10.67(10.59)
4x	3,4,5-OH	4-OCH3	188	77	53.91(53.80)	3.99(3.87)	7.40(7.34)

Table 2. Spectral Characterization of synthesized compounds 4(a -x)

Compound	Spectral Characteristics
4a	IR (KBr):√max, 3038 (Ar – H), 1691(>C=O), 1731(β-Lactum >C=O), 768 (C-Cl), 1210(N-N), 3320 (-NH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.25-7.64 (m) (10H, -Ar-H); 8.39 (s) (1H, -CONH); 5.01(d) (1H, -CHCl); 5.29(d) (1H, -CH-Ar).
4b	IR (KBr):√max, 3032 (Ar – H), 1689(>C=O), 1732 (β-Lactum >C=O), 798 (C-Cl), 1214(N-N), 3320 (-NH), 3239(-OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.39-7.80 (m) (10H, -Ar-H); 8.52 (s) (1H, -CONH); 5.12(d) (1H, -CHCl); 5.30(d) (1H, -CH-Ar).
4c	IR (KBr):√max, 3074 (Ar – H), 1687(>C=O), 1722(β-Lactum >C=O), 768 (C-Cl), 1213(N-N), 3378 (-NH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.41-7.92 (m) (9H, -Ar-H); 8.64 (s) (1H, -CONH); 5.18(d) (1H, -CHCl); 5.32(d) (1H, -CH-Ar); 11.85(s) (1H, -OH).
4d	IR (KBr):√max, 3027 (Ar – H), 1697(>C=O), 1742(β-Lactum >C=O), 816 (C-Cl),1211 (N-N), 3341 (-NH), 1344(Ar - N) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.90 - 8.20 (m) (9H, -Ar-H); 8.72 (s) (1H, -CONH); 5.22(d) (1H, -CHCl); 5.49(d) (1H, -CH-Ar).
4e	IR (KBr):√max, 3029 (Ar – H), 1697(>C=O), 1743(β-Lactum >C=O), 820 (C-Cl),1211 (N-N), 3345 -(NH), 1347(Ar - N) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.92 - 8.26 (m) (9H, -Ar-H); 8.78 (s) (1H, -CONH); 5.24(d) (1H, -CHCl); 5.47(d) (1H, -CH-Ar).
4f	IR (KBr):√max, 3050 (Ar – H), 1693(>C=O), 1747(β-Lactum >C=O), 814(C-Cl),1212 (N-N), 3334 (-NH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.75 - 7.76 (m) (9H, -Ar-H); 8.65 (s) (1H, -CONH); 5.14(d) (1H, -CHCl); 5.32(d) (1H, -CH-Ar); 3.72 (s) (3H, -OCH_3).
4g	IR (KBr):√max, 3045 (Ar – H), 1702(>C=O), 1743(β-Lactum >C=O), 785 (C-Cl), 1212(N-N), 3326 (-NH), 3262(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.48-7.94 (m) (9H, -Ar-H); 8.43 (s) (1H, -CONH); 5.09(d) (1H, -CHCl); 5.35(d) (1H, -CH-Ar); 11.85(s) (1H, -OH).
4h	IR (KBr):√max, 3374 (Ar – H), 1687(>C=O), 1728(β-Lactum >C=O), 812 (C-Cl), 1216(N-N), 3384 (-NH), 3545(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.65-8.34 (m) (10H, -Ar-H); 8.42 (s) (1H, -CONH); 5.11(d) (1H, -CHCl); 5.36(d) (1H, -CH-Ar); 11.92(s) (1H, -OH).
4i	IR (KBr):√max, 3092 (Ar – H), 1678(>C=O),1729(β-Lactum >C=O), 798 (C-Cl), 1211(N-N), 3365 (-NH) , 3384(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.72-8.37 (m) (10H, -Ar-H); 8.31 (s) (1H, -CONH); 5.08(d) (1H, -CHCl); 5.28(d) (1H, -CH-Ar); 12.08(s) (1H, -OH).
4j	IR (KBr):√max, 3078 (Ar – H), 1695(>C=O), 1726(β-Lactum >C=O), 810 (C-Cl),1210 (N-N), 3358 (-NH), 1348(Ar - N) , 3562(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.92 - 8.44 (m) (10H, Ar-H); 8.73 (s) (1H, -CONH); 5.26(d) (1H, -CHCl); 5.39(d) (1H, -CH-Ar); 12.32(s) (1H, -OH).
4k	IR (KBr):√max, 3076 (Ar – H), 1693(>C=O), 1739(β-Lactum >C=O), 802 (C-Cl),1211 (N-N), 3351 (-NH), 1343(Ar - N) , 3558(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.95 - 8.48 (m) (10H, Ar-H); 8.76 (s) (1H, -CONH); 5.27(d) (1H, -CHCl); 5.40(d) (1H, -CH-Ar); 12.33(s) (1H, -OH).
4l	IR (KBr):√max, 3050 (Ar – H), 1693(>C=O), 1737(β-Lactum >C=O), 810(C-Cl),1214 (N-N), 3379 (-NH) , 3510(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.79 - 8.14 (m) (10H, Ar-H); 8.59 (s) (1H, -CONH); 5.16(d) (1H, -CHCl); 5.19(d) (1H, -CH-Ar); 12.04(s) (1H, -OH) 3.77 (s) (3H, -OCH3).
4m	IR (KBr):√max, 3057 (Ar – H), 1694(>C=O), 1734(β-Lactum >C=O), 787 (C-Cl), 1206(N-N), 3346 (-NH), 3282(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.51-7.97 (m) (9H, Ar-H); 8.45 (s) (1H, -CONH); 5.08(d) (1H, -CHCl); 5.32(d) (1H, -CH-Ar); 11.87(s) (1H, -OH).
4n	IR (KBr):√max, 3404 (Ar – H), 1682(>C=O), 1730(β-Lactum >C=O), 815 (C-Cl), 1210(N-N), 3394 (-NH), 3557(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ ppm); 6.66-8.36 (m) (10H, Ar-H); 8.44 (s) (1H, -CONH); 5.10(d) (1H, -CHCl); 5.35(d) (1H, -CH-Ar); 11.90(s) (1H, -OH).
4o	IR (KBr):√max, 3086 (Ar – H), 1681(>C=O), 1726(β-Lactum >C=O), 784 (C-Cl), 1204(N-N), 3354 (-NH) , 3364(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.74-8.40 (m) (10H, Ar-H); 8.33 (s) (1H, -CONH); 5.11(d) (1H, -CHCl); 5.27(d) (1H, -CH-Ar); 12.10(s) (1H, -OH).
4p	IR (KBr):√max, 3058 (Ar – H), 1675 (>C=O), 1736 (β-Lactum >C=O), 808 (C-Cl),1211 (N-N), 3356 (-NH), 1343(Ar - N) , 3551(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.96 - 8.48 (m) (10H, Ar-H); 8.75 (s) (1H, -CONH); 5.27(d) (1H, -CHCl);

	5.41(d) (1H, -CH-Ar); 12.35 (s) (1H, -OH).
4q	IR (KBr):√max, 3066 (Ar – H), 1683 (>C=O), 1741(β-Lactum >C=O), 812 (C-Cl),1209 (N-N), 3341 (-NH), 1338(Ar - N) , 3548(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, - ppm); 6.97 - 8.50 (m) (10H, Ar-H); 8.79 (s) (1H, -CONH); 5.30(d) (1H, -CHCl); 5.42(d) (1H, -CH-Ar); 12.31(s) (1H, -OH).
4r	IR (KBr):√max, 3053 (Ar – H), 1671(>C=O), 1723(β-Lactum >C=O), 806(C-Cl),1204 (N-N), 3374 (-NH) , 3490(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, - ppm); 6.77 - 8.20 (m) (10H, Ar-H); 8.62 (s) (1H, -CONH); 5.18(d) (1H, -CHCl); 5.23(d) (1H, -CH-Ar); 12.14(s) (1H, -OH) 3.79 (s) (3H, $-OCH_3$).
4s	IR (KBr):√max, 3034 (Ar – H), 1690(>C=O), 1731(β-Lactum >C=O), 758 (C-Cl), 1202(N-N), 3358 (-NH), 3314(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, - ppm); 6.71-8.17 (m) (9H, Ar-H); 8.57 (s) (1H, -CONH); 5.10(d) (1H, -CHCl); 5.27(d) (1H, -CH-Ar); 12.17(s) (1H, -OH).
4t	IR (KBr):√max, 3076 (Ar – H), 1688(>C=O), 1728(β-Lactum >C=O), 772 (C-Cl), 1208(N-N), 3316 (-NH), 3240(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.96-8.76 (m) (10H, Ar-H); 8.49 (s) (1H, -CONH); 5.12(d) (1H, -CHCl); 5.38(d) (1H, -CH-Ar); 12.25(s) (1H, -OH).
4u	IR (KBr):√max, 3074 (Ar – H), 1687(>C=O), 1740(β-Lactum >C=O), 768 (C-Cl), 1213(N-N), 3378 (-NH) , 3239(-OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, ppm); 6.94-8.59 (m) (10H, Ar-H); 8.36 (s) (1H, -CONH); 5.14(d) (1H, -CHCl); 5.30(d) (1H, -CH-Ar); 12.27(s) (1H, -OH).
4v	IR (KBr):√max, 3027 (Ar – H), 1697(>C=O), 1728(β-Lactum >C=O), 816 (C-Cl),1211 (N-N), 3341 (-NH), 1344(Ar - N) , 3282(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 7.06 - 8.68 (m) (10H, -Ar-H); 8.72 (s) (1H, -CONH); 5.31(d) (1H, -CHCl); 5.46(d) (1H, -CH-Ar); 12.35 (s) (1H, -OH).
4w	IR (KBr):√max, 3029 (Ar – H), 1697(>C=O), 1729(β-Lactum >C=O), 820 (C-Cl),1211 (N-N), 3345 (-NH), 1347(Ar - N) , 3239(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 7.07 - 8.72 (m) (10H, -Ar-H); 8.82 (s) (1H, -CONH); 5.34(d) (1H, -CHCl); 5.49(d) (1H, -CH-Ar); 12.31(s) (1H, -OH).
4x	IR (KBr):√max, 3050 (Ar – H), 1693(>C=O), 1734(β-Lactum >C=O), 814(C-Cl),1212 (N-N), 3334 (-NH) , 3276(OH) cm^{-1}. 1H-NMR (DMSO-D6, δ, -ppm); 6.97 - 8.34 (m) (10H, -Ar-H); 8.66 (s) (1H, -CONH); 5.21(d) (1H, -CHCl); 5.27(d) (1H, -CH-Ar); 12.24(s) (1H, -OH) 3.82 (s) (3H, $-OCH_3$).

Antimicrobial activity

Method of testing: Cup plate method

The compounds were screened for their antibacterial activity using cup plate method [13].Sterile nutrient agar media was poured into the sterilised Petri dishes. The poured agar media was allowed to solidify for 30 min, on the surface of the media microbial suspension were spread with help of sterilised spreader and there after cups were made into the agar surface with help of sterile cork borer. The test compound solution 0.1 ml was placed into these cups with the help of micro pipette. The plates were kept in freeze for diffusion, for one hr. For antibacterial studies, incubation was carried out at 37^0C for 24 hr. The test solution was prepared using DMSO as solvent. Clinically antimicrobial drug streptomycin was used as the positive control and DMSO for blank. The solution was diffuses trough agar around its cup and produces clear zone of inhibition which was measured in mm and the results were recorded.

RESULTS AND DISCUSSION

We have reported simple and efficient method in synthesis of some new azetidione derivatives by reaction of different benzoates (1a-x) with hydrazine hydrate in microwave irradiation technique for 2-3 mins. yields substituted benzohydrazide (2a-x) which on condensation with different benzaldehydes gave corresponding N'-[(E)-(substituted) phenyl methylidene] benzohydrazide (3a-x). These N'-[(E)-(substituted) phenyl methylidene] benzohydrazide with dimethyl formamide in presence of triethyl amine and chloroacetyl chloride on microwave irradiation for 3-4 mins. targeted N-[3-chloro-2-(Substituted)-4-oxoazetidin-1-yl]-(Substituted) benzamide (4a-x) in 69-79%. All the synthesized compounds were established on the basis of IR, NMR and elemental analysis. IR spectrum of compounds 2a-x showed absorption at 1639 - 1651 and 1527 - 1536 cm^{-1} is due to presence of >C=O and -C-N of the amide group. The bands at 3265 - 3271 and 3316 - 3325 cm^{-1} appeared due to the presence of $–NH_2$ and -OH groups respectively. The N'-[(E)-(substituted)phenylmethylidene] benzohydrazides (3a-x) showed disappearance of band at 3265 - 3271 cm^{-1} due to $-NH_2$ group indicates formation of the product. The corresponding N-[3-chloro-2-(Substituted)-4-oxoazetidin-1-yl]-(Substituted)benzamides (4a-x) showed absence of the bands at 1594-1610; 1266-1312; and 2836-2887 cm^{-1} due to the C=N; C-N; and N=C-H stretching vibrations of N'-[(E)-(substituted)phenylmethylidene]benzohydrazides (3a-x). While targeted compounds exhibit absorption band at 1722 – 1747 cm^{-1} due to β-Lactum >C=O and 768 - 820 cm^{-1} due to C-Cl confirms formation of azetidinone ring. In H1 NMR spectra of compounds 4 (a-x) showing doublet at 5.01 - 5.34 ppm are showing presence of -CHCl which is absent in 3 (a-x) conforms formation of β-Lactum ring and multiplets due to aromatic proton observed at δ 6.9-7.9 ppm.. The spectral data of new synthesized compounds are shown in Table 2.

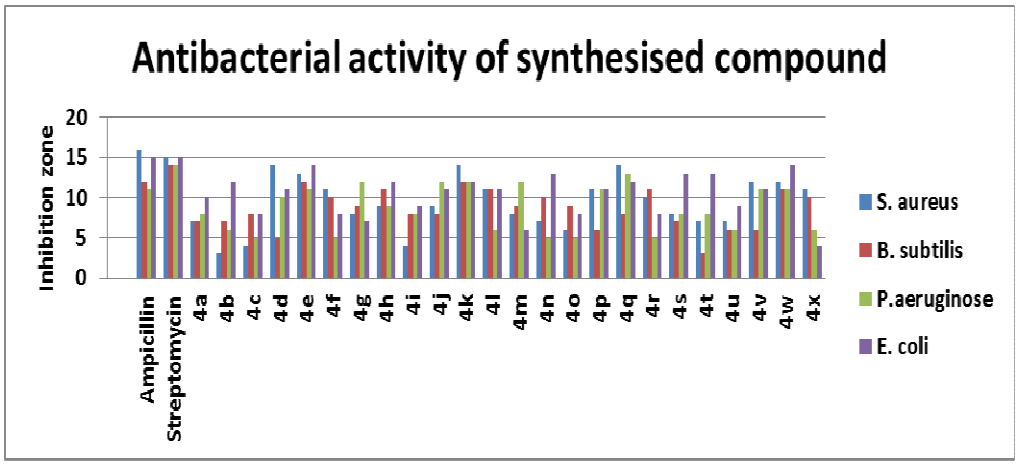
Antibacterial activity

All the synthesized compounds were evaluated for their antibacterial activity against *E.coli* and *S.aureus* using cup plate method, at 50µg/ml using DMSO as a control while Ampicillin and Streptomycin as the reference antibiotics [15]. Most of the synthesized compounds showed moderate to good antibacterial potential as compared to the standard (**Table 3).**Literature survey showed that incorporation of the electron withdrawing and electron donating groups into the heterocyclic compounds increases lipophilicity of the compounds, which results in easier penetration

of lipid membranes and compounds showed better antibacterial potential. Out of the synthesized compounds 4d, 4e, 4k, 4q and 4b, 4e, 4h, 4n, 4s, 4t, 4w are highly active against *S. aureus* and *E. coli* respectively. The rest of the compounds were found to moderate active.

Antifungal activity

Similarly, the antifungal screening of the compounds was carried out in vitro by paper disc method against *Aspergillus niger* and *Penicillum notatum* by using Griseofulvin at 50 µg/ml. against the tested microorganisms . Out of the synthesized compounds 4k, 4q ,4v and 4w are highly active against *A. niger* and *P. notatum*. The rest of the compounds were found to moderate to good active as presented in Table 3.



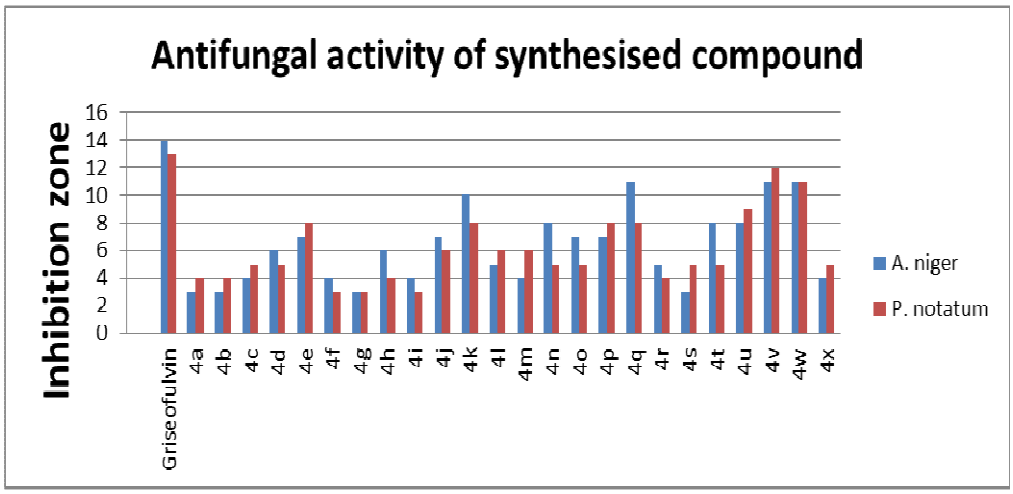


Table 3. Antibacterial activity of the Synthesized compounds (4a-4x)

Compound	Gram Positive bacteria		Gram Negative bacteria		Antifungal activity	
	S. aureus	*B. subtilis*	*P. aeruginosa*	*E. coli*	*A. niger*	*P. notatum*
Ampicillin	16	12	11	15	-	-
Streptomycin	15	14	14	15	-	-
4a	07	07	08	10	03	04
4b	03	07	06	12	03	04
4c	04	08	05	08	04	05
4d	14	05	10	11	06	05
4e	13	12	11	14	07	08
4f	11	10	05	08	04	03
4g	08	09	12	07	03	03
4h	09	11	09	12	06	04
4i	04	08	08	09	04	03
4j	09	08	12	11	07	06
4k	14	12	12	12	10	08
4l	11	11	06	11	05	06
4m	08	09	12	06	04	06
4n	07	10	05	13	08	05
4o	06	09	05	08	07	05
4p	11	06	11	11	07	08
4q	14	08	13	12	11	08
4r	10	11	05	08	05	04
4s	08	07	08	13	03	05
4t	07	03	08	13	08	05
4u	07	06	06	09	08	09
4v	12	6	11	11	11	12
4w	12	11	11	14	11	11
4x	11	10	06	04	04	05
Griseofulvin	-	-	-	-	14	13

Zone of inhibition in mm, MIC in 50 µg/ml

CONCLUSION

In summary, we have developed a simple and ecofriendly method for preparation of some N-[3-chloro-2-(Substituted)-4-oxoazetidin-1-yl]-(Substituted) benzamide derivatives using microwave irradiation. Reaction procedures are very simple and overall yield of the product using microwave irradiation technique was 75 – 79 % (Table 1) and the reaction time was 3-4 min. The reagents utilized in the proposed method are readily available without the need for expensive instrumentation and chemicals. All the compounds were characterized by using analytical techniques. The synthesized compounds are purified by column chromatography on silica gel (60-120 mesh) using Ethyl acetate (20%) and n-hexane (80%) as a solvent system. All the synthesized compounds were showed moderate to good antibacterial and antifungal activity.

Acknowledgement
Author thanks to Department of Chemistry, Y.C. Institute of Science, Satara and Department of Applied Science, Government Polytechnic, Karad for providing research facilities and Biotechnology Department of YCIS Satara for the antimicrobial screening and also National Chemical laboratory, Pune, India for providing spectral interpretation.

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