Studies on Synthesis and Antimicrobial Activity of Epoxides derived from Chalcones

[1]A. P. Shetye, [2]M. G. Pawar

[1]Priyadarshini Indira Gandhi College of Engineering, Nagpur
[2]Yeshwant Mahavidyalaya, Nanded
Email: shetyearchana@gmail.com

[Received: 1st Jul.2017; Accepted:15th Jul.2017]

Abstract : Epoxides (1-6) were synthesized from halogeno substituted chalcones and evaluated in vitro for antibacterial activity against Escherichia coli, Staphylococcus aureus (animal pathogens) , Xanthomonas citri and Xanthomonas malvacearum (plant pathogens). The compounds 2 and 6 showed good antibacterial activity.

Keywords: Epoxide, chalcone, antibacterial activity.

I. INTRODUCTION

Chalcones and different compounds synthesized from chalcones are reported to have antibacterial[1], antifungal[2], antimalaria[3], anti-inflammatory[4], anticancer[5,6], and antitubercular[7] properties.

Epoxides are useful building blocks in organic synthesis as they participate in numerous reactions. Epoxides are used to prepare industrially important products such as surfactants[8], corrosion protection agents[9], additives to laundry detergents, lubricating oils, textiles and cosmetics. The aim of the present work, therefore, was to synthesize different substituted epoxides from chalcones and to evaluate antibacterial activities.

Chalcones required to synthesize epoxides were prepared as reported[10]. Chalcones were dissolved in 5% ethanol and about 10 ml sodium hydroxide was added. The reaction mixture was stirred for 20 mins to dissolve chalcone completely and then 30% hydrogen peroxide (5 ml) was added slowly. The solid separated out after stirring the reaction mixture for 2 hrs. The solid filtered, was washed with cold water and recrystallized from ethanol. Structures of epoxides were confirmed by spectral data and elemental analysis.

Epoxides (1-6) gave IR (cm^{-1}): 3280-3150 is due to OH group stretching, a band at 1606 cm^{-1} due to carbonyl C=O and aromatic stretch nearer to 1600-1400 cm-1. ^{1}H-NMR (DMSO-d_6): All epoxides (1-6) showed multiplet 6.12-8.45 due to CH=CH and hydrogen present on phenyl ring. Compounds 1, 3, 5, and 6 showed singlet at 12.31 due to OH group. Compound 3 and 6 gave singlet at 2.35 due to CH_3 group.

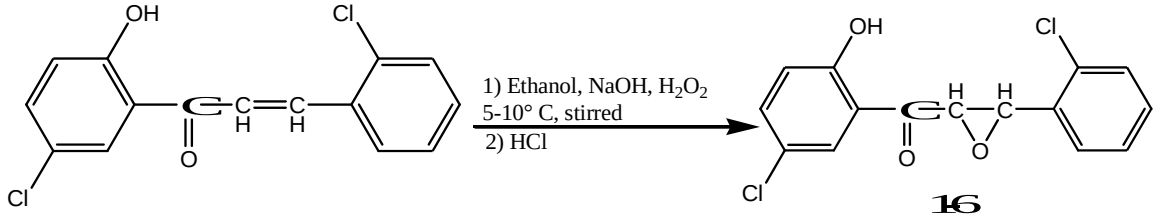
II. MATERIALS AND METHODS

Melting points were determined in an open capillary tube and are uncorrected. IR spectra were recorded in KBr on a Perkin-Elmer spectrometer. ^{1}H NMR spectra were recorded on a Gemini 300-MHz instrument in DMSO as solvent and TMS as an internal standard. The purity of products was checked by Thin Layer Chromatography (TLC) on silica gel.

Synthesis of 1-(2-hydroxy 5-chloro phenyl)-3-(2-chloro phenyl) 1-oxo-2,3-epoxy propane (1-6)

The chalcone 0.01 ml (0.293 g) was taken in a dry conical flask and ethanol (25 ml) was added followed by NaOH 5% (10 ml). The reaction mixture was stirred until chalcone get dissolved completely. To this reaction mixture hydrogen peroxide 30% (5 ml) was added. The reaction mixture was stirred for 2 hrs. The solid gets separated out. The solid was filtered, washed with cold water and recrystallized from ethanol. The epoxides 2-6 were also prepared by same procedure. M.P. and yield is given in table I.

Scheme I



Spectral Data

1-(2-hydroxy-5-chloro phenyl)-3-(2-chloro phenyl) 1-oxo-2,3-epoxy propane

IR: ν max (cm^{-1}): 3120 (OH), 1640 (C=O), 1682, 1585 (C=C aromatic)

^{1}H NMR: δ 4.3 (d, 2H, CH), 4.45 (d, 2H, CH), 12.3 (s, 1H, OH), 7.56 (m, 3H, ArH), 7.95 (m, 4H, ArH)

1-(2-hydroxy- 3-methyl-5-chloro phenyl)-3-(2-chloro phenyl) 1-oxo-2,3-epoxy propane

IR: ν max (cm^{-1}): 3125 (OH), 1640 (C=O), 1680, 1595 (C=C aromatic)

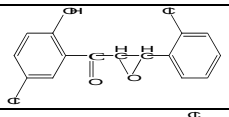
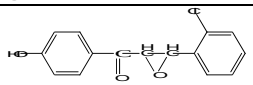
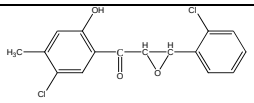
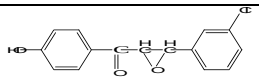
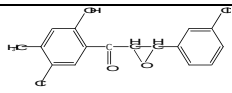
^{1}H NMR: δ 4.43 (d, 2H, CH), 4.40 (d, 2H, CH), 12.35 (s, 1H, OH), 2.33 (s, 3H, CH_3), 7.61 (m, 2H, ArH), 7.20 (m, 4H, ArH)

III. RESULTS AND DISCUSSION

Antibacterial Activity

The epoxides (1-6) were evaluated for antibacterial activity against animal pathogen E. coli, S. aureus and plant pathogens X. malvacearum and X. citri using disc diffusion method[11]. The Filter paper discs were soaked in solution of different compounds at concentration of 100 ppm. The solvent aqueous DMF (5% 1ml) used for preparing solution of the compounds. The disc soaked in solution of compound placed at the center of bacteria seeded nutrient agar plates (Petri dishes). The Petri dishes were incubated at 26± 1°C for 24 hrs. The strength is reported by measuring the diameter of zone of inhibition in mm and results were standardized against tetracycline. The zone of inhibition was measured and reported in table 1.

Table 1: Analytical, physical and bioactivity data of compounds

Sr No	Structure	M.P.	Yield	Appearance	Halogen Analysis		Diameter of Zone of Inhibition in mm			
					Found	Required	E. coli	S. aureus	X. malvacearum	X. citri
1		158	60	Pale Yellow	22.32	22.72	12	9	14	16
2		144	58	Pale Yellow	13.39	13.02	10	7	11	12
3		200	70	Yellow	22.00	21.73	15	11	**24**	**26**
4		153	72	Brown	12.50	12.15	18	14	17	21
5	S	162	69	Brown	13.40	13.02	11	10	15	16
6		165	62	Pale Yellow	20.01	21.73	**21**	16	19	22
Tetracycline							22	26	23	24

III. CONCLUSION

In summary, we have synthesized some epoxides from chalcone by conventional method, which are screened for biological activity. All the compounds showed potent antibacterial activity.

IV. ACKNOWLEDGEMENT

The authors are thankful to the Principal, Yeshwant Mahavidyalaya, Nanded for providing laboratory facilities and Director, IICT, Hyderabad for providing facilities for spectral analysis.

REFERENCES

[1] Y. B. Vibhute, S. S. Wadje, "Antimicrobial Activity of some Chalcones and Flavones", Indian Jouranl of Experimental Biology, vol. 14, pp. 739, September 1976.

[2] K. L. Lahtchev, D. Batovska, S. P. Parushev, A. Sibirny, "Antifungal activity of chalcones: a mechanistic study using various yeast strains", European Journal of Medicinal Chemistry, vol. 43(10), pp. 2220-8, February 2008.

[3] R. Li, G. L. Kenyon, F. E. Cohen, X. Chen, B. Gong, J. N. Dominguez, E. Davidson, G. Kurzban, R. E. Miller, E. O. Nuzum, P. J. Rosenthal, J. H. McKerrow, "In vitro antimalarial activity of chalcones and their derivatives", Journal of Medicinal Chemistry, vol. 38, pp. 5031, December 1995.

[4] J. F. Ballesteros, M. J. Sanz, A. Ubeda, M. A. Miranda, S. Iborra, M. Paya, M. J. Alearaz, "Synthesis and pharmacological evaluation of 2′-hydroxychalcones and flavones as inhibitors of inflammatory mediators generation", Journal of Medicinal Chemistry, vol. 38, pp. 2794, July 1995.

[5] L. W. Wattenberg, J. B. Coccia, A. R. Galhaith, "Inhibition of carcinogen-induced pulmonary and

mammary carcinogenesis by chalcone administered subsequent to carcinogen exposure", Cancer Letters, vol. 83, pp. 165-169, August 1994.

[6] A. T. Dinkova-Kostova, C. Abeygunawardana, P. Talalay, Journal of Medicinal Chemistry, "Chemoprotective properties of polypropenoids, Bis(bezylidine), cycloalkanones and related Michael reaction acceptors: Correlation of potencies as phase 2 enzyme inducers and radical scavengers", vol. 83, pp. 5287-5296, November 1998.

[7] R. Doshi, P. Kagthara and H. Parekh, "Synthesis and biological evaluation of some novel isoxazoles and cyanopyridines, a new class of potential anti-tubercular agents", Indian Journal of Chemistry, vol. 38B, pp. 348-352, March 1999.

[8] L. M. Landoll, Chemical Science Division Herculus Incorporated Research Center, Delaware 1989.

[9] K. Ghosh, P. Garcia, E. Galgoci, "Recent advances in epoxy curing agent technology for low temperature cure coatings", Anti-corrosion Methods and Materials, vol. 46:2, pp. 100-110, March 1999.

[10] Y. B. Vibhute, "Synthesis and antimicrobial activity of some halo-chalcones and flavones", Journal of Indian Chemical Society, vol. 53, pp. 736, 1976.

[11] C. H. Collins, Microbiological Methods, Butterworth, London, PP 364, 1967.