SYNTHESIS AND CHARACTERISATION OF SOME BROMO [1, 4]-BENZODIAZEPINE DERIVATIVES DERIVED FROM CHALCONES

B. Brindha[1*], Dr.R. Girija[2]

Abstract

The synthesis of bromo [1,4] benzodiazepine derivatives has been reported to be accomplished with ease and excellence. Using ethanol as a solvent, benzaldehyde, acetone, bromine and ethylene diamine were condensed to create benzodiazepine derivatives in the presence of sodium hydroxide as a catalyst. Shorter reaction times, an easier workup method, superior yields with simple recovery and make this process beneficial. For the purpose of characterizing the synthesized products, 1H and 13C nuclear magnetic resonance, Fourier transform infrared, and mass spectroscopy were employed.

Keywords: Benzaldehyde, Bromo diazepine,Ethanol,Sodium hydroxide,Bromine

[1]Research scholar, Queen Mary's College, Chennai-04
[2]Bioinformatics infrastructure facility center, Queen Mary's College, Chennai-04.
Email: brindha2886@gmail.com.

***Corresponding Author:** B. Brindha
*Research scholar, Queen Mary's College, Chennai-04

DOI: 10.53555/ecb/2022.11.11.253

INTRODUCTION

Heterocyclic compounds have attracted a lot of interest, especially in medicinal chemistry. As it happens, most modern drugs have a heterocyclic ring [1]. The synthesis of benzodiazepines, a significant class of biologically active compounds, has drawn a lot of interest in the fields of medicinal and pharmaceutical chemistry because of their use as sedative, anticonvulsant, anti-inflammatory, analgesic, hypnotic, and hypnotic agents as well as their hypnotic activity.[2-7] The insertion of heterocyclic moieties with a biologically active scaffold into the traditional chemical structure has become a requirement for the development of pharmacologically potent candidates in the drug arena. A benzene ring is fused to a seven-membered diazepine ring with two nitrogen atoms to form the bicyclic heterocyclic compound known as benzodiazepines (BDZs) [8]. The distinct structure of the [1,4] benzodiazepine resembles a peptide linkage. The focus of medicinal chemists on [1, 4] benzodiazepines has significantly shifted from CNS-acting medicines to anticancer medications as a result of this intriguing discovery were reported by Gill Kaur Rupinder **et al**.

By using the 1,4-phenyl linkage, four novel series of quinazolin-2,4-diones containing five-, six-, and seven-membered heterocyclic moieties (such as pyrazole, oxazole, pyrimidine, and azepines) were created and synthesized, and their antibacterial properties were reported by **Mohamed El-Naggar et al**. [9] **B. Shankara et al.** reported that novel {5-[4-hydroxy-3-(4-phenyl-2,3-dihydro-1H-benzo[b] [1,4]diazepin-2- By using the 1,4-phenyl linkage, four novel series of quinazolin-2,4-diones containing five-, six-, and seven-membered heterocyclic moieties (such as pyrazole, oxazole, pyrimidine, and azepines) were created and synthesized, and their antibacterial properties were reported by **Mohamed El-Naggar et al.** [9**] B. Shankara et al.** reported that novel {5-[4-hydroxy-3-(4-phenyl-2,3-dihydro-1H-benzo [b][1,4]diazepin-2-yl)benzyl] compounds have been identified and their antifungal and antimicrobial activity evaluated [10]. **Demet CoGkun et al.** identified that 3-aryl-1-(5-bromo-1-benzofuran-2-yl)-2-propanones are a new sequence of chalcones that were created, synthesized, and analyzed. Using human breast cancer (MCF-7) and prostate cancer (PC-3) cell lines, the in vitro anticancer properties of the newly synthesized chalcone compounds were assessed [11]. **H. Shah et al**. discussed that the relevance of benzazepine derivatives is highlighted in this review in relation to their use as antidepressants, antihypertensives, anti-ischemic, anorectics, antihistamines, AChE inhibitors, TRPV1 antagonists, and in the management of hyponatremia. There are additional reports of recent searches for other pharmacologically active compounds with a benzazepine moiety [12]. **Kibrom Mezgebe et al.** stated that recent developments in synthetic methods and pharmacological properties of chalcone derivatives containing N-heterocyclic moieties at either the A- or B-ring, such as antibacterial, antifungal, antitubercular, antioxidant, antimalarial, anticancer, anti-inflammatory, and antifilarial properties, were assessed [13]. At the moment, a wide variety of chalcones and their derivatives have been synthesized with the use of heterocyclic scaffolds; in particular, chalcones with heterocyclic moieties show greater efficiency and have potential for use in pharmaceutical medication manufacturing [14, 15, 16].

EXPERIMENTAL

Chemicals and Materials

From Sri Mahalakshmi Scientific Company in Chennai, India, ethanol, acetone, and benzaldehyde were procured. The source of ethanol was the Chennai-based Ravi Scientific Company. In this investigation, other compounds included bromine (MVM Scientific Company), hexane, and chloroform (Kesari Scientific company). Unless specified differently, all substances were used exactly as received. The reaction process was tracked using thin-layer chromatography using aluminum sheets that had previously been coated with silica gel (Merck, F-254 from Germany) at a thickness of 0.2 mm. In column chromatography, silica gel [(mesh size 230-400) Merck] was employed.

Characterization Methods

General Methods:

Thin-layer chromatography (TLC) using Merck silica gel 60 F254 percolated plates (0.25 mm) was used to observe all reactions under controlled conditions. Column chromatography was employed to purify the silica gel. Calculations were made on the chemical yields of certain, pure compounds. The spectrum data were displayed in ppm relative to the internal standard tetramethylsilane (TMS) and the 1H and 13C NMR spectra were collected in a CDCl3 solution. When the 13C NMR spectra were being recorded, there was no problem with the proton decoupling. High-resolution mass spectra were obtained using the quadrupole electrospray ionization (ESI) method. Melting points were found with the use of a melting point

instrument. Table 1 displays the compounds (1a–1j)'s measured yields (85–92%).

Synthetic Process Routes(1a-j):
The technique offers a generic diagrammatic representation of the two stages of the routes of the synthetic process. Benzaldehyde and acetone were condensed after an hour of churning in a water/ethanol environment to form chalcones (1). Chalcone and liquid bromine are combined, and the mixture is then exposed to glacial acetic acid in a chloroform medium for two hours in order to create bromochalcone (2).

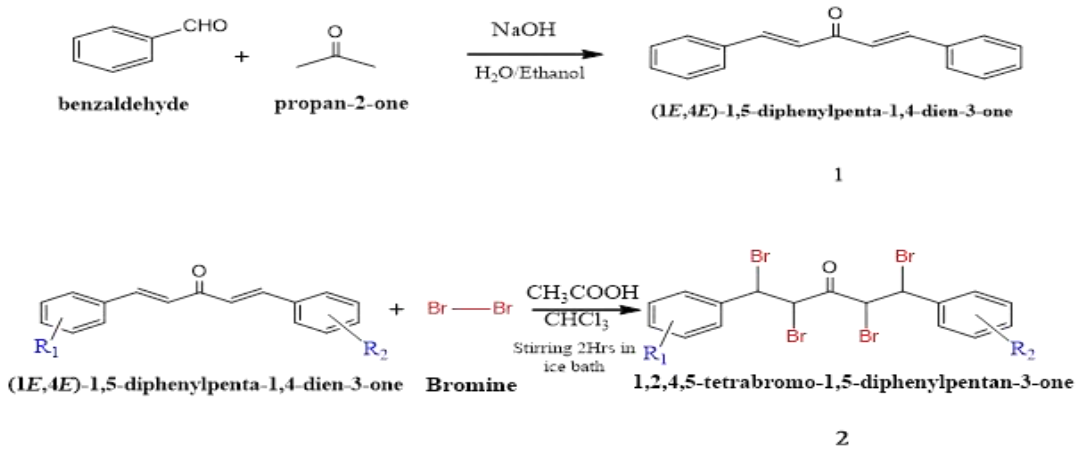


Figure 1: Schematic diagram

Bromo chalcone derivatives were combined with sodium hydroxide and ethylene diamine. This was done in an ethanol medium for two to three hours. The end products were 1a–j bromodiazepine molecules.

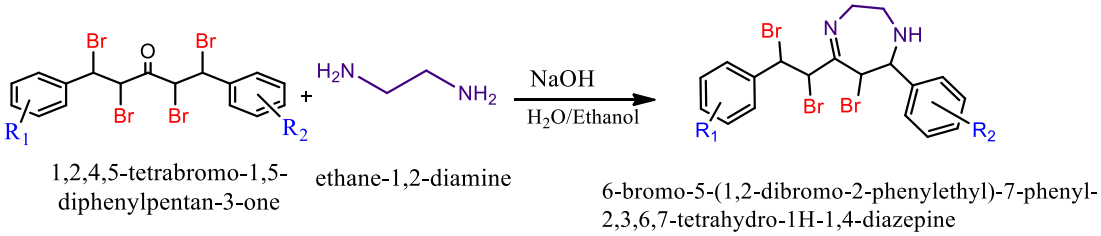


Figure 2: Schematic diagram

1a-j R_1, R_2 - H, 3,4 dihydroxy, 4-Hydroxy, 4-bromo2-nitro,4-methoxy, 3,4,5-tri methoxy, 4-nitro, 2-chloro-4-methyl, 2,3-dimethyl, 2,6-dichloro -4-methyl

The formula for calculating yield percentage:
The yield percentage was estimated using the following formula in all organic transformation processes.
Percentage of yield = Isolated yield /Theoretical yield *X* 100

RESULTS AND DISCUSSION:
Sodium hydroxide (1 M) and ethylenediammine (1 M) were used to stir 1 M of 1,2,4,5-tetrabromo-1,5-diphenylpentanone via agitation. For three hours, the ethanol medium was employed in this experiment. 6-bromo-5-(1,2-dibromo-2-phenylethyl)-7-phenyl-2,3,6,7-tetrahydro-1H-1,4-diazepine was the final chemical. Utilizing rapid TLC, the chemicals were monitored. Utilizing column chromatography, the final product was purified. The manufacture of a chrome yellow solid (1a) yielded an 91% return. The product's melting point was measured and noted. The same protocol was used for the remaining derivatives

Table 1: Physical data compounds (1a-1j)

Compound	Compound Name	Reaction Time (Hours)	Yield (%)	Melting point^{0}C
1a	6-bromo-5-(1,2-dibromo-2-phenylethyl)-7-phenyl-2,3,6,7-tetrahydro-1H-1,4-diazepine	3 Hrs	91%	141° C -143° C
1b	4-(6-bromo-5-(1,2-dibromo-2-(3,4-dihydroxyphenyl)ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepin-7-yl)benzene-1,2-diol	3 Hrs	92%	153° C -155° C
1c	4-(6-bromo-5-(1,2-dibromo-2-(4-hydroxyphenyl)ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepin-7-yl)phenol	3 Hrs	89%	157° C -159° C
1d	6-bromo-7-(4-bromo-2-nitrophenyl)-5-(1,2-dibromo-2-(4-bromo-2-nitrophenyl)ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	2 Hrs	90%	186° C -189° C
1e	6-bromo-5-(1,2-dibromo-2-(4-methoxyphenyl)ethyl)-7-(4-methoxyphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	3 Hrs	89%	154° C -156° C
1f	6-bromo-5-(1,2-dibromo-2-(2,3,4-trimethoxyphenyl)ethyl)-7-(2,3,4-trimethoxyphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	3 Hrs	91%	168° C -170° C
1g	6-bromo-5-(1,2-dibromo-2-(4-nitrophenyl)ethyl)-7-(4-nitrophenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	4 Hrs	86%	168° C -170° C
1h	6-bromo-7-(2-chloro-4-methylphenyl)-5-(1,2-dibromo-2-(2-chloro-4-methylphenyl)ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	3 Hrs	91%	157° C -159° C
1i	6-bromo-5-(1,2-dibromo-2-(2,3-dimethylphenyl)ethyl)-7-(2,3-dimethylphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	3Hrs	88%	147° C -150° C
1j	6-bromo-5-(1,2-dibromo-2-(2,6-dichloro-4-methylphenyl)ethyl)-7-(2,6-dichloro-4-methylphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine	2 Hrs	84%	160° C -162° C

The 1 H NMR data of 1a showed, multiplet with the range of 7.904-7.284 ppm which was attributed to aromatic protons. A doublet at 4.204-3.183 ppm was due to methylene proton and the bromide proton doublet with the range of 5.418-4.863 ppm was designated for aromatic alcohol. The singlet at 2.653 ppm was attributed to an N-H proton. In the 13C NMR spectrum, peaks at 77.40-76.76 ppm and were due to methyl bromo carbons. The peaks ranging between 138.26-122.6 ppm were assigned to aromatic carbons (Fig. 2). The peak at 146.17 ppm was attributed to nitrogen bonded with carbon. The HR-MS spectrum declared the peak of molecular ion (M+) at m/z 55.084 (Fig. 3). Using elemental analysis, the formation of the product was firmly authenticated. In the IR data, broad peak at 3440.38 was designated for aromatic group.

Characterization of synthesized compound 1a-j

Table 2: Characterization of 6-bromo-5-(1,2-dibromo-2-phenylethyl)-7-phenyl-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.904-7.284 (multiplet aromatic proton), δ 4.204,3.727, 3.710,3.183(d,methyleneproton),δ5.418,5.213,4.863(d, bromides proton), δ 2.653(amine proton)
^{13}C-NMR	δ 138.26-122.16(multiplet aromatic proton), [77.40(1C, S),77.08(1C S),76.76(1C, S) (methyl bromide)] δ 50.23,49.52 (1C-Aliphatic-methylene carbon, S), δ 146.17 (Aliphatic C-N carbon, s)
Mass: m/z	515.084
IR	δ 3440.38 (Aromatic C-H), δ 667.49, δ 635.43, δ 565.04 (C-Br), δ 1204.33 (C=N), δ 1331.61 (C-N-H) cm-1

Table 3: Characterisation of 4-(6-bromo-5-(1,2-dibromo-2-(3,4dihydroxyphenyl) ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepin-7-yl) benzene-1,2-diol

^{1}H-NMR	δ 7.918-7.296 (multiplet aromatic proton), δ 4.209,3.733, 3.716,3.187(dmethyleneproton),δ5.425,5.221,4.870(d,bromides proton), δ 2.661(amine proton)
^{13}C-NMR	δ 139.25-123.26(multiplet aromatic proton), [77.54(1C, S),77.28(1C S),76.80(1C, S) (methyl bromide)] δ 51.65,50.49 (1C-Aliphatic-methylene carbon, S), δ 147.57 (Aliphatic-CN carbon, s)
Mass: m/z	579.082
IR	δ 3446.12 (Aromatic C-H), δ 669.51, δ 647.41, δ 570.09 (C-Br), δ 1207.28 (C=N), δ 1335.72 (C-N-H) cm-1

Table 4: Characterisation of 4-(6-bromo-5-(1,2-dibromo-2-(4-hydroxyphenyl) ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepin-7-yl) phenol

^{1}H-NMR	δ 7.914-7.290 (multiplet aromatic proton), δ 4.206,3.730, 3.714,3.185(d,methylene proton),δ5.423,5.218,4.867(d,bromides proton), δ 2.655(amine proton)
^{13}C-NMR	δ 138.96-128.56(multiplet aromatic proton), [77.69(1C, S),77.20(1C S),76.15(1C, S) (methyl bromide)] δ 52.11,51.25 (1C-Aliphatic-methylene carbon, S), δ 147.12 (Aliphatic-CN carbon, s)
Mass: m/z	547.083
IR	δ 3444.95 (Aromatic C-H), δ 667.49, δ 635.43, δ 565.04 (C-Br), δ 1204.33 (C=N), δ 1331.61 (C-N-H) cm-1

Table5: Characterisation of 6-bromo-7-(4-bromo-2-nitrophenyl)-5-(1,2-dibromo-2-(4-bromo-2-nitrophenyl) ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.935-7.298 (multiplet aromatic proton), δ 4.325,3.827, 3.721,3.197(dmethyleneproton),δ5.456,5.895,4.278(d,bromides proton), δ 2.673(amine proton)
^{13}C-NMR	δ 139.85-123.24(multiplet aromatic proton), [77.87(1C, S),77.28(1C S),76.74(1C, S) (methyl bromide)] δ 50.83,49.76 (1C-Aliphatic-methylene carbon, S), δ 145.68 (Aliphatic-CN carbon, s)
Mass: m/z	762.872
IR	δ 3478.38 (Aromatic C-H), δ 671.49, δ 641.21, δ 578.12 (C-Br), δ 1218.38 (C=N), δ 1337.78 (C-N-H) cm-1

Table 6: Characterisation of 6-bromo-5-(1,2-dibromo-2-(4-methoxyphenyl) ethyl)-7-(4-methoxyphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.915-7.251 (multiplet aromatic proton), δ 4.278,3.721, 3.718,3.196(dmethyleneproton),δ5.454,5.298,4.863(d,bromides proton), δ 2.671(amine proton), δ 3.752(methoxy protons)
^{13}C-NMR	δ 137.56-118.21(multiplet aromatic proton),[77.14(1C, S),77.01(1C S),76.84(1C, S) (methyl bromide)] δ 50.98,49.12 (1C-Aliphatic-methylene carbon, S), δ 145.48 (Aliphatic-CN carbon, s) δ 56.12(methoxy carbon,S)154.67(Acetyl carbon)
Mass: m/z	575.137
IR	δ 3446.54 (Aromatic C-H), δ 668.19, δ 645.53, δ 567.38 (C-Br), δ 1211.5 (C=N), δ 1337.69 (C-N-H) cm-1

Table 7: Characterisation of 6-bromo-5-(1,2-dibromo-2-(2,3,4-trimethoxyphenyl) ethyl)-7-(2,3,4-trimethoxyphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.874-7.301 (multiplet aromatic proton), δ 4.104,3.827, 3.750,3.218(dmethyleneproton),δ5.481,5.231,4.683(d,bromides proton), δ 2.563(amine proton), δ 3,746(methoxy proton)
^{13}C-NMR	δ 140.26-121.42(multiplet aromatic proton), [77.89(1C, S),77.48(1C S),76.05(1C, S) (methyl bromide)] δ 50.98,49.11

	(1C-Aliphatic-methylene carbon, S), δ 147.21 (Aliphatic-CN carbon, s) δ 144.42,144.23,140.12(methoxy carbon, S)
Mass: m/z	695.242
IR	δ 3448.74 (Aromatic C-H), δ 658.51, δ 645.13, δ 556.12 (C-Br), δ 1215.45 (C=N), δ 1338.72 (C-N-H) cm-1

Table8: Characterisation of 6-bromo-5-(1,2-dibromo-2-(4-nitrophenyl) ethyl)-7-(4-nitrophenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.911-7.184 (multiplet aromatic proton), δ 4.257,3.621, 3.590,3.173(d, methylene proton),δ5.498,5.237,4.745(d, bromides proton), δ 2.518(amine proton)
^{13}C-NMR	δ 139.98-124.16(multiplet aromatic proton), [77.71(1C, S),77.48(1C S),76.46(1C, S) (methyl bromide)] δ 50.99,49.71 (1C-Aliphatic-methylene carbon, S), δ 147.15 (Aliphatic-CN carbon, s)
Mass: m/z	605.08
IR	δ 3442.95 (Aromatic C-H), δ 677.59, δ 639.43, δ 569.34 (C-Br), δ 1218.24 (C=N), δ 1337.54 (C-N-H) cm-1

Table9: Characterisation of 6-bromo-7-(2-chloro-4-methylphenyl)-5-(1,2-dibromo-2-(2-chloro-4-methylphenyl) ethyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.897-7.312 (multiplet aromatic proton), δ 4.232,3.784, 3.732,3.243(dmethyleneproton),δ5.478,5.253,4.811(d,bromides proton), δ 2.653(amine proton), δ 2.562(methyl protons)
^{13}C-NMR	δ 138.26-122.16(multiplet aromatic proton), [77.40(1C, S),77.08(1C S),76.76(1C, S) (methyl bromide)] δ 50.23,49.52 (1C-Aliphatic-methylene carbon, S), δ 146.17 (Aliphatic-CN carbon, s) δ 21.32(methyl carbon)
Mass: m/z	612.028
IR	δ 3448.24 (Aromatic C-H), δ 668.12, δ 645.23, δ 567.24 (C-Br), δ 1216.43 (C=N), δ 1335.81 (C-N-H) cm-1

Table10: Characterisation of 6-bromo-5-(1,2-dibromo-2-(2,3-dimethylphenyl) ethyl)-7-(2,3-dimethylphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.895-7.301 (multiplet aromatic proton), δ 4.225,3.757, 3.731,3.193(dmethyleneproton),δ5.479,5.323,4.913(d,bromides proton), δ 2.703(amine proton), δ 2.2134,2.222,2.224,2.229 (methyl protons)
^{13}C-NMR	δ 139.56-123.16(multiplet aromatic proton), [77.86(1C, S),77.28(1C S),76.84(1C, S) (methyl bromide)] δ 51.13,49.72 (1C-Aliphatic-methylene carbon, S), δ 147.57 (Aliphatic-CN carbon, s), δ 20.11,16.85(methyl carbon)
Mass: m/z	571.192
IR	δ 3442.18 (Aromatic C-H), δ 669.49, δ 612.43, δ574.87 (C-Br), δ 1214.53 (C=N), δ 1335.32 (C-N-H) cm-1

Table11: Characterisation of 6-bromo-5-(1,2-dibromo-2-(2,6-dichloro-4-methylphenyl) ethyl)-7-(2,6-dichloro-4-methylphenyl)-2,3,6,7-tetrahydro-1H-1,4-diazepine

^{1}H-NMR	δ 7.845-7.184 (multiplet aromatic proton), δ 4.218,3.787, 3.690,3.192(dmethyleneproton),δ5.432,5.203,4.896(d,bromides proton), δ 2.754(amine proton), δ 2.551(methyl protons)
^{13}C-NMR	δ 137.41-119.26(multiplet aromatic proton), [77.35(1C, S),77.27(1C S),76.91(1C, S) (methyl bromide)] δ 50.87,49.11 (1C-Aliphatic-methylene carbon, S), δ 147.01 (Aliphatic-CN carbon, s),δ 21.32(methyl carbon)
Mass: m/z	680.918
IR	δ 3446.18 (Aromatic C-H), δ 675.19, δ 654.34, δ 578.24 (C-Br), δ 1208.11 (C=N), δ 1332.67 (C-N-H) cm-1

Figure 3: 1H NMR Spectrum

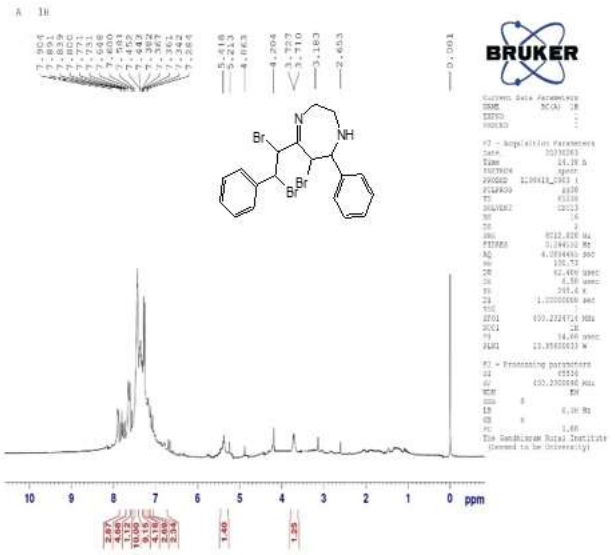


Figure 4: 13C NMR Spectrum

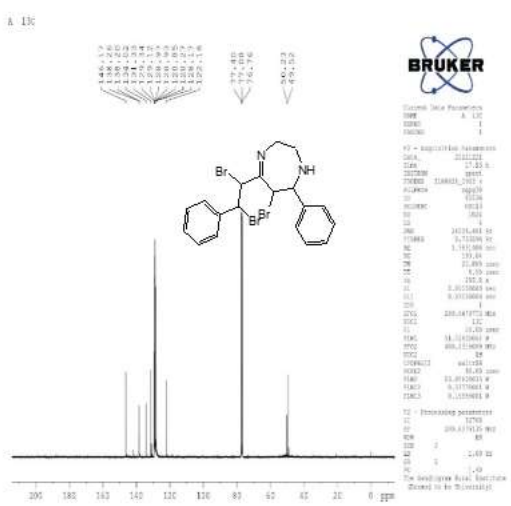


Figure 5: Mass Spectrum

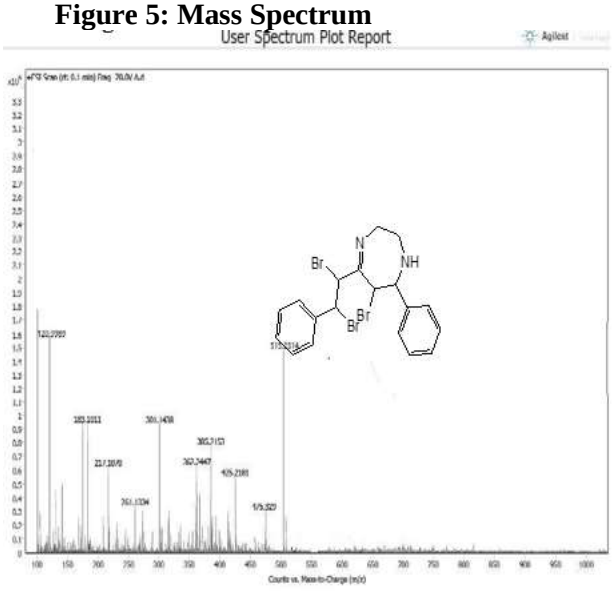
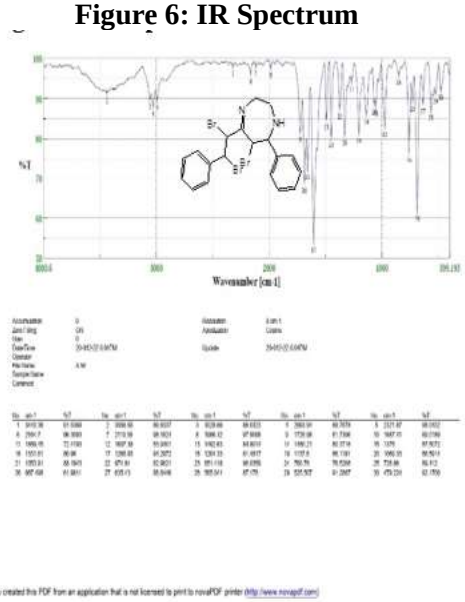


Figure 6: IR Spectrum



CONCLUSION

Bromo chalcone and ethjylene diammine can be used to successfully synthesize 6-bromo-5-(1,2-dibromo-2-phenylethyl)-7-phenyl-2,3,6,7-tetrahydro-1H-1,4-diazepine. The derivatives of the synthesized compounds (1a-j) were created in the presence of sodium hydroxide using ethanol as a solvent. Superior yield enhanced the results (Table 1). We have finished employing several spectrum characterizations to verify the created compounds structural integrity. The findings of evaluating the biological activity of the synthesized substances are being studied.

ACKNOWLEDGEMENTS

The authors are grateful to the Department of Chemistry at Gandhigram Rural University for recording FTIR and NMR, and to the HRMS recording team at IIT Madras.

REFERENCES

1. Maurizio D'Auria, Ambra Guarnaccio, Rocco Racioppi, Sonia Stoia, Lucia Emanuele, Chapter 1-Photochemical synthesis of heterocyclic compounds, Photochemistry of Heterocycles, Elsevier,2023, Pages1-89,https://doi.org/10.1016/B978-0-12-823745-8.00006-6.

2. de Baun JR, Pallos FM, Baker DR. 5-furoyl-2,2,4-trimethyl-1,4-dihydro-1H-1,5-benzodiazepine as an anti-inflammatory agent. 1976. US Patent 3,978,227.
3. . de Baun JR, Pallos FM, Baker DR. 5-furoyl-2,2,4-trimethyl-1,4-dihydro-1H-1,5-benzodiazepine as an anti-inflammatory agent. *Chemical Abstracts*. 1977;86:p. 5498d. [Google Scholar]
4. Schultz H. *Benzodiazepines*. Heidelberg, Germany: Springer; 1982. [Google Scholar]
5. Smiley RK. *Comprehensive Organic Chemistry*. Oxford, UK: Pergamon; 1979. [Google Scholar]
6. Landquist JK. *Comprehensive Heterocyclic Chemistry*. Vol. 1. Oxford, UK: Pergamon; 1984. [Google Scholar]
7. Randall LO, Kappel B. Pharmacological activity of some benzodiazepines and their metabolites. In: Garattini S, Mussini E, editors. *Benzodiazepines*. New York, NY, USA: Raven; 1973. [Google Scholar]
8. Nidhi Arora, Prashant Dhiman, Shubham Kumar, Gurpreet Singh, Vikramdeep Monga, Recent advances in synthesis and medicinal chemistry of benzodiazepines, Bioorganic Chemistry,Volume97,2020,103668,ISSN0045 2068,https://doi.org/10.1016/j.bioorg.2020.103 668
9. Gill Kaur Rupinder, Kaushik Om Shiv, Chugh Jasreen, Bansal Sumit, Shah Anamik and Bariwal Jitender, Recent Development in [1,4]Benzodiazepines as Potent Anticancer Agents: A Review, Mini-Reviews in Medicinal Chemistry 2014; 14(3) https://dx.doi.org/10.2174/1389557511313999 0081
10. Cyclization of Chalcone Derivatives: Design, Synthesis, *In Silico* Docking Study, and Biological Evaluation of New Quinazolin-2,4-diones Incorporating Five-, Six-, and Seven-Membered Ring Moieties as Potent Antibacterial Inhibitors MohamedElNaggar,[†‡] HudaR.M.Rashdan,[§] and AboubakrH.Abdelmonsef doi: 10.1021/acsomega.3c02478
11. Synthesis, Antimicrobial Evaluation, and Docking Studies of Some Novel Benzofuran Based Analogues of Chalcone and 1,4-Benzodiazepine1 B. Shankara , P. Jalapathia* , M. Ramesha , A. Kishore Kumara , M. Ragavendera , and G. Bharathb DOI: 10.1134/S107036321607029X
12. Synthesis, Characterization, and Anticancer Activity of New Benzofuran Substituted Chalcones Demet CoGkun,1 Suat Tekin,2 Süleyman Sandal,2 and Mehmet Fatih CoGkun1 https://doi.org/10.1155/2016/7678486
13. Pharmacological and Biological Activities of Benzazepines: An Overview H. Shah, Jigar; Hindupur, Rama M.; N. Pati, Hari Current Bioactive Compounds, Volume 11, Number 3, 2015, pp. 170-188(19)
14. .Synthesis and Pharmacological Activities of Chalcone and Its Derivatives Bearing *N*-Heterocyclic Scaffolds: A Review Kibrom Mezgebe, Yadessa Melaku, and Endale Mulugeta *ACS Omega* 2023 *8* (22), 19194-19211 DOI: 10.1021/acsomega.3c01035.
15. Zhang, S.; Li, T.; Zhang, L.; Wang, X.; Dong, H.; Li, L.; Fu, D.; Li, Y.; Zi, X.; Liu, H.-M.; Zhang, Y.A novel chalcone derivative S17 induces apoptosis through ROS dependent DR5 up-regulation in gastric cancer cells. *Sci. Rep.* 2017, *7* (1), 9873, DOI: 10.1038/s41598-017-10400-3 [Crossref], [PubMed], [CAS], Google Scholar
16. Alam, M. S.; Rahman, S. M.; Lee, D. U. Synthesis, biological evaluation, quantitative-SAR and docking studies of novel chalcone derivatives as antibacterial and antioxidant agents. *Chem. Papers* 2015, *69* (8), 1118– 1129, DOI: 10.1515/chempap-2015-0113 [Crossref], [CAS], Google Scholar
17. Hailemariam, A.; Feyera, M.; Deyou, T.; Abdissa, N. Antimicrobial Chalcones from theSeeds of *Persicaria lapathifolia*. *Biochem. Pharmacol.* 2018, *7* (1), 1000237, DOI: 10.4172/2167-0501.1000237 [Crossref], Google Scholar