Journal of science faculty at Sirte University
JSFSU
2021
Peer-review Periodical Journal

جامعة سرت
Sirte University
1989

ISSN INTERNATIONAL STANDARD SERIAL NUMBER
eISSN: 2789-858X

SCIENTIFIC JOURNAL FOR THE FACULTY OF SCIENCE – SIRTE UNIVERSITY

DOI: 10.37375/issn.2789-858X – Indexed by Crossref, USA

VOLUME 3 ISSUE 1 APRIL 2023

Bi-Annual, Peer- Reviewed, Indexed, and Open Accessed e-Journal

SJFSSU

معامل التأثير العربي = 1.02

Legal Deposit Number@NationaL Library (Benghazi): 990/2021

Sjsfsu@su.edu.ly
journal.su.edu.ly/index.php/JSFSU

Scientific Journal for the Faculty of Science-Sirte University Vol. 3, No. 1 (2023) 54-60

Scientific Journal for the Faculty of Science-Sirte University

Journal home page: http://journal.su.edu.ly/index.php/JSFSU/index

DOI: 10.37375/issn.2789-858X

Synthesis and Spectral Characterization of New Compounds Containing Benzotriazole Ring from 2 - chloro – *N* – (Substitutedphenyl) Acetamide

Ghazala Hashim[1], Nsreen Abdalfarg[2] and Hanan Bashir[1]

[1]*Chemistry Department, Science Faculty, Omar Al-Mokhtar University, Libya.*
[2]*Chemistry Department, Science Faculty, Derna University, Libya.*

DOI: https://doi.org/10.37375/sjfssu.v3i1.837

ARTICLE INFO:

Received: 30 December 2022

Accepted: 07 March 2023

Published: 17 April 2023

Keywords:

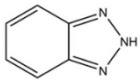
o – phenylene diamine, 2 – chloro - *N* - (substituted phenyl) acetamide, 1*H*-benzo[*d*] 1,2,3-triazole, synthesis.

A B S T R A C T

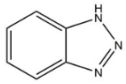
A series of 2 – (1H – benzo[d] 1, 2, 3 – triazol -1 – yl) – N – (substituted phenyl) acetamide (3 -8) were synthesized by reacting 1H -benzo [d] 1, 2, 3 – triazole **(2)** and 2 - chloro – N – (substituted phenyl) acetamide (a1 - a6) in DMF in present K_2CO_3 was heated on water bath. 1H – benzo [d] 1, 2, 3 – triazole **(2)** is bicyclic heterocyclic system consisting of three nitrogen atoms and fused benzene ring, shows wide range of biological and pharmacological activities. Benzotriazole **(2)** can be synthesized by diazotization process using o -phenylene diamine with sodium nitrite and acetic acid. The synthesized compounds were isolated and purity was checked by TLC method. The structures of all new benzotriazoles derivatives were confirmed by melting point and spectroscopic methods (IR, ^{1}HNMR, ^{13}CNMR, Mass spectrometry and elementary analysis). Furthermore, the purpose of this research is to synthesize some heterocyclic compounds that are of importance in the field of science and research. In addition, most of the studies based on benzotriazole derivatives possess wide spectrum of biological activities like including antibacterial, antifungal, antiviral, anti-inflammatory, antihypertensive, analgesic properties.

1 Introduction

A heterocyclic is an organic compound having a ring including at least one additional element, such as O, S, or N, and one or more carbon atoms. Since at least one heterocyclic component may be found in almost half of all known organic molecules, heterocyclic compounds are relatively common in nature. As they are essential to the metabolism of all living cells, their functions are frequently of basic relevance to living systems (Suma et al. 2011). Benzotriazole is a heterocyclic compound formed by the fusion of the benzene ring with the 4,5-positions of 1,2,3-triazole (Ram et al. 2019). It is also known as 1*H*-benzo[d]-1,2,3-triazole and Most of benzotriazole derivatives are prepared as a mixture of two isomers – the 2*H*- benzotriazole **(1)** and 1*H*-benzotriazole **(2)** isomers. In some instances, both isomers display a similar reactivity while in some specific cases they display distinct reactivity profiles. A simple chromatography on silica gel usually suffices for their separation (Ueno et al. 2003).



(1)



(2)

Besides, benzotriazole is readily available in large quantities and is, most importantly, inexpensive. Anchored on molecular scaffolds, the benzotriazole moiety acts as an enabling group conveying its unique electronic, steric, and stereoelectronic properties to the surroundings. Four major properties of the benzotriazole fragment interplay and are responsible for the synthetic versatility of its derivatives: excellent leaving group ability, electron-donating or electron-withdrawing

Corresponding author: E-mail: mohammednsreen3@gmail.com

character, stabilization of α-negative charges and stabilization of radicals. Most of benzotriazole derivatives are characterized by a long shelf-life, and their preparations are amenable to large scales (Alpana et al. 2020). Compounds containing benzotriazoles have been discovered to have a variety of uses in organic synthesis, such as biologically active systems, dye materials and fluorescent compounds, corrosion inhibitors, and photostabilizers in both medicine and industry (Uesaka et al. 2020). According to a review of the literature, the benzotriazole nucleus exhibits a variety of pharmacological properties, including anti - inflammatory (Jain et al. 2013), antibacterial (Jamkhandi et al. 2013), antifungal (Al-Omran et al. 2002), and anticancer (Noolvi et al. 2012) effects.

2 Materials and Methods

Melting point were decided in open capillary tube on VEEGO (VMP-D) softening point device and are uncorrected. IR spectro (KBr pellets) were recorded on a SHINADZU infrared spectrophotometer. The ^{1}HNMR spectra were determined in DMSO - d6 at 300MHz on a BRUKER DP – X300NMR spectrophotometer using TMS as an internal standard. ^{13}CNMR were measured on Bruker 400MHz with internal reference TMS=0. Mass spectra were recorded at 70 ev with a GCMS - QP 1000 EX spectrometer.

Synthesis of 2-(1*H*-benzo[d]1,2,3 – triazol-1-yl) – *N*-(substituedphenyl) acetamide (3,4,5,6,7,8):

Equimolar quantity of 2 – Chloro – *N* – substituted phenyl) acetamide **(a_1-a_6)** (0.01mol) with 1*H*-benzo[d]1,2,3-triazole **(2)** (Bashir., et el. 2021) (0.01 mol) in present K_2CO_3 were dissolved in DMF, this mixture was heated on water bath for 24 hrs. The reaction was cooled at room temperature and poured into water (200 ml) with stirring for 15min, the solid obtained was filtrated and finally recrystallized from absolute ethanol.

2-(1*H*-benzo[d]1,2,3 -triazol-1-yl) – *N*-(4-methoxy-3 – nitrophenyl) acetamide (3):

Yield 70%, m.p. 203-204 ^{0}C. IR (ῡmax, cm^{-1}): 3323(NH), 3100 (CH- aromatic), 2921(CH- aliphatic) and 1689(CONH). ^{1}HNMR (DMSO, δH, ppm):3.8(s, 3H, OCH_3), 5.7(s, 2H, CH_2CO), 7.3 -8.1 (m, 7H, aromatic-H) and 10.7 (s, 1H, NH). M/S, m/z (%) = 327(M^+, 5), 104(M^+, $C_9H_9N_3O_4$, 100) and 76(M^+, $C_9H_9N_5O_4$, 36), Anal. Calc. for $C_{15}H_{13}N_5O_4$ (327): C, 55.05; H, 4.00; N, 21.40; O, 19.55%, found: C, 55.15; H, 3.99; N, 21.60 %.

2-(1*H* – benzo[d]1,2,3 – triazol-1-yl) – *N*-(3-nitrophenyl) acetamide (4):

Yield 64%, m.p. 286-288 ^{0}C. IR (ῡmax, cm^{-1}): 3186(NH), 3012 (CH-aromatic), 2969(CH- aliphatic) and 1705(CONH). ^{1}HNMR (DMSO, δH, ppm): 5.8(s, 2H, CH_2CO), 7.4 -8.6 (m, 8H, aromatic-H) and 11.1(s, 1H, NH). M/S, m/z (%) = 297(M^+, 2), 132(M^+, $C_7H_5N_2O_3$, 35), 104(M^+, $C_8H_7N_3O_3$, 2), 77(M^+, $C_8H_8N_5O_3$, 100) and 78 (M^+, $C_8H_9N_5O_3$,41). C^{13}NMR: 50.049(1C),110.85(1C), 113.33(1C), 118.19(1C), 123.84 (2C), 125.13 (2C), 127.37 (1C), 130.21 (1C), 133.80 (1C), 139.42(1C), 145.03 (1C), 147.85 (1C) and 165.17(1C). Anal. Calc. for $C_{14}H_{11}N_5O_3$(297): C, 56.56; H, 3.73; N, 23.56, found: C, 56.80; H, 3.99; N, 24.00%.

2 - (1*H* – benzo [d] 1,2,3 – triazol -1 – yl) – *N*- (2 - nitrophenyl) acetamide (5):

Yield 70%, m.p.195-197 ^{0}C. IR (ῡmax, cm^{-1}): 3316(NH), 3093 (CH-aromatic), 2929 (CH-aliphatic) and 1689(CONH). ^{1}HNMR (DMSO, δH, ppm): 5.8(s, 2H, CH_2CO), 7.4 -8.1 (m, 8H, aromatic-H) and 10.9(s, 1H, NH). M/S, m/z (%) = 297(M^+, 1), 132(M^+, $C_7H_5N_2O_3$, 61), 104(M^+, $C_8H_7N_3O_3$, 17), 77(M^+, $C_8H_8N_5O_3$, 100),78 (M^+, $C_8H_9N_5O_3$,31) and 76(M^+, $C_8H_7N_5O_3$, 23). Anal. Calc. for $C_{14}H_{11}N_5O_3$(297): C, 56.56; H, 3.73; N, 23.56, found: C, 57.00; H, 3.84; N, 23.60%.

2 - (1*H* – benzo[d]1,2,3 – triazol-1-yl) – *N* - (4-nitrophenyl) acetamide (6):

Yield 78%, m.p. 269-271 ^{0}C. IR (ῡmax, cm^{-1}): 3314(NH), 3093 (CH-aromatic), 2938(CH- aliphatic) and 1697(CONH). ^{1}HNMR (DMSO, δH, ppm): 5.8(s, 2H, CH_2CO), 7.4 -8.1 (m, 8H, aromatic-H) and 11(s, 1H, NH). M/S, m/z (%) = 297(M^+, 4), 132(M^+, $C_7H_5N_2O_3$, 4), 104(M^+, $C_8H_7N_3O_3$, 15), 76(M^+, $C_8H_7N_5O_3$, 40), 77 (M^+, $C_8H_8N_5O_3$, 100) and 78 (M^+, $C_8H_9N_5O_3$,30). C^{13}NMR: 50.50 (1C),110.86(1C), 118.86(1C), 120.27 (1C), 123.86 (2C), 124.97 (2C), 127.38(2C), 133.79 (1C), 142.51 (1C), 145.07 (1C) and 165.40(1C). Anal. Calc. for $C_{14}H_{11}N_5O_3$(297): C, 56.56; H, 3.73; N, 23.56, found: C, 57.00; H, 3.84; N, 23.60%.

2 - (1*H* – benzo[d] 1, 2, 3 – triazol - 1-yl) – *N* - (3 - hydroxyphenyl) acetamide (7):

Yield 74%, m.p. 209-211 ^{0}C. IR (ῡmax, cm^{-1}): 3407(OH), 3360(NH), 3083 (CH-aromatic), 2935(CH-aliphatic) and 1667(CONH). ^{1}HNMR (DMSO, δH, ppm): 5.7(s, 2H, CH_2CO), 6.5 -8.1 (m, 8H, aromatic-H),9.4(s,1H, OH) and 10.5(s, 1H, NH). M/S, m/z (%) = 268(M^+, 34), 133(M^+, $C_7H_7NO_2$, 29), 104(M^+, $C_8H_{12}N_2O_2$, 56), 76(M^+, $C_8H_{12}N_4O_2$, 100) and 78 (M^+, $C_8H_{14}N_4O_3$, 69). Anal. Calc. for $C_{14}H_{12}N_4O_2$ (268): C, 62.68; H, 4.51; N, 20.88; found: C, 63.01; H, 4.72; N, 21.00%.

2 - (1*H* – benzo[d] 1, 2, 3 – triazol - 1-yl) – *N* - (*p* -toly) acetamide (8):

Yield 80%, m.p. 244-246 ^{0}C. IR (ῡmax, cm^{-1}): 3276(NH), 3126 (CH-aromatic), 2979(CH- aliphatic) and 1688(CONH). ^{1}HNMR (DMSO, δH , ppm): 2.5(s,3H,CH_3), 5.7(s, 2H, CH_2CO), 7.1 -8.1 (m, 8H, aromatic-H) and 10.5(s, 1H, NH). M/S, m/z (%) = 266(

M+, 53), 132(M+, C_8H_8NO, 12), 104(M+, $C_9H_{10}N_2O$, 38), 76(M^+, $C_9H_{10}N_4O$, 13), 78 (M^+, $C_9H_{12}N_4O$, 32) and 77 (M^+, $C_9H_{11}N_4O$,100). C^{13}NMR: 50.42 (1C),110.88(1C), 118.97(1C), 123.79(2C), 127.25(2C), 129.2 (2C), 132.72 (1C), 133.83(1C), 135.88(1C), 145.04 (1C) and 164.06(1C). Anal. Calc. for $C_{15}H_{11}N_4O$ (266): C, 67.65; H, 5.30; N, 21.04, found: C, 68.00; H, 5.44; N, 20.99%.

3 Results and Discussion

In the present work, 1*H*-benzo(*d*)1,2,3-triazole derivatives **(3,4,5,6,7,8) (scheme1)** obtained by reacting 1*H*-benzo(*d*)1,2,3-triazole **(2)** (Bashir, H., *el et* 2021) with 2-hloro-*N*-substitutedphenyl) acetamide **(a_1 -a_6)** in DMF in present K_2CO_3 on water bath for 24 hrs. The structure of compound **(3)** was confirmed by Elemental analysis and the IR spectrum. Which showed stretching bonds at 3323cm^{-1} and1689 cm^{-1} corresponds (-NH-) and (-CO-) groups respectively. The ^{1}HNMR spectrum revealed the appearance of singlet single at 5.7 ppm attributed methylene protons, in addition to multiplet signals 7.3-8.1 ppm to seven aromatic protons and singlet signal at 10.7 ppm (-NH-). The mass spectrum of **(3)** showed molecular ion peak at m/z (327).

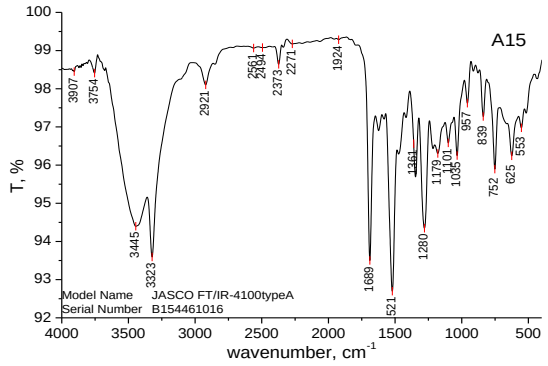


Figure: (1).IR spectrum (cm^{-1}) of compound **(3)**

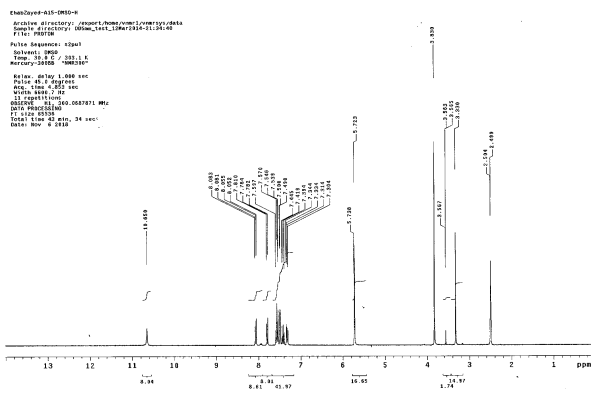


Figure: (2). ^{1}HNMR spectrum of compound **(3)**

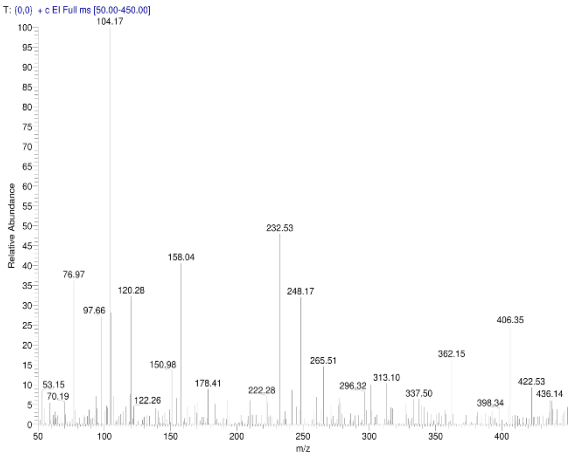


Figure: (3). Mass spectrum of compound **(3)**

The structures of compound (**4,5**and **6)** were characterized by the present of strong absorption bands of amidic carbonyl group at 1705cm^{-1}, 1689cm^{-1} and 1697cm^{-1} respectively, but absorption bands of (-NH-) group of compounds **(4**,**5**and **6)** appeared at 3186 cm^{-1},3316 cm^{-1} and 3314cm^{-1}respectively. The ^{1}HNMR spectrum of compound **(4,5** and **6)** showed singlet signals of (-NH-) group at 11.1ppm ,10.9 ppm and 11ppm respectively, also appeared singlet signal of (-CH_2-) group at 5.8 ppm of compound **(4, 5** and **6**). The mass spectrum of compounds (**4,5** and **6**) showed molecular ion peak at 286 that was consistent with the molecular weight of compounds. ^{13}CNMR spectrum of compounds **(4)** and **(6)** appeared carbonyl group of amide (-CO-) at 165.17 ppm and 165.40 ppm respectively, in additional singles peak at 50.42 ppm and 50.50 ppm that indicated to (-CH_2-) group, respectively.

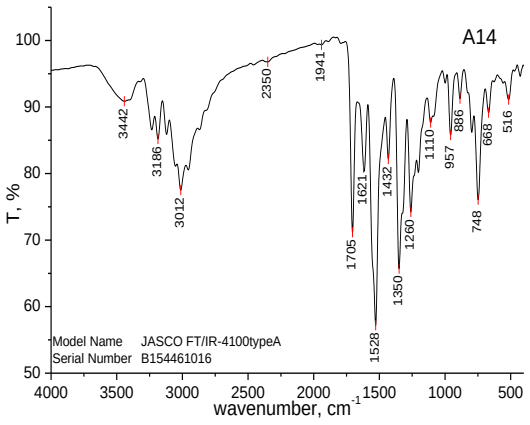


Figure: (4).IR spectrum (cm^{-1}) of compound **(4)**

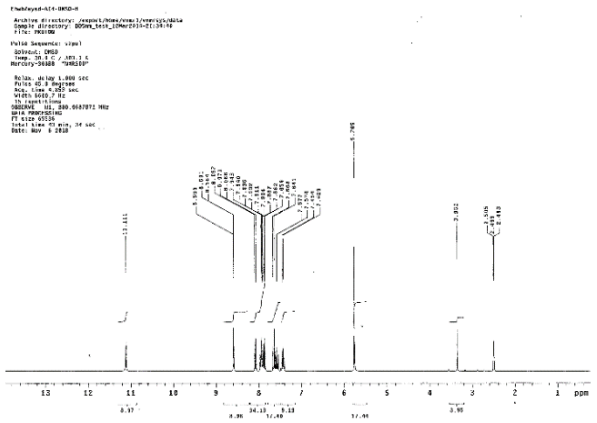


Figure: (5).^{1}HNMR spectrum of compound **(4)**

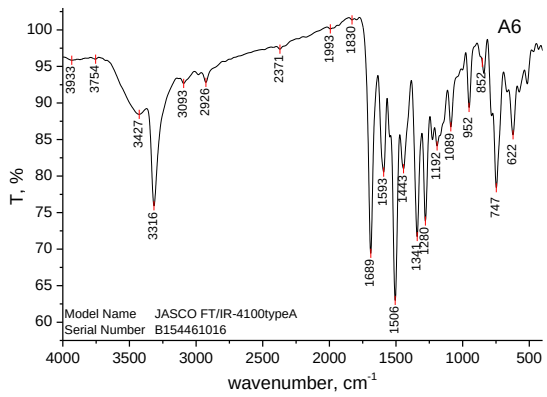


Figure: (8).IR spectrum (cm^{-1}) of compound **(5)**

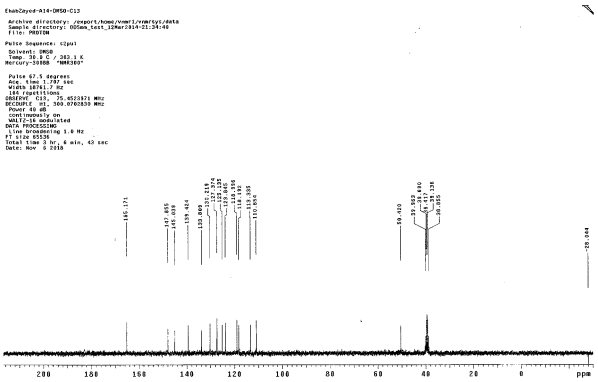


Figure: (6).^{13}CNMR spectrum of compound **(4)**

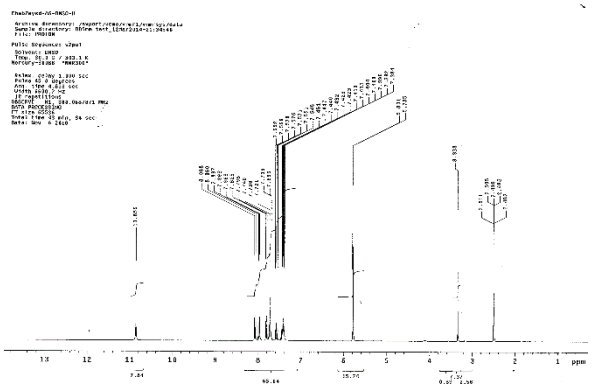


Figure: (9).^{1}HNMR spectrum of compound **(5)**

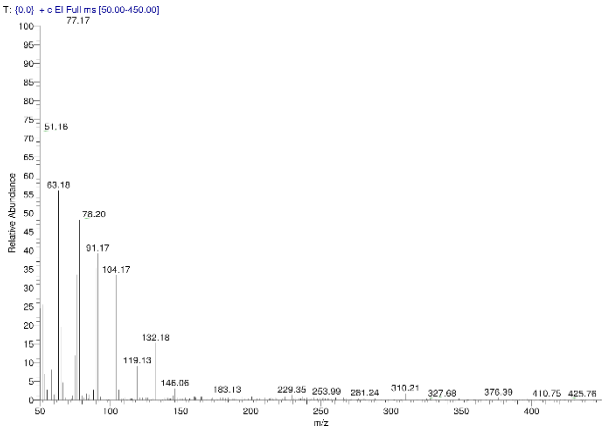


Figure: (7). Mass spectrum of compound **(4)**

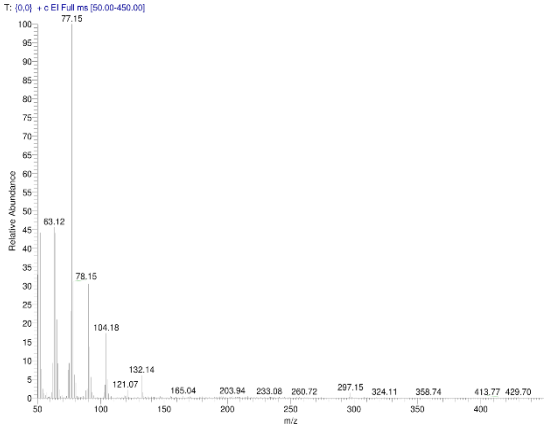


Figure: (10). Mass spectrum of compound **(5)**

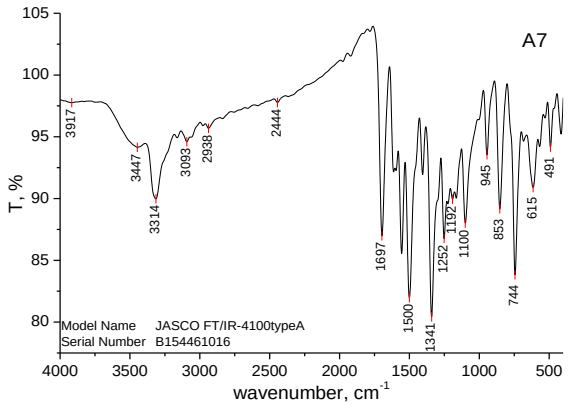


Figure: (11).IR spectrum (cm^{-1}) of compound (6)

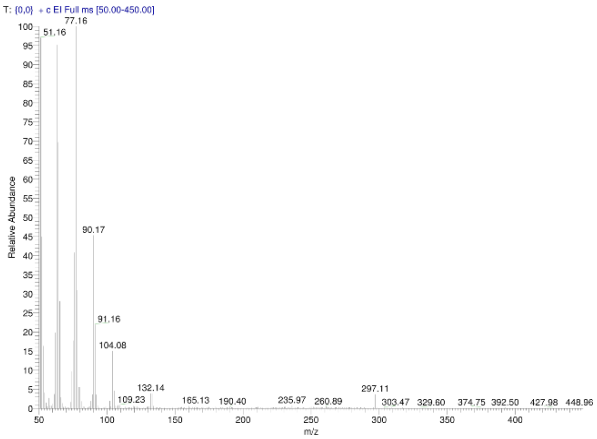


Figure: (14). Mass spectrum of compound (6)

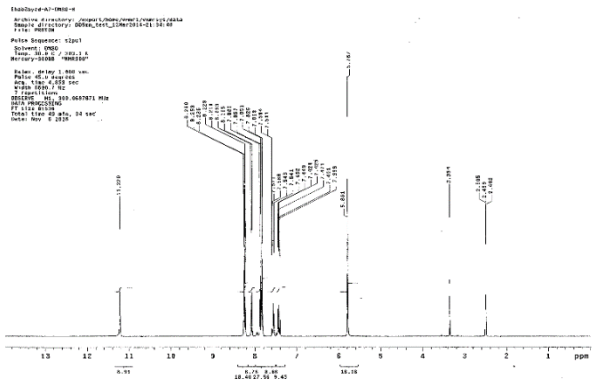


Figure: (12).[1]HNMR spectrum of compound **(6)**

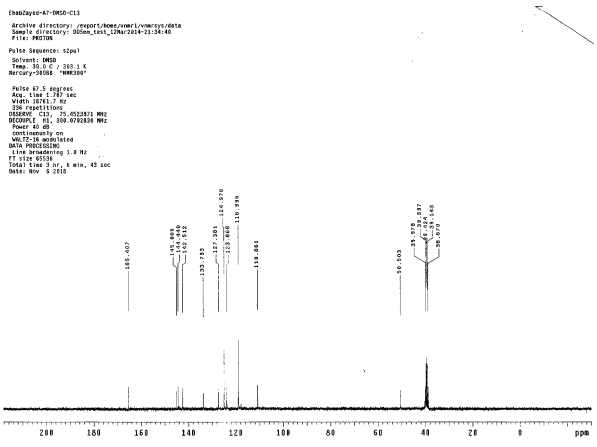


Figure: (13).[13]CNMR spectrum of compound **(6)**

The structures of compound **(7,8)** were confirmed via [1]HNMR spectrum which revealed singlet signals of amidic groups at 10.5 ppm. also, singlet signal of (-OH) group at 9.4 ppm for compound **(7).** but its appeared singlet signal of compound **(8)** at 2.5 ppm. In other side its appeared methylene group of compound **(7)** and **(8)** at 5.7ppm. IR spectrum of compounds **(7)** and **(8)** showed strong absorption bands of amidic group $1667cm^{-1}$ and $1688cm^{-1}$ respectively. The mass spectrum of compound **(7)** and **(8)** revealed m/z 268 and m/z 266 which corresponding to the molecular formula $C_{14}H_{12}N_4O_2$ and $C_{15}H_{14}N_4O$ respectively. The [13]CNMR spectrum of compound (**8**) appeared carbonyl group of amide (-CO-) at 164.03 ppm, also ($-CH_2-$) group observed at 50.42 ppm. We proposed a possible mechanism for the synthesis of substituted benzotriazoles from 1*H*-benzo(*d*)1,2,3-triazole **(2)** and 2 – Chloro – *N* – substituted phenyl) acetamide **(a_1-a_6)** using K_2CO_3 as the catalyst **(scheme 2)**

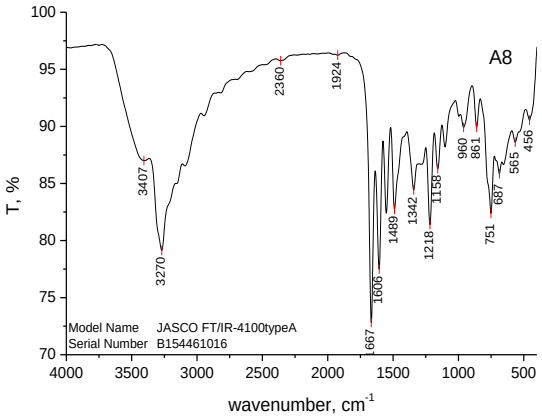


Figure: (15).IR spectrum (cm^{-1}) of compound **(7)**

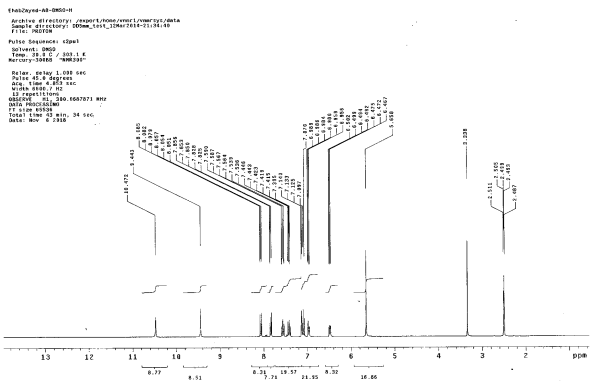


Figure: (16). ^{1}HNMR spectrum of compound **(7)**

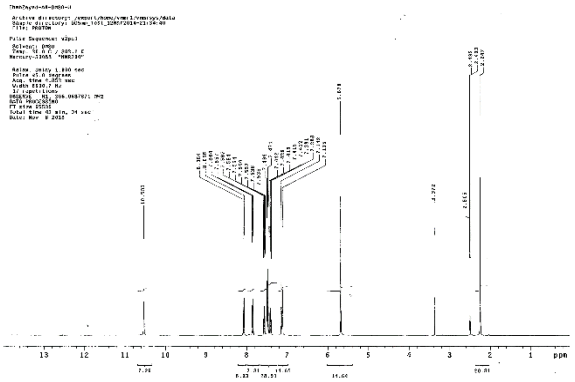


Figure: (19). ^{1}HNMR spectrum of compound **(8)**

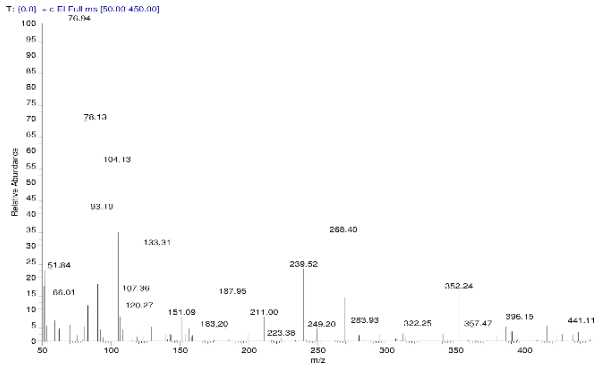


Figure: (17). Mass spectrum of compound **(7)**

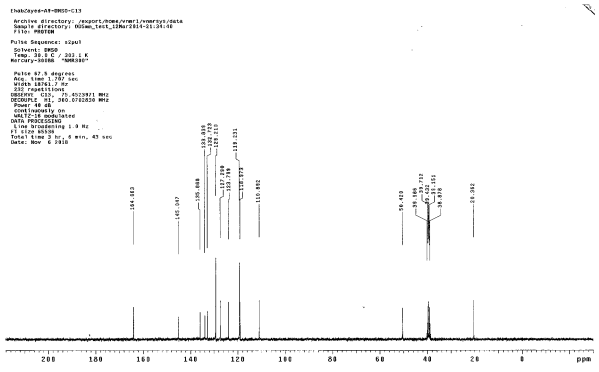


Figure: (20). ^{13}CNMR spectrum of compound **(8)**

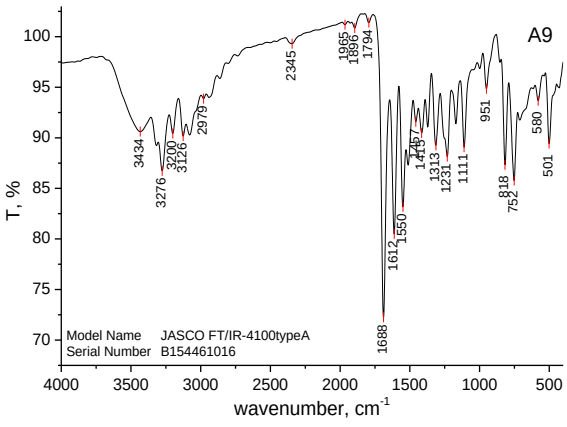


Figure: (18). IR spectrum (cm^{-1}) of compound **(8)**

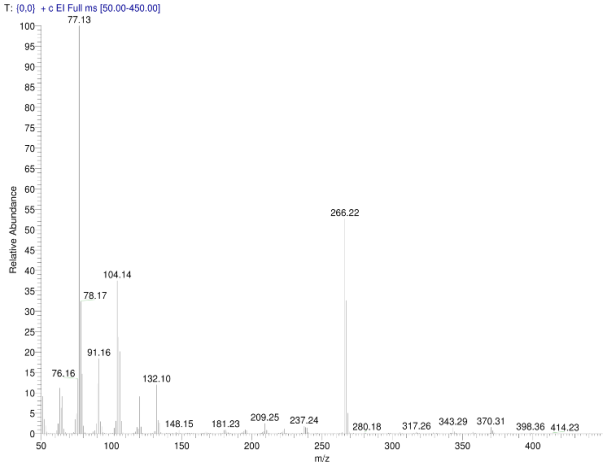
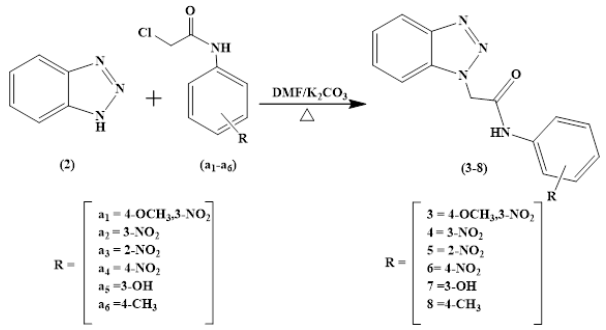
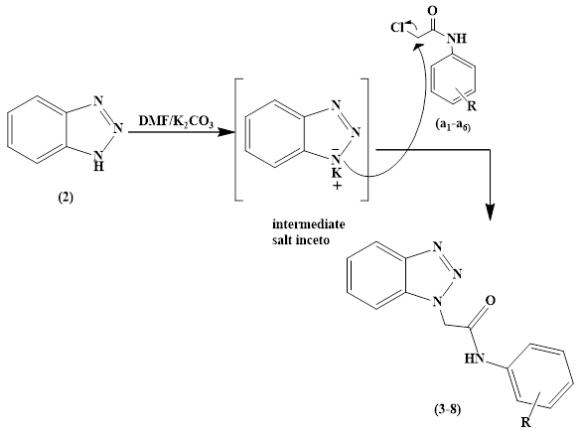


Figure: (21). Mass spectrum of compound **(8)**



Scheme 1



Scheme 2: proposed mechanism for the formation of compounds (3-8)

4 Conclusions

1*H*-benzo[d]1,2,3-triazole **(2)** is heterocyclic compound consisting of three nitrogen atoms and fused benzene ring. it is synthesized via diazotization process by treatment *o* -phenylene diamine w$_3$ith sodium nitrite in glacial acetic acid. Which react with 2-chloro-*N*-(substituted phenyl) acetamide **(a_1 - a_6)** in present K_2CO in DMF to give 2-(1*H*-benzo[d]1,2,3-triazol-1-yl)-*N*-(substituted phenyl) acetamide **(3-8)** their structures were confirmed by infrared, ^{1}HNMR, ^{13}CNMR and mass spectrometric analysis.

Acknowledgements

We thank the research committee and the Department of Chemistry of the University of Omar Al-Mukhtar for providing financial support.

Conflict of Interest: The authors declare that there are no conflicts of interest.

References

Al-Omran, F., Mohareb, R. M., Abou El-Khair, A., (2002), synthesis and biological effects of new derivatives of benzotriazole as antimicrobial and antifungal agents, J. heterocyclic chem, 39, 877 – 883.

Alpana, A., Shrikant, M., Pratyush, K., Abhibnav, B., Ruchita, T., (2020), Review on synthetic study of benzotriazole, GSC biological and pharmaceutical sciences, 11(02), 215 -225. https://doi.org/10.30574/gscbps.2020.11.2.0137

Bashir, H., Hashim, G. and Abdalfarg, N., (2021), Synthesis of Benzotriazole Derivatives, international Invention of Scientific Journal, 05 (3), 17-26. https:// doi :10.1016/j.ejmech.2012.05.028

Jain, N. P., Upassani, C. D., Kalkotwar, R. S., Jain, U. P., (2013), Synthesis and anti – inflammatory activity of *N* – (alkyl or aryl) – 2 – (1*H* – benzotriazole -1 – yl) acetamide derivatives, Research journal of pharmaceutical, biological and chemical sciences, 4(3) 1470 -1480.

Jamkhandi, C. M., Disouza, J. I., (2013), Synthesis and antimicrobial evaluation of 1*H* – Benzotriazol -1 -yl {2- hydroxy -5-[(E) phenyldiazenyl] phenyl} methanone derivative, international journal of pharmacy and pharmaceutical sciences, 5(3)225 - 228.

Noolvi, M. N., Patel, H. M., Kaur, M., (2012), Benzotriazoles: search for anticancer aggents, European journal of medicinal chemistry, 54, 447-462.

Ram, V. J., Sethi, A., Nath, M., Pratap, R., (2019), Five-membered heterocycles. In *The Chemistry of Heterocycles*, 149-478. Elsevier. https://doi.org/10.1016/B978-0-08-1010334.00005-X.

Suma, B.V., Natesh, N. N., Madhavan, V., (2011), Benzotriazole in medicinal chemistry: An overview, Journal of chemical and pharmaceutical research, 3(6):375-381.

Ueno, L. T., Ribeiro, R. O., Rocha, M.S., Suárez-Iha, M. E.V., Iha, K., Machado, F. B. C., (2003), About the benzotriazole tautomerism: An ab initio study, Journal *of Molecular Structure (theochem)*, 207-215. https://doi.org/10.1016/j.theochem.2003.09.004

Uesaka, T., Ishitani, T., Sawada, R., Maeda, T., Yagi, S., (2020), Fluorescent 2-phenyl-2*H*-benzotriazole dyes with intramolecular *N–H···N* hydrogen bonding: Synthesis and modulation of fluorescence properties by proton-donating substituents, Dyes and pigments, https://doi.org/10.1016/j.dyepig.2020.108672

Scientific Journal For the Faculty of Science – Sirte University

Sjsfsu@su.edu.ly

journal.su.edu.ly/index.php/JSFSU