Indian Journal of Heterocyclic Chemistry
Vol. 33 - Number 02 (Apr-Jun 2023) 215-219
https://connectjournals.com/01951.2023.33.215
https://doi.org/10.59467/IJHC.2023.33.215

ISSN (Print) : 0971-1627
ISSN (Online) : 2456-4311

Synthesis and Antimicrobial Evaluation of 3-Carbonyl-(pyrid-4-yl)-5-hepta-*O*-benzoyl-β-D-lactosylimino-2-arylimino-1,3,4-thiadiazolidines

Dipali S. Mankar[1]*, Mamata T. Sangole[1] and Sham H. Mankar[2]

[1]Department of Chemistry, Shri Shivaji College of Arts, Commerce and Science, Akola, Maharashtra, India
[2]Department of Mechanical Engineering, Pimpri Chinchwad College of Engineering and Research, Pune, Maharashtra, India

ABSTRACT A new series of 3-carbonyl-(pyrid-4-yl)-5-hepta-*O*-benzoyl-β-D-lactosylimino-2-arylimino-1,3,4-thiadiazolidines was synthesized by the interaction of 1-carbonyl-(pyrid-4-yl)-4-hepta-*O*-benzoyl-β-D-lactosyl-3-thiosemicarbazide with aryl isocyanodichlorides. The required 1-carbonyl-(pyrid-4-yl)-4-hepta-*O*-benzoyl-β-D-lactosyl-3-thiosemicarbazide was synthesized by the interaction of 1-hepta-*O*-benzoyl-β-D-lactosyl isothiocyanates and isoniazid. These compounds were screened for their antibacterial and antifungal activity against some pathogenic organisms to get potent bioactive molecule.

KEYWORDS 1-hepta-*O*-benzoyl-β-D-lactosyl isothiocyanate, Thiosemicarbazide, Thiadiazolidines, Antimicrobial activity.

How to cite this article: Mankar, D.S., Sangole, M.T. and Mankar, S.H. Synthesis and Antimicrobial Evaluation of 3-Carbonyl-(pyrid-4-yl)-5-hepta-*O*-benzoyl-β-D-lactosylimino-2-arylimino-1,3,4-thiadiazolidines,*Indian J. Heterocycl. Chem.*,**2023**,*33*, 215–219.(https://doi.org/10.59467/IJHC.2023.33.215)

INTRODUCTION

Carbohydrates mediate a variety of important, medicinally relevant biological processes, playing a key role in numerous diseases.[1] The ability to understand their functions is of paramount importance for the development of new drugs and therapeutics to treat human diseases.

Heterocyclic compounds[2] play a vital role among organic compounds with biological activities that are used as medicines in human and veterinary drugs or as insecticides and pesticides in agricultural applications. Chemical rings, available in various medicines, may have pharmacological characteristics or may provide a platform for the pharmacophoric sets, which will work to gather with the receptors. Thiadiazoles belong to the group of nitrogen–sulfur-containing heterocycles with wide application as structural parts of biologically active molecules and as useful intermediates in medicinal chemistry. Since the past few years, substituted 1,3,4-thiadiazole derivatives have received important consideration and have been increasingly investigated due to their large spectrum of pharmacological characteristics. It is assumed that 1,3,4-thiadiazole derivatives show different biological activities due to the occurrence of =N-C-S- moiety. Other authors assume that the biological activities of 1,3,4-thiadiazole derivatives are due to strong aromaticity of the ring, which also gives great *in vivo* stability to this five-membered ring system and low toxicity for higher vertebrates, including humans.

1,3,4-Thiadiazoles are significant heterocyclic compounds with a wide range of applications in medicinal, agricultural, and materials chemistry.[3] Their derivatives bearing an amino or imino group display a broad spectrum of pharmaceutical and biological properties[4] including antimicrobial,[5] antitubercular,[6] anticancer,[7] anti-inflammatory/analgesic,[8] antidepressant,[9] and antioxidant activities.[10] In view of these observations, we report herein synthesis and antimicrobial evaluation of some new 3-carbonyl-(pyrid-4-yl)-5-hepta-*O*-benzoyl-β-D-lactosylimino-2-arylimino-1,3,4-thiadiazolidines.

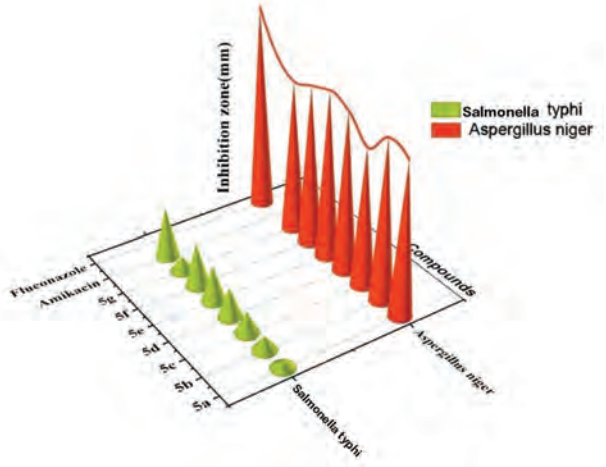
*Corresponding author: Email: dipalimhaisne@rediffmail.com

Published & Hosted by :
Journal Homepage :
www.connectjournals.com/ijhc
www.connectjournals.com

Table 2: Antimicrobial activities of newly synthesized 3-carbonyl-(pyrid-4-yl)-5-hepta-*O*-benzoyl-β-D-lactosylimino-2-arylimino-1,3,4-thiadiazolidines (5a-g)

Compound	Antibacterial	Antifungal
	Salmonella typhi	*Aspergillus niger*
5a	21	21
5b	19	22
5c	15	19
5d	18	22
5e	22	23
5f	20	22
5g	19	21
Amikacin	26	-
Fluconazole	-	28

**Zone of inhibition measured in mm, (15 or less) resistance, (16–20 mm) moderate and (more than 20 mm) sensitive



in mm. The compounds were taken at a concentration of 1 mg/mL using dimethyl sulfoxide as a solvent. The minimum inhibition concentration of all the synthesized compounds was obtained. Similarly, study was also conducted for the reference standard amikacin for antibacterial activity and fluconazole for antifungal activity. The zone of incubation observed around the cup after incubation was measured. The results are presented in **Table 2.** The results of this preliminary screening study are also shown in the graphical method. From the data, it is clear that novel compounds 5a, 5b, 5d, 5e, 5f possess good activity, while compounds 5c possess moderate activity against bacteria (*S. typhi)* and fungi (*A. Niger*).

CONCLUSION

Novel compounds were prepared with good yields through a facile synthetic pathway, and their chemical structures were characterized by detecting their physicochemical properties and analyzing their IR, ^{1}H NMR and mass spectra. These compounds also were screened for their antimicrobial activity against bacteria (*S. typhi*) and fungi (*A. niger*) using a solution of amikacin and fluconazole as a positive control, respectively. Some of these compounds possess a high response against bacteria as well as fungi. Therefore, these novel compounds can be considered as an encouraging wide spectrum antibacterial agent and antifungal agent.

ACKNOWLEDGMENT

Authors are grateful to CIF, SPPU, Pune, for providing the spectral data and also to Dr. A. L. Kulat Principal, Shri Shivaji College of Art's Commerce and science Akola, for encouragement and providing necessary facilities.

REFERENCES

[1] Fernandez-Tejada, F., Canada, F.J. and Jimenez-Barbero, J. Recent developments in synthetic carbohydrate-based diagnostics, vaccines, and therapeutics, *Chem. Eur. J*., **2015,** *21*, 10616–10628.

[2] Serban, G., Stanasel, O., Serban, E. and Bota, S. 2-Amino-1,3,4-thiadiazole as a potential scaffold for promising antimicrobial agents, *Drug Des. Devel. Ther*., **2018,** *12*, 1545–1566.

[3] Zhengyan Huang, Qianqian Zhang, Qiongli Zhao, Wenquan Yu and Junbiao Chang, Synthesis of 2-Imino-1,3,4-thiadiazoles from Hydrazides and Isothiocyanates via Sequential Oxidation and P(NMe2)3-Mediated Annulation Reactions American Chemical Society Org. Lett., **2020**, *22*, 4378–4382.

[4] (a) Supuran, C.T., Briganti, F., Tilli, S., Chegwidden, W.R. and Scozzafava, A. Carbonic anhydrase inhibitors: Sulfonamides as antitumor agents?, *Bioorg. Med. Chem*., **2001,** *9*, 703−704. (b) Serban, G., Stanasel, O., Serban, E. and Bota, S. 2-Amino-1,3,4-thiadiazole as a potential scaffold for promising antimicrobial agents, *Drug Des. Devl. Ther*., **2018,** *12*, 1545−1566.

[5] (a) Chandrakantha, B., Isloor, A.M., Shetty, P., Fun, H.K. and Hegde, G. Synthesis and biological evaluation of novel substituted 1,3,4-thiadiazole and 2,6-di aryl substituted imidazo [2,1-b] [1,3,4] thiadiazole derivatives, *Eur. J. Med. Chem*., **2014,** *71*, 316−323. (b) Farghaly, T.A., Abdallah, M.A., Masaret, G.S. and Muhammad, Z.A. New and efficient approach for synthesis of novel bioactive [1,3,4] thiadiazoles incorporated with 1,3-thiazole moiety, *Eur. J. Med. Chem*., **2015**, *97*, 320−333. (c) Kumar, G.S., Poornachandra, Y., Reddy, K.R., Kumar, C.G. and Narsaiah, B. Synthesis of novel triazolothione, thiadiazole, triazole-functionalized furo/thieno[2,3-b] pyridine derivatives and their antimicrobial activity, *Synth. Commun*., **2017,** *47*, 1864−1873.

[6] (a) Alegaon, S.G., Alagawadi, K.R., Sonkusare, P.V., Chaudhary, S.M., Dadwe, D.H. and Shah, A.S. Novel imidazo[2,1-b][1,3,4]thiadiazole carrying rhodanine-3-acetic acid as potential antitubercular agents, *Bioorg. Med. Chem. Lett*., **2012,** *22*, 1917−1921. (b) Patel, H.M., Noolvi, M.N., Sethi, N.S., Gadad, A.K. and Cameotra, S.S. Synthesis and antitubercular evaluation of imidazo[2,1-b][1,3,4]thiadiazole derivatives, *Arabian J. Chem*., **2017,** *10*, S996−S1002.

[7] (a) Andreani, A., Burnelli, S., Granaiola, M., Leoni, A., Locatelli, A., Morigi, R., Rambaldi, M., Varoli, L., Calonghi, N., Cappadone, C., Voltattorni, M., Zini, M.,

Stefanelli, C., Masotti, L. and Shoemaker, R.H. Antitumor activity of bis-indole derivatives (1), *J. Med. Chem*., **2008,** *51*, 7508−7513. (b) Noolvi, M.N., Patel, H.M., Singh, N., Gadad, A.K., Cameotra, S.S. and Badiger, A. Synthesis and *in vitro* antitumor activity of substituted quinazoline and quinoxaline derivatives: Search for anticancer agent, *Eur. J. Med. Chem*., **2011,** *46*, 4411−4418. (c) Yang, X.H., Xiang, L., Li, X., Zhao, T.T., Zhang, H., Zhou, W.P., Wang, X.M., Gong, H.B., Zhu, H.L. Synthesis, biological evaluation, and molecular docking studies of 1,3,4-thiadiazol-2-amide derivatives as novel anticancer agents, *Bioorg. Med. Chem*., **2012,** *20*, 2789−2795. (d) Li, Y.J., Qin, Y.J., Makawana, J.A., Wang, Y.T., Zhang, Y.Q., Zhang, Y.L., Yang, M.R., Jiang, A.Q. and Zhu, H.L. Synthesis, biological evaluation and molecular modeling of 1,3,4-thiadiazol-2-amide derivatives as novel antitubulin agents, *Bioorg. Med. Chem*., **2014,** *22*, 4312−4322. (e) Dawood, K.M. and Gomha, S.M. Synthesis and anti-cancer activity of 1, 3, 4-thiadiazole and 1, 3-thiazole derivatives having 1, 3, 4-oxadiazole moiety, *J. Heterocyclic Chem*., **2015,** *52*, 1400−1405. (f) Gomha, S.M., Abdulla, M.M. and Abou-Seri, S.M. Identification of novel aminothiazole and aminothiadiazole conjugated cyanopyridines as selective CHK1 inhibitors, *Eur. J. Med. Chem*., **2015,** *92*, 459−470.

[8] (a) Gadad, A.K., Palkar, M.B., Anand, K., Noolvi, M.N., Boreddy, T.S. and Wagwade, J. Synthesis and biological evaluation of 2-trifluoromethyl/sulfonamido-5,6-diaryl substituted imidazo[2,1-b]-1,3,4-thiadiazoles: A novel class of cyclooxygenase-2 inhibitors, *Bioorg. Med. Chem*., **2008**, *16*, 276−283. (b) Gilani, S.J., Khan, S.A. and Siddiqui, N. Synthesis and pharmacological evaluation of condensed heterocyclic 6-substituted 1,2,4-triazolo-[3,4-b]-1,3,4-thiadiazole and 1,3,4-oxadiazole derivatives of isoniazid, *Bioorg. Med. Chem. Lett*., **2010,** *20*, 4762−4765.

[9] Jubie, S., Ramesh, P.N., Dhanabal, P., Kalirajan, R., Muruganantham, N. and Antony, A.S. Synthesis, antidepressant and antimicrobial activities of some novel stearic acid analogues, *Eur. J. Med. Chem*., **2012,** *54*, 931−935.

[10] (a) Al-Omair, M.A., Sayed, A.R. and Youssef, M.M. Synthesis of novel triazoles, tetrazine, thiadiazoles and their biological activities, *Molecules*, **2015**, *20*, 2591−2610. (b) Badrey, M.G., Gomha, S.M., Arafa, W.A.A. and Abdulla, M.M. An approach to polysubstituted triazipines, thiadiazoles and thiazoles based on benzopyran moiety through the utility of versatile hydrazonoyl halides as *in vitro* monoamine oxidase inhibitors, *J. Heterocyclic Chem*., **2017**, *54*, 1215−1227.

[11] Tale, P.V. and Deshmukh, S.P. Synthesis of 2-phenylimino-3-aryl-4-S-benzyl-6-hepta-O-acetyl- β -Dlacosylimino-2,3-dihydro-1,3,5-thiadiazine hydrochlorides, *Indian J. Chem*., **2006**, *45B*, 558–560.

[12] Yadgire, A.V., Barate, D.L. and Deshmukh, S.P. Dithiazolidines: Synthesis and anti-microbial activity of some novel n-maltosides, *Rasayan J. Chem*., **2011**, *4*, 780–783.

[13] Silverstein, R.M. and Webster, F.X. S*pectrometric Identification of Organic Compounds*, 6th ed. John Wiley and Sons, Inc., New York, **2011**.

[14] Dyer, J.R. *Applications of Absorption Spectroscopy of Organic Compounds, PHI Learning Private Limited*, New Delhi, **2010.**

[15] Williams, D.H. and Fleming, L. *Spectroscopic Methods in Organic Chemistry*. 6th ed. United States: Tata McGraw-Hill Education, **2011.**

[16] Budzikiewicz, H., Djerassiand, C. and Williams, H. *Structural Elucidation of Natural products by mass Spectrometry*, Vol. 2. Holden-Day 207, San Francisco, **1964.**

[17] Kawangh, F. *Analytical Microbiology*, Academic Press, NewYork, **1963.**

[18] British Pharmacopeia-II. *Biological Assay and Tests*, The Stationary Office Ltd., London, **1998**, pA205.

[19] Kumar, V.M.M.J., Jayadevaiah, K.V., Nagaraj, T.S., Jayachandran, E., Bharathi, D.R. Sreenivasa, G.M., Synthesis, characterization and antimicrobial activity of new N-substituted-3-chloro-2-azetidinones, *Arch. Pharm. Sci. Res*., **2009,** *1*, 31–29.

Received: 31 Jan 2023; Accepted: 24 May 2023