Synthesis and biological properties of chosen symmetrical amides and thioamides of terephthalic acid

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Introduction

Modern Organic Chemistry is a research area which connects not only the synthesis of new chemical compounds with interesting properties, but also the design and prediction of attractive structures and properties. The new compounds are widely used in various industries such as pharmaceutical, electronics, chemical and others.

Experimental methods

The aim of this study was the synthesis of new diamide and dithioamide derivatives of terephtalic acid and testing for biological activity.

Synthesis of diamides of terephthalic acid consisted in reactions of aminoacids with terephthalic acid chloride¹⁾. Synthesis of dithioamide derivatives consisted in thionation²⁾.

Table 1. Antifungal activity

$MIC (IC_{80}) (\mu M/L)$							
	clogP	C. albicans	C. krusei	C. parapsilosis			
		CCM 8261	CCM 8271	CCM 8260			
1a	-0.15 ± 0.52	> 128	> 128	> 128			
2a	3.83 ± 0.67	> 128	> 128	> 128			
3a	1.61 ± 0.53	> 128	> 128	> 128			
1b	1.66 ± 0.66	64	64	64			
2b	6.00 ± 0.66	> 128	> 128	> 128			
3b	3.42 ± 0.66	> 128	> 128	> 128			

Table 2. Antibacterial activity

MIC (IC ₈₀) (μM/L)								
	clogP	S. aureus MRSA SA 630	S. aureus MRSA SA 3032	S. aureus MRSA Sa	S. aureus SA 63718 ATCC 29213	Escheric hia coli		
1a	-0.15 ± 0.52	> 256	> 256	> 256	> 256	> 256		
2a	3.83 ± 0.67	> 256	> 256	> 256	> 256	> 256		
3a	1.61 ± 0.53	> 256	> 256	> 256	> 256	> 256		
1b	1.66 ± 0.66	256	64	64	64	> 256		
2b	6.00 ± 0.66	> 256	256	128	> 256	> 256		
3b	3.42 ± 0.66	256	128	128	128	> 256		

Diamides of terephthalic acid obtained in the reactions with amino acids possess interesting properties. Functionalization using bioactive compounds is attractive in terms of synthesis, as in this way it is possible to get new active analogs.

The compounds were tested for their antibacterial³⁾, antifungal⁴⁾ and antimycobacterial³⁾ activities.

Results and discussion

The chemical structure of the received compounds, oxygen (1a-3a) and sulphur (1b-3b) analogs, was confirmed using ¹H spectra and ¹³C NMR, and mass spectrometry.

Setting a MIC (Minimal Inhibitory Concentration) parameter defined antifungal properties (Table 1). For the tests, three pathogenic species of the fungi species Candida (*C. albicans, C. fragile, C. parapsolosis*) were used.

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Table 3. Antimycobacterial activity

MIC (IC ₈₀) (μM/L)							
	clogP	M. smegmatis	M. marinum	M. kansasii			
		ATCC 700084	CAMP 5644	DSM 44162			
1a	-0.15 ± 0.52	> 256	> 256	256			
2a	3.83 ± 0.67	> 256	> 256	> 256			
3a	1.61 ± 0.53	> 256	> 256	> 256			
1b	1.66 ± 0.66	256	> 256	128			
2b	6.00 ± 0.66	> 256	> 256	> 256			
3b	3.42 ± 0.66	> 256	> 256	256			

The next stage of research was to determine the antimicrobial properties (Table 2). For this purpose the strains of Gram-positive bacteria *S. aureus* (Sa ATCC 29213), methicillin-resistant *S. aureus* (MRSA 63718, SA 630, SA 3202) and Gram-negative *E. coli* were used.

The final stage of biological research was to test the activity of bacteria species mycobacterium (Table 3). The tests were carried out using different incubation time, i.e. 3 to 21 days for the corresponding strain of bacteria.

Conclusions

The tests of biological properties of new derivatives show an increase in activity for the thioamides in relation to their oxygen counterparts. However, none of the analogs tested showed high biological activity.

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Conflicts of interest: none.

References

- Yu S-L., Doub X-Q., Qua D-H., Feng Ch-L. C2-symmetric benzene-based organogels: A rationally designed LMOG and its application in marine oil spill. J. Mol. Liq., 2014; 190, 94–98.
- Polshettiwar V., Kaushik M. P. A new, efficient and simple method for the thionation of ketones to thioketones using P4S10/Al2O3. Tetrahedron Lett. 2004; 45, 6255–6257.
- Pauk K., Zadrazilova I., Imramovsky A., Vinsova J., Pokorna M., Masarikova M., Cizek A., Jampilek J. New derivatives of salicylamides: Preparation and antimicrobial activity against various bacterial species. Bioorg. Med. Chem. 2013; 21, 6574–6581.
- Adlard P. A., Cherny R. A., Finkelstein D. I., Gautier E., Robb E., Cortes M., Volitakis I., Liu X., Smith J. P., Perez K., Laughton K., Li Q-X., Charman S. A., Nicolazzo J. A., Wilkins S., Deleva K., Lynch T., Kok G., Ritchie C. W., Tanzi R. E., Cappai R., Masters C. L., Barnham K. J., Bush A. I. Rapid Restoration of Cognition in Alzheimer's Transgenic Mice with 8-Hydroxy Quinoline Analogs Is Associated with Decreased Interstitial AB, Neuron 2008; 59, 43–55.