

Antibiotics and Antibiotic Resistance

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Hybrid antibacterial agents as a tool to overcome the problem of bacterial resistance: Studies on 1, 2, 4-triazole-ciprofloxacin hybrids

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The spread of bacterial resistance is an increasingly serious threat to global public health, being a worldwide problem. There are high proportions of resistant bacteria that cause not only serious nosocomial diseases but also common community acquired infections. The dual-action/targeting concept can be regarded as one of the solutions to overcome the problem of growing bacterial resistance. The various hybrid antibacterial agents have been developed and described, including a series of 1, 2, 4-triazole-ciprofloxacin hybrids obtained by a molecular hybridization of ciprofloxacin and different 1, 2, 4-triazole derivatives. These hybrids showed good inhibitory effect against Gram-positive bacteria such as *Staphylococcus aureus* ATCC 25923, *S. aureus* ATCC 6538, methicillin-resistant *S. aureus* MRSA Microbank 14001, *Staphylococcus epidermidis* ATCC 12228, *Micrococcus luteus* ATCC 10240, *Bacillus subtilis* ATCC 6638 and *Bacillus cereus* ATCC 10876 as well as Gram negative bacteria, including *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 13883, *Proteus mirabilis* ATCC 12453, *Pseudomonas aeruginosa* ATCC 9027 and *Haemophilus influenzae* ATCC 10211. A number of these compounds displayed enhanced potency as compared with ciprofloxacin. The results of enzymatic assays have proven that stronger antibacterial activity of novel 1, 2, 4-triazole-ciprofloxacin hybrids (as compared to ciprofloxacin) cannot be caused by the increased affinity towards bacterial type II topoisomerases; the analyzed compounds demonstrated other preferences towards primary and secondary molecular targets than ciprofloxacin. These hybrids were found to be active not only against planktonic cells but also against biofilm forming cells of *Haemophilus* spp. The 1, 2, 4-triazole-ciprofloxacin hybrids may be considered as starting compounds for designing of the agents with improved antibacterial activity, including anti-biofilm properties.

Biography

Anna Malm has completed her PhD in 1989 from Medical University in Lublin, Poland. She is the Head of Department of Pharmaceutical Microbiology in Medical University in Lublin. She works as a full Professor and is a Specialist in Medical Microbiology. She has published more than 200 papers mainly in reputed journals in the field of medical microbiology, including studies on antibacterial/antifungal activity *in vitro* of the compounds of plant or synthetic origin.

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