# Abstract

Tertiary phosphine oxides, phosphine sulfides, and phosphine selenides containing pyridine, imidazole, and pyrazole groups have been synthesized via the reaction of elemental phosphorus or secondary phosphine oxides with functional pyridines, imidazoles, and pyrazoles. Tris(2-pyridylethyl)phosphonium iodide and bromide are also obtained by quaternization of the corresponding phosphine. Antimicrobial activity of the synthesized compounds, including nitrogen-containing heterocycles, phosphorus, selenium, and sulfur, with respect to *Enterococcus durans, Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa* microorganisms is evaluated. It is found that phosphine chalcogenides bearing imidazole (**14, 19**), pyrazole (**13**), and pyridine fragments (**5, 9**) and phosphonium salts (**11, 12**) can be considered as new promising antibacterial agents. For some synthesized compounds, LC50 is determined. Phosphine oxide with methylpyrazole fragments (**13**) and phosphonium salts (**11, 12**) show strong profile of antimicrobial activity, and cytotoxic effect of phosphonium bromide having a long chain radical (**12**) is by order of magnitude higher than that of cisplatin. We believe that the results obtained may contribute to the development of highly effective agents for the treatment and prevention of bacterial infections and cancers.