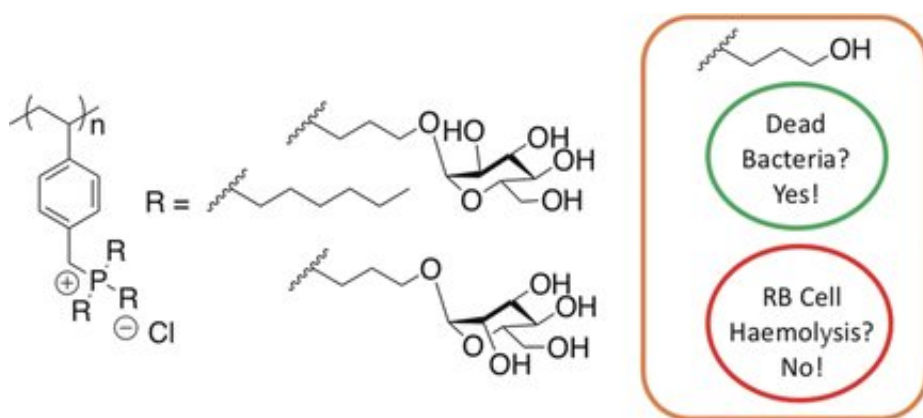


Surprising antibacterial activity and selectivity of hydrophilic phosphonium polymers

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Credit: Wiley

Artificial polymers, like antibiotic peptides, need both hydrophobic and hydrophilic domains in their molecular structure to exert antibacterial activity. Now, researchers from Canada have synthesized a phosphonium polymer that challenges this view. As outlined in the journal *Angewandte Chemie*, their polymer salt contained no hydrophobic alkyl chains but still acted as an extraordinarily efficient biocide. A re-evaluation of established strategies in antibiotics polymer research might be necessary.

To combat multiresistant bacteria and discover new antibiotics, scientists increasingly turn to the design and exploration of short artificial

polymers. As these polymers can mimic the powerful peptide antibiotics, Paul J. Ragona and Beth Gillies at Western University, London, ON (Canada), and their groups focus on phosphorus-containing polymers, the polyphosphoniums. Their [molecular structure](#) consists of a hydrocarbon backbone and a positively charged phosphorus center in every repeat unit. A balanced display of hydrophobic alkyl chains and positive charges was considered essential for effective adhesion to bacterial [cells](#) and membrane disruption. Envisaging still more effective cell lysis, the scientists started to fine-tune this amphiphilic nature of the polyphosphoniums.

Varying the relative content of hydrophobic and hydrophilic functional groups, the Western team introduced mannose sugars in the [polymer](#). The sugar was intended to act as a "bait" to attract bacteria, according to the authors, but they found that this plan failed. "Our initial hypothesis that the mannose-containing phosphonium polymer ManP(P) would provide exceptional targeted activity proved incorrect," they wrote. However, another functional group was extremely successful—and took the researchers by surprise.

They expected that the short alcoholic chain hydroxypropyl would not give any hydrophobicity to the polyphosphonium compound, thus producing neither bacterial cell lysis nor hemolysis of [red blood cells](#). The degree to which a compound destroys red blood cells indicates the drug's selectivity against mammalian cells. Thus, the hydroxy-modified polyphosphonium was intended for use as a control. However, it killed the bacteria with unprecedented activity while leaving red blood cells intact, the authors recorded. "This is an unprecedented result in the context of the literature on antimicrobial polyonium or related materials," they wrote.

Their results signify that hydrophobic alkyl chains are no pivotal functional groups to attain cell lysis ability in phosphonium salt

polymers. Instead, the authors hypothesize that the polystyrene backbone or the single terminal hydrophobic group of the synthesized polymers also play a role. These findings towards bactericide polymer structures deserve further investigation. A re-evaluation of the established models may be necessary. This is interesting news in the quest to design new antibacterial substances.

More information: Tyler J. Cuthbert et al, Surprising Antibacterial Activity and Selectivity of Hydrophilic Polyphosphoniums Featuring Sugar and Hydroxy Substituents, *Angewandte Chemie International Edition* (2018). [DOI: 10.1002/anie.201806412](https://doi.org/10.1002/anie.201806412)

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